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A Review of the International Machine Tool Industry

THE recent international Machine Tool Exhibition in London (June-July) has brought out the importance of the machine-tool industry as the one upon which practically all productivity depends and a survey of the stage of development reached in this industry by various western countries upto the end of 1955 makes interesting reading. There are in fact several difficulties in presenting an accurate survey because of the various ways adopted by different countries in compiling official statistics in regard to the machine-tool industry.

United States accounted for nearly more than half of the total value of the machine-tools produced during the year 1955 in United Kingdom, France, West Germany, Switzerland, Italy, Belgium, Austria, Sweden, Netherlands and Canada. American production in this industry during 1955 was some 19% lower than in the preceding year, but on the other hand new orders during 1955 showed an 88% increase over the former years. American exports were mainly for Canada, United Kingdom, France, and West Germany.

In United Kingdom there are nearly 490 Machine Tools manufacturers of various types but of these only about 130 are responsible for 95% of the total production. Export prices in United Kingdom were lowest of all countries during the year under review apart from Belgium. At the end of 1955 the U.K. Machine Tool Industry had in hand orders worth about £100 million for execution, say about 15 months production. Although U.K. Exports have not touched the peak figure of 1952 they point out a slight increase over 1954 target, the main countries to whom exports were made being Australia, India, France and South Africa.

Imports have also shown a slight decrease from the previous 1952 level (£ 58.8 million) which was presumably due to. heavy external buying for the defence expansion programmes.

France mainly exported machine-tools to Spain, Italy and the United Kingdom but imports into France during the year amounted to 21,730 tons. French prices both home and export registered a slight decline.

In the case of Switzerland it has not been possible to separate the metal-working from the wood-working machine statistics, but on the export side it is estimated that the inclusion of these figures does not affect the total by more than 3%. The main destinations for exports were Germany, France, United Kingdom and the United States.

Production in Italy has remained at approximately the same level as before i.e. during the last four years showing a very slight increase during 1955. Exports were mainly destined to Argentine, France, West Germany and Switzerland.

In spite of the very large proportion of machine-tools exported by Belgium, she is on balance mainly an importing country as the value of the imports last year slightly exceeded the total production in the country. Considered on tonnage basis the exports were destined to France, United Kingdom, Netherlands and Spain. Imports were mainly from West Germany.

MESSAGES

Vice-President,
India,
New Delhi.

1st August, 1956.

I am glad to know that you are bringing out a new journal. I send my best wishes for its success.

Raj Bhavan,
Malabar Hill,
Bombay 6.

12th July, 1956.

I am glad to know that the journal on ''Industrial Engineering'' is shortly going to be published from Bombay. Since India is on the way to industrialisation, it is necessary that all about Industrial Engineering should be made available to the public for their use and knowledge. I wish the journal all success.

Raj Bhavan,
Kurnool.

22nd July, 1956.

I am glad to learn that a new quarterly publication entitled ''Industrial Engineering'' will shortly be published from Bombay. We have embarked on rapid industrialisation with special emphasis on basic and heavy industries. Knowledge of industrial engineering is a vital element in plans for industrialisation, and questions such as the design, layout and erection of plants and equipment, quality control techniques, etc. require a great deal of study. I am sure the ''Industrial Engineering'' will concentrate on this and other aspects of industrialisation, drawing upon the experience of other countries and adapting that experience to the conditions prevailing in India. I wish all success to the journal.

Bihar Governor's Camp,
Ranchi.

13th July, 1956.

I am glad to know that you are bringing out a quarterly journal on ''Industrial Engineering''.

Engineers today are the builders of new industrial India and have a place of honour in the onward march that our country is registering.

I wish the venture full success.

Raj Bhavan,
Puri.

13th July, 1956.

I send my best wishes to the Quarterly Publication entitled JOURNAL OF INDUSTRIAL ENGINEERING which, I understand, is expected to be brought out shortly.

In view of the distinctive and dominating role of technologists in all spheres of national development, it is essential that those who are connected with the designing, erection and running of the country's various industrial units have a forum of their own for discussing all matters of common interest. I am, therefore, glad that the JOURNAL OF INDUSTRIAL ENGINEERING is being started to that end. Such publications are a legion in countries which are more industrially advanced than ours, and I trust that this new venture in Indian technical journalism, with its expert Editorial Board, will serve as an effective clearing house of all information for our industrial engineers, and through enabling them to keep abreast of developments in their respective fields of technology, contribute also to the more efficient promotion of the nation's industrial advancement and progress.

I wish the Journal every success.

Minister of Industries,
India,
New Delhi.

18th July, 1956.

Wish you success in your endeavour to bring out publication on ''Industrial Engineering''.

N. Kanungo

8 Royal Exchange Place,
Calcutta-1.

11th July, 1956.

I am glad to learn that you are bringing out a journal of Industrial Engineering. I wish your publication every success.

B. M. Birla

Bombay House,
Fort, Bombay-1.

7th August, 1956.

.....I am glad you have already received several messages from distinguished personalities and I take this opportunity of wishing you every success in the venture you have undertaken.

N. H. Tata

Krishna Vilas,
Vepery, Madras.

2nd August, 1956.

On the occasion of the launching of ''Journal of Industrial Engineering'', I have great pleasure in sending my best wishes to this publication, and its sponsors. Free India has lost no time in undertaking nation building projects on a planned basis. With the Second Five Year Plan, we are progressing into more emphasis on heavy Industries and consumer goods on a socialistic pattern. The basic need is to keep flowing the fruits of Science particularly in the field of industrial engineering, in order to make the national plan a success from the point of life of the common man. A regular journal aspiring to mirror the facets of this development, is a welcome feature, and I have no doubt the sponsor of the ''Journal of Industrial Engineers'' will be fully satisfying the public in a precise and progressive manner.

Rm. Alagappa Chettiar

15-A, Elphinstone Circle,
Fort, Bombay-1.

12th July, 1956.

I am glad to note that you are bringing out shortly a quarterly magazine 'Industrial Engineering'.

Engineering is the backbone of any industry and in it lies the development of all countries. A magazine dealing in technical subjects as enumerated by you is long awaited in the country. The Editorial Board of such Magazines plays an important part and with the association of eminent Chief Engineers the magazine

should really be very valuable and particularly when the country is in its development stage.

I have no doubt, the public in general and the industry in particular will be eagerly awaiting the issue of the magazine and I wish you all success in this venture.

Shriyans Prasad

Ewart House, Bruce Street,
Fort, Bombay.

12th July, 1956.

I am glad to know that you are bringing out a quarterly publication entitled 'journal of Industrial Engineering'.

India is on the threshold of an industrial era. Both the learned and the laity find, in speedy industrialisation, the salvation of the country. To achieve this end, India needs all the sinews of the Industry – namely, men, materials and technical know-how, to come to her aid. At this stage of country's economic life, 'Journal of Industrial Engineering', it is my hope, well render invaluable assistance to the country's developing economy in its task of furnishing first hand information on industrial engineering, and in this endeavour I wish you every success.

Babubhai Chinai

Industrial Estates,
Lalbaug, Bombay-12.

6th August, 1956.

I am glad to know that you are proposing to bring out a quarterly publication entitled ''Industrial Engineering''.

Industrial Engineering as a profession is assuming progressively greater importance in the context of increasing emphasis on industrial development under the Second Five-Year Plan. The work of Industrial Engineers is mainly of a technical and organisational character and the publication of a journal devoted to the study of the various problems which will have to be dealt with by the Industrial Engineers is highly desirable.

I hope that the Journal will contribute to the dissemination of useful technical information among Industrial Engineers and I wish the publication every success.

Morarji Jadavji Vaidya

I am happy to send you this short message of good wishes for the Inaugural Number of your Journal of industrial Engineering.

I would like to congratulate you on this new venture which will fulfil a much felt need. This pioneering effort will, I am sure, be crowned with success. The propagation of scientific information and technological know-how in an era of

rapid industrialisation is not only indispensable to a professional Engineer, but also to all those who, both in public and private sector, are engaged in fulfilling the targets of the Second Five Year Plan.

J. K. Srivastava

Modinagar,
U. P.

7th August, 1956.

I am glad to learn that you are starting publication of a Journal on ''Industrial Engineering''. The subjects selected by you are really very useful during the present times when our country is trying to industrialise rapidly. The manufacturers and Engineers would like to be benefitted by such technical matters as designs of plants and equipments, quality control techniques, erection of factories etc. I hope the language would be simple and although the subjects are technical but they will be explained in words which are not over technical so that the Journal may prove useful for one and all.

Wishing a long life of useful service to your new enterprise.

Rai Bahadur G. M. Modi

Swadeshi House,
Kanpur.

18th July, 1956.

I am glad to note that you are bringing out a quarterly publication ''Journal of Industrial Engineering''. India today is on the eve of industrialisation. The Second Five Year Plan has given it its proper place. All round industrial and engineering development is expected in the coming years. At such a time, I feel confident to say, your journal should be able to do good service to the cause of industrial engineering.

I wish you all success.

Seth M. R. Jaipuria

Bhiwndi,
Dist. Thana.

14th July, 1956.

I am glad to learn that you are publishing a Journal on such a vitally important subject as ''Industrial Engineering''. In the process of rapid Industrialisation through which our Country is passing, the aspect of Industrial engineering needs closer study. May this new Journal be a sincere guide to the industrialists who are trying to build prosperous and happy India of tomorrow.

G. G. Dandekar

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Technical contributions are invited from Works Managers, Production Engineers, Technical & Industrial Consultants on all subjects of interest to Industrialists & Manufacturing Organisations.

Articles should be elaborate supported by illustrations, wherever available, and should be of a high order. Only original photograph prints should be sent and drawings should be on drawing paper or cloth in India Ink. Ferroprints are not accepted.

Summary of technical papers read before Professional Institutions or at meetings of Engineers are also accepted if they are of sufficient interest to the Industrial Engineers.

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The Managing Editor reserves the right to delete, amend, or add any paragraph / paragraphs to the contributions.

ACCEPTED ORIGINAL CONTRIBUTIONS WOULD BE PAID FOR AT OUR RATES, IF DESIRED

Structural Engineering Aspects of Aluminium Industry

By S. K. Ghaswala, B.E., A.M.I.E., M.I.I.M., Assoc.M.ASCE., Mem. ASME., M.I.Ae.S., M.Soc.C.E. (France), M.I.Met., F.R.S.A. (Lond.)

INTRODUCTION

THE acceptance of a new material like aluminium for engineering work represents a significant event in the history of a country's industrial progress. Steel, together with its multifarious alloys, has upto now been rightly regarded as the raw material of the present industrial and technological age and the entire gamut of engineering applications from screws to suspension bridges, or skyscrapers, has been carried out in this metal. As a result the claims of other non-ferrous metals were put aside in spite of their good intrinsic physical and mechanical properties. Aluminium is one among such non-ferrous metals as is evident from the fact that its commercial development has taken place within the memory of many now living. Metals like gold and silver and iron have been known since antiquity and can look back on several thousand years of development while aluminium and other light metals like magnesium and beryllium have been obtained in their metallic form from their ores only since the dawn of the 19th century. The chronological order (1) in which the production of various metals was begun is given in Table I.

TABLE I

Metal	*Year of Production*
Gold, Silver, Copper	5,000 B. C.
Tin, Bronze	3,500 „
Lead, Iron	3,100 „
Iron, Beginning of Systematic Production	2,000 „
Metallic Aluminium	1,825 A. D.
„ Beryllium	1,828 „
„ Magnesium	1,830 „
First Commercially successful Electrolytic reduction plant for aluminium	1,886 „
First successful production of high strength aluminium alloy of " Duralumin " type by Alfred Wilm and inauguration of large scale industry	1,909 A. D.

It can be clearly seen that aluminium is a comparatively young metal, although surprisingly enough, next to Silicon, it is the most abundant material in the earth's crust, as shown in Table II.

TABLE II

Metal	*Percentage contents of the Earth's Crust*
Silicon	25.80
Aluminium	7.50
Iron	4.70
Magnesium	1.90
Zinc	0.02
Copper	0.01
Lead	0.0008
Beryllium	0.0005
Silver	0.000004

PRODUCTION AND PRICE TRENDS

The wide fall in the price of this metal from its early beginning to the present era, forms a clear indication of its rising output. Thus some eight decades ago aluminium cost Rs. 11,43,520 per ton (£8200 per ton) while the present cost of (virgin) Ingots is round about Rs. 3000/- (£214) per ton and for finished products like plates and sections, anything between Rs. 4500/- (£322) to Rs. 6300/-(£450) per ton. The comparative prices prevailing August 1953 in long tons for different non-ferrous metals in different countries is given in Table III below.

TABLE III

Metal	U. K.	Canada	U. S. A.	France	Western Germany	Italy	Japan
	(Basic price of unalloyed metal in Rupees per long ton)						
ALUMINIUM							
Ingot	2100/-	2156/-	2408/-	2618/-	2688/-	2968/-	3080/-
Sheet 16 s.w.g.	3332/-	—	3920/-	—	—	—	
Extruded Bar 1″ diam.	2870/-	—	4186/-	—	—	—	
MAGNESIUM							
Ingot	4508/-	3640/-	3024/-	6440/-	—	—	—
Sheet 16 s.w.g.	—	—	7336/-	—	—	—	—
Extruded Bar 1″ diam.	—	—	6496/-	—	—	—	—
COPPER							
Ingot	3290/-	3360/-	3332/-	3570/-	3500/-	3808/-	4550/-
Sheet	4074/-	—	5656/-	—	—	—	
Extruded Bar 1″ diam.	—	—	5740/-	—	—	—	
ZINC							
Ingot	1022/-	1358/-	1232/-	1400/-	—	1666/-	2170/-
Sheet	1414/-	—	2576/-	—	—	—	

On an average, worked aluminium alloy sections cost from Rs. 2–4–0 (sh. 0–3–2) to Rs. 2–12–0 lb. (sh. 0–3–10) as against Rs. 0–5–0 (5d) to Rs. 0–8–0 (8d) lbs. for mild structural steel. In order to bring down the price of the light metal, it is imperative to develop its productive side, especially in view of the fact that India ranks 9th among the 23 world producers of aluminium with a beauxite capacity of over 29 million tons and an estimated reserve of 250 million tons.

In 1891, an English scientist, attached to the Madras Engineering College, first proposed to the British Government for the utilisation of water power for the production of aluminium. An expert committee went into this question and the matter dragged on for nearly 10 years without avail, till 1900, when a company was formed to develop manufacture of hollo-ware in this light metal. Later further schemes were worked out in the early years of this century including the Koyna Valley Hydro Electric project, the Rewa State scheme in Central India, and the Kolhapur State scheme. All these projects were turned down in the interests of British Government, and India remained in the background till 1936/1937 when definite schemes were planned and a primary aluminium industry was born in this country. Actual production started in 1943 and has since been developing as shown in Table IV, which gives the production figures of both the ore and the metal, while for purposes of comparison production figures for other countries of the world are also given.

TABLE IV

Year	*Aluminium Production in metric tons.* India		France	U. S. A.	Russia	U. K.	Italy	Germany
	Aluminium	Bauxite						
1943	1292	24548	46462	835,000	62000	56557	46192	203068
1944	1751	12330	26154	—	—	36038	16796	191000
1945	2250	14116	37225	—	—	32432	4347	20000
1946	3240	7592	47952	372,000	90000	32067	11040	—
1947	3220	11000	53225	—	—	29384	24859	—
1948	3372	19000	64785	—	—	30510	33083	7306
1949	3516	40650	54140	—	—	30832	25647	28848
1950	3590	—	61000	—	—	29941	37070	26951
1951	3876	—	91080	—	—	28200	49750	74136
1952	3566	—	106100	850,000	300000	29000	52000	100000
1953 (half yearly)	1682	—	—	—	—	—	—	—

It is a common knowledge that the production of one ton of aluminium requires approximately 4½ tons of Bauxite, 0.16 to 0.2 tons of Caustic Soda; 0.07 to 0.10 ton of Cryolite; 0.035 to 0.04 ton of Aluminium Fluoride; 0.007 to 0.008 ton of fluorspar; 0.75 ton of Petroleum Coke; 0.2 ton of pitch; 4.0 tons of coal; 0.5 ton of Furnace Oil and last but not the least 20,000 to 24,000 KWH of Electrical Energy.

The ideal aluminium plant would be one situated near abundant raw deposits, adjacent to coal mines and with limitless cheap electric power. In addition to these many other factors come into play and as such an accurate rating of the potentialities of all countries as regards aluminium production is difficult. However, some idea can be had from the average statistical conditions of the production facilities of different countries and their comparison with India (2). This comparison is given in Table V.

TABLE V

Countries	Power	Bauxite	Coal	Transport facilities	
Canada	A	E	A	B	Note:
U. S. A.	A	B	A	B	A = Excellent
Germany	B	D	A	C	B = Good
Russia	B	D	C	D	C = Average
France	A	A	B	A	D = Fair
Italy	B	B	E	B	E = Poor
Norway	A	E	E	C	
U. K.	D	E	A	B	
Japan	D	D	C	C	
Switzerland	A	E	E	D	
India	D	B	C	D	

It is evident from this table that in order to develop her aluminium industry, India must concentrate on power production and transport facilities if it is to make use of her latent sources of Bauxite, since in these two items its standards are comparatively low.

DISTRIBUTION OF CONSUMPTION

Having considered the general trend of development and the wide potentialities of the aluminium industry it is necessary to visualise the manner by which the metal can best be utilised. The applications of aluminium in the general field of engineering are rapidly increasing (3, 4, 5, 6, 7). In this paper, only one of the facets will be considered, *viz.* its utility in structures familiarly met with in the wide field of civil engineering. In India in 1951 the total consumption of aluminium in all forms was 16,000 tons. A break up of this figure as shown in Table VI indicates clearly that over 62% was being utilised in the manufacture of utensils and the remainder for other purposes.

TABLE VI

Mode of Application.	*Actual Consumption as Percentage of Total Production in Pre and Post War Years* India 1951	Europe 1949	U.K. 1949	Switzerland 1949	U.S.A. 1949	U.S.A. 1942	U.S.A. 1935/39	Italy 1952
Utensils	62.5	5	8.4	9	14	1	12	10
S. C. A. Conductors	15.6	10			10			
Foil & Packing	6.3		5.6	15				6
Mining & Colliery equipment			0.3					
Transport Air, rail & sea		35	24.7	15	29	63	22.2	20
Machinery			5.5		15	6	3.5	
Electrical Industry		5	4.1	9			23.7	27
Architecture & Building Construction	—	10	17.9	17	8	3		6
Chemical & Food Industry		5	1.2	15	11	5		6
Metallurgical Industry	0.6	15		10	9	21	28.3	7
Armaments excluding aircraft		10	4.8					
Direct Exports			19.0					
Miscellaneous	15	5	8.5	10	4	1	10.3	18
Total Production in Tons	16000	231890	230835	21000	617538	472700	234000	52000

These figures are compared with the applications of aluminium in foreign countries, especially in the field of building construction to indicate the existing inadequacy of India's contribution.

As in other fields, an index of a country's achievement can be expressed on a per capita basis.

In Table VII are collected statistics of different countries regarding the per capita production of aluminium and a comparison made with a similar index for Iron and Steel. Along side are also given the per capita power consumption of the three leading countries of the world, to indicate the poor state of affairs still prevalent in this country.

TABLE VII

Country	Per Capita Production of Aluminium, Iron & Steel in lbs.			Per Capita Power consumption in kwh	Aluminium Consumption in 1949 expressed in 1938 level
	Aluminium 1938	Aluminium 1949	Iron & Steel 1948		
Switzerland	6.006	5.676	—	—	94
Germany	5.808	3.366	175	—	—
U.K.	2.860	8.184	670	1110	286
Sweden	2.288	7.590	407	—	331
France	1.474	2.640	398	—	179
U.S.A.	1.382	9.988	1210	2207	722
Italy	1.366	1.760	102	—	129
Japan	1.208	—	47	—	—
Canada	1.074	7.722	490	3905	719
U.S.S.R.	0.7084	—	260	—	—
Belgium	0.555	—	1022	—	—
India	—	0.00001	6	14	—
Norway	—	9.526	—	—	—
Holland	—	3.30	—	—	—
Austria	—	2.464	206	—	—

In 1938 the major individual consumer of aluminium was Switzerland, while in 1949, the United States topped the rating, followed by Norway. In Europe, France increased its consumption, while Britain has also come into prominence. To enable a direct comparison to be made, the 1949 consumption is expressed in 1938 level, taking the latter as an index year, 100, as shown in the last column of Table VII.

The enhancement of India's aluminium production envisaged in the Five Year Plan, will bring the capacity to a figure of 20,000 tons by 1955–56, which can be roughly estimated at 1/170th of the world production. Even with this enhancement, the per capita rating will be 0.000055 as against the 0.00001 for 1949 level, i. e. approximately 36000 times lower than the lowest European per capita producer of aluminium. It is therefore quite imperative to see that this capacity is still further increased by setting up a 50,000 to 100,000 tons production plant at a suitable site having cheap electricity, and raw materials at hand. A site near the Bokaro Thermal Station appears to have wide possibilities for such a plant and require to be thoroughly studied and investigated.

APPLICATION TRENDS

The quality of the modern light alloys have been profoundly influenced by the discoveries of Wilm of Germany. Prior to his work, the light metal was mostly produced in an unalloyed condition used for pressing, deep drawing and in roofing work. Probably the first use of the metal in the latter form was made in 1897 in the roof of the Roman Church of St. Gioacchino, the material being supplied by Aluminium Industrie A. G. Neuhansen, Switzerland. After 40 years service it was re-examined and found to be in a perfect condition except a mean wear of the sheets by 0.01969 inch. Since that period its applications have steadily grown all over, various structures having being installed in all parts of the world such as the roofs in the A. I. A. O. structures in Leopoldsville, Belgian Congo, Kingstrand type houses in Israel and Karachi, Vallot Refuge on Mt. Blanc, approx. 14,300 feet above sea level, and in several roofs over structures in Germany, Australia and other places (8, 9, 10).

In spite of these uses in roofs and a few other items, their major utility in structures was not recognised till a comparatively recent date. This is all the more surprising when it is known that ever since Wilm's discovery of age hardening and the production of strong light alloys of "Duralumin" type, the aircraft industry has made extensive use of aluminium alloys, in major stress carrying components. This particular state of affairs can be attributable to such factors as:

(a) Lack of knowledge of the principles of design and mechanical properties of aluminium on the part of designers outside the aircraft field.

(b) Difficulty of selecting alloys and sections due to a general non-standardisation.

(c) Insufficiency of production of the right type of forms and sections in this country.

Combined with these factors there is a deep set belief prevalent in India that aluminium is a metal fit for kitchen utensils only and is too soft and weak for any major engineering use.

As it often happens, it was only when both technical and commercial requirements combined to force the issue, as during and after the last war that aluminium made some strides and established itself as a worthy piece of metal fit for use in major structural engineering work. Unfortunately at present the applications of this light metal are limited in a very large degree to copying steel construction, which prevents full exploitation of its inherent characterists. Aluminium has come into the structural engineering field via the aircraft industry, and as such should furnish a striking proof of its beneficial and progressive influence provided it is not side tracked into the familiar pattern of imitation of traditional materials as shown by the author elsewhere (II).

In the structural field, the building construction industry offers probably the largest single outlet and scope for utilisation of aluminium, as is evident from the fact that next to the transport and aircraft industries building industry is at present the largest user of aluminium in U. K. and U. S. A. consuming over 30% of the output of all fabricated products. The science of building construction or as a matter of fact any other type of civil engineering construction predominantly centres round static or immobile structures, so that it becomes difficult to visualise the specific advantages that would accrue by using aluminium instead of traditional materials like bricks, timber, steel and reinforced concrete. The value of the metal lies in one or more of the following factors:

(a) The high strength/weight ratio of the metal resulting in the utilisation of reduced volume for same strength or higher load carrying capacity for the same volume.

(b) Superior resistance to corrosion and decay, resulting in the possibilities of use of much thinner sections than normally required in ferrous materials.

(c) Readiness and ease of machining and fabrication thereby reducing production costs.

(d) Lower overall density resulting in economy in transport as compared with bricks stone, reinforced concrete and steel. Aluminium has the same density as glass, asbestos stone and slate, and is nearly one third the weight of brass and steel. It is nearly 40% heavier than bricks, 60 to 70% heavier than timber, and 10% heavier than reinforced concrete.

(e) Its neat and pleasing appearance, which can be enhanced further by painting in any shade or colour or by anodising.

(f) Good thermal and electrical properties rendering it useful in lighting conduction and bus bars.

(g) High reflectivity of radiant energy in all wave lengths ensuring its suitability in coverings exposed to heat especially in tropical countries.

(h) The non-toxic, non-magnetic and insulating characteristics rendering it useful for refrigeration purposes.

(i) Comparatively low modulus of elasticity giving it a greater resilience during deflection and rendering it ideally suitable for diving boards, and dance floors.

SCOPE IN BUILDING CONSTRUCTION

Having considered the broad outline of applications, it is interesting to analyse the various specific categories in which the building industry should function from the point of view of production of components and other members used therein. Actually six major categories are recognisable as outlined below:

(i) Complete buildings prefabricated in aluminium, or buildings with an aluminium frame filled in with insulating material such as glass, foamed concrete etc.

(ii) Structural components such as roofs, trusses, beams, columns, and sidings.

(iii) Special structures such as large canopies, lifts, escalators, etc.

(iv) Standardised components such as door, window and partition frames and filler material, electrical and other ducting and tubing, scaffolding, hoists, rainwater goods, soil pipes etc.

(v) Hardware and other Fittings such as locks, handles, nails, bolts, screws etc.

(vi) Decorative accessories such as railings, balustrades and window grilles.

Out of these six categories, it is necessary to investigate which one or more best suits the Indian conditions and can be fully exploited and developed.

(i) Fully Prefabricated Buildings

In the opinion of the author the time is not ripe for complete prefabricated buildings in aluminium to have a very wide market in this country, mainly due to the high cost of production. It may be true that in special circumstances, such prefabs may have certain advantages but in the general industrial pattern they do not fit in well. An example of this type is the well known Kingstrand frameless house built on the principles of stressed skin or "monocoque" construction familiar to aircraft designers. Such structures have been used in thousands for housing colonies in Damodar Valley Scheme, in Sindri Factory, in Karachi, and in Israel. Walls and roof of this structure consist of troughed aluminium sheets 0.032 inch thickness as shown in Fig. 1, and are made of Noral 3SH alloy (Al+1.25% Mn)

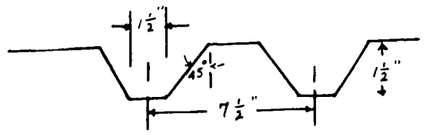


FIG. 1.

having a tensile strength of over 11 tons/sq. in. This forms the basic unit of the structure and resists all stresses coming within the roof and walls. These components are secured together by means of angles of the same alloy but varying in thickness from 0.0408 inch to 0.104 inch. These angles act purely as brackets between wall and roof panels and therefore do not require to be stiff, although they are rigid enough for carrying handling stresses. Gable walls have horizontal angles at eaves level which are of a stiffer section to strengthen this part of the house.

Doors and windows are made of the same sections, and are stiffened and braced by top-hat sections. The basic units are available in two or four room houses with different types of verandha attachment, all of which can be bolted and set in position by four to five men in just three days. The weights of houses vary from 800 lbs. to 2300 lbs. depending on the size.

The simplest design comprises a house of 2 rooms 10'x12'-6" each, and having an eaves height of 9 ft. and a ridge height of 11 ft. The largest type and the most expensive is an eight room house with front and rear verandah. The four main rooms are 10'x12'-6", the four secondary rooms 5'x7'-6", and the two verandahs are 5'x10' each, the eaves and gable remaining at the same level as before. The cost of the former is approx. Rs. 2165/-(£ 155/-) and the latter Rs. 5065/-. (£ 362/-) As they stand they cover respectively a plinth area of 250 sq. ft. and 750 sq. ft. including the verandah. This works out to Rs. 8/12/- (sh-/12/6) per sq. ft. and Rs. 6/12/-(sh-/9/6) per sq. ft. The average cost is therefore Rs. 7/12/-(sh-/11/-) sq. ft. To this has to be added the cost of transporting the imported structure to the site, labour for erecting it and providing the necessary flooring either in plane concrete or with any variety of paving required. Working on an average type of house, weighing about 1500 lbs. the cost of the above ancillaries would work out to Rs. 1/4/-(sh-/1/10) sq. ft. or a total plinth area rate of Rs. 9/-(sh-/13/-) sft. If other facilities have to be installed, the cost would run round Rs. 10/-(sh-/14/6) per sft. which by any standard of measurement, is high for industrial and rural housing, since locally constructed structures range within Rs. 7/-(sh-/10/-) to 9/-(sh-/13/-) sq. ft. The relatively high cost of the house arises from the fact that the troughed sections, which from the principal structural unit cost Rs. 2/5/-(sh-/3/4) per lb. and each running foot of the unit which is 2'-6"+12'-0" weighs 17 lbs. In other words, a troughed aluminium alloy sheet in this type of house costs Rs. 2/2/-(sh-/3/3) per sq. ft. which is relatively higher than the cost of a 9" brick panel wall or a plain or corrugated G. I. or asbestos sheet used with timber supports for roof or even siding. However it is a little cheaper than a 5" reinforced concrete flat slab used for roof and covered with the usual waterproofing medium, such as brickbat coba and plaster, or China mosaic, or cement tile paving or bituminous compound layers. This examine furnishes a stricking proof that a completely prefabricated house built from imported sections entirely in aluminium cannot complete with the traditional modes unless in special cases where there is a dearth of local materials or where the cost of transportation of such materials would be very high.

(ii) Structural Components

The second category provides for components in aluminium, leaving out the structure to be erected in the best and cheapest possible material available. The author believes that this type of structure is best suited

to Indian conditions where local materials are available in plenty and labour is comparatively cheap and abundant. From a wide global study, it is evident that aluminium would be best suited for purlins, rafters, roof trusses and sheets, in both large and small span structures. In the case of small spans upto 10 feet, a truss can be dispensed with and an ordinary 20 to 24 gauge plain or corrugated sheeting used with a central purlin if desired. A plain 20 gauge (0.036" thick) sheet weighing 1/2 lb. per sft. costs Rs. 1/1/-(sh-/1/7) sft. (or Rs. 2/2/-(sh-/3/3) per lb.) and once installed requires little maintenance, as these light alloys do not rust, corrode or decay for a very long period. If it is found that a thinner sheet can be replaced say 24 gauge (0.022 inch thick) weighing 0.31 lbs./sft. it is advisable to use a corrugated section, as this form is capable of resisting higher stresses. A 10/3 corrugated sheet having 10 corrugations of 3 inch pitch, in 24 gauge, costs about Rs. 1/13/-(sh-/2/7) per running foot i.e. 31"×12" or in other words Rs.-/12/-(sh-/1/1) sft. It can readily be seen that this form of application becomes quite economical and can easily compete with the older accepted roofing materials. Experimental investigations have shown that due to high reflectivity of aluminium, most of the solar heat is reflected back and only a very small portion is allowed to pass through generally in the vicinity of 10 per cent. Even this heat does not spread from the underside of the roof right down to the floor but is localised in a portion just 10 to 12 inches immediately below the surface of the sheet. If for a place situated at 30° latitude, and having a wind speed of 15 m. p. h. a value of 300 B. T. U. per sq. ft. per hour is assumed as the maximum value for solar radiation, then the amount of heat which would be transferred by aluminium sheeting would be only 76 B. T. U./sft./hour, as contrasted with 154 B. T. U./sft./hour for asbestos sheeting and 250 B. T. U./sft./hour for galvanised iron sheets.

The surface of aluminium sheets requires no painting and presents a bright clean and well groomed appearance. If however an additional æsthetic value is desired they can be spray painted, the cost of which works to no more Rs. -/4/- (4d) sq. ft. Under very special cases anodising can be resorted to in which case the general cost becomes very high and the process prohibits a large scale application.

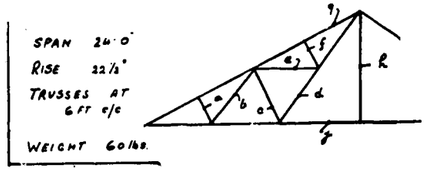
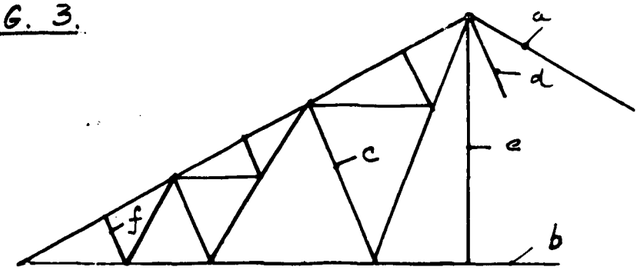


FIG. 2.

a, b, c, e, f. ⌊ s 1½"×1½"×0.08"
g. ⊤ s 2"×1½"×0.08"
d, g. ⊥ s 1½"×1½"×0.08"

FIG. 3.



SPAN 52'-0"
RISE 24°
TRUSSES AT 12'-6" c/c
WEIGHT 360 lbs.

a,	⊤ s	2½" × 2" × 3/16"
b, c,	⊤ s	2½" × 2" × 5/32"
d,	⊤ s	2½" × 1½" × 1/8"
e, f.	⌊ s	2" × 1" × 1/8"
All others	⊤ s	2" × 1" × 1/8"

The inherent characteristics of lightness of aluminium has been widely recognised in this application in roof trusses. Such structures, whether they cover large or small spans can be easily fabricated in the workshop and brought to site and erected with a very light lifting tackle and a small labour gang. Economy in the speed of erection is therefore considerable as compared with a similar steel truss. An indication of these aspects is evident from Figs. 2 and 3 which show two trusses in aluminium.

The weight of the 24 feet aluminium truss is 60 lbs. and that of 52 ft. truss 360 lbs. A similar truss in steel would weight 470 and 1500 lbs. respectively. In addition to this saving in weight the supporting structures can be made much lighter, while maintenance cost for the trusses is practically nil. The overall economy in trusses does not lie in just substituting steel by aluminium, but in several other factors such as correct spacing of trusses, a good selection of roofing material; appraisal of wind loading, evolution of new sections especially for large trusses for industrial structures such as N— lights; and the incorporation of stressed skin principles in which the sheeting forms an integral part of the structure and in addition to acting as a mere covering also carries a part of the principal stresses.

The general principals of truss design apply equally well to aluminium beams and girders. An aluminium alloy beam of 25 T/sq. in tensile strength shows for equal loading and strength a weight saving of nearly 60% over steel; and for equal stiffness (i. e. equal deflection) a saving of nearly 38%. In these cases the actual area of material used is 8 to 10% more than steel for equal loading and strength. In the case of compression members the problems of elastic instability come into play, and every section has to be designed on its individual merits. The low elastic modulus of the metal results in a larger deflection and increased resilience, a property which can be put to good use in dance floors, and diving boards, where fatigue can be minimised by this increased springiness. An excellent example of this property is furnished in aluminium bicycles which show considerable ease and lightness in riding than the conventional steel ones (13).

The future development of beams should proceed on the manufacture of unconventional sections such as the ones shown in Fig. 4 as these have proved to be more economical from the point of view of material utilisation than the conventional forms of joists, channels, angles and tees.

A rational utilisation of aluminium can only be made, when the correct mode of sectioning is recognised, and

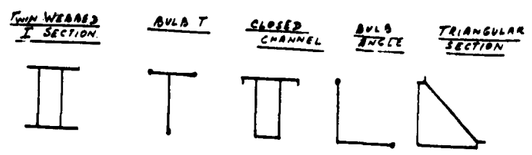


FIG 4

"designing in shape" rather than "designing in strength" is given due thought. (12). A correctly designed assembly would be one in which every component of the assembly and in turn every inch of the component is utilised to the limit of maximum permissible stressing. By avoiding the use of massive sections and using lattice structures and sheet built members, material can be dispensed around the neutral zone and considerable economy achieved. Thus for example in Fig. 5 (a) and (b) are shown two 6" aluminium channels both having a weight of 2.91 lbs./rft.

Channel (a) is of standard form while (b) is an extrusion designed to distribute the load more evenly. As a result of this change in form, channel (b) carries a load practically double of that which can be borne by channel (a) acting as a long column.

It can thus be realised that it is imperative for the structural aluminium industry to concentrate on the development of such sections for stress carrying components instead of going in for the orthodox conventional forms suitable for steel construction.

SPECIAL STRUCTURES

In special structures such as large canopies, lifts and escalators aluminium is no doubt an ideal material.

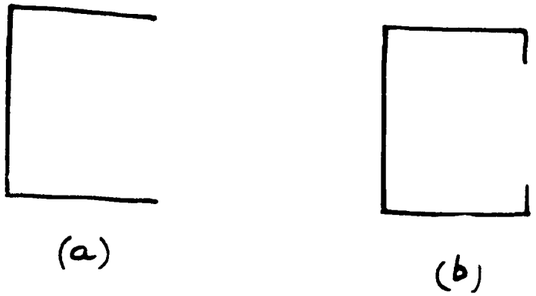


FIG 5

Large stores in the United States, France, Switzerland and in other European countries have lifts and escalators in light alloys. In addition to the increased pay load and lighter handling, the electrical cost of running these structures, is also reduced. Large ships like the "Queen Mary" and the "United States" have lifts in aluminium.

In a country like India, development of escalators does not appear very justifiable at this stage, in view of its negligible demand. However the use of light alloys in lifts is a very serious proposition and should be examined thoroughly as there is likely to be an appreciable saving in electrical energy, in spite of the initial high cost of installation.

(iv to vi) *Frames & fittings*

Out of the remaining three categories, the development of door and window sections, on a large scale and of other items like, scaffolding tubes, railings, ducting and ornamental grillework on a smaller scale appear to warrant attention. Aluminium entered the field of window and door frames in 1920 and within a decade has established itself as a worthy material. The cost of an aluminium window installation mainly depends on design, for there are several instances when competitive work results if thought is given in using efficient sections not only in frames but also in glazing bars. In addition to the bare cost, the cost of maintenance requires to be duly considered, for, in aluminium, painting is rarely required and maintenance is reduced to just occasional cleaning. All the usual type of windows, including casement, double-hung and fixed sash are suitable for manufacture in aluminium, including the sliding variety, fanlights and roof lights. The extrusion process of manufacture allows more freedom than any other method in the design and permits efficient distribution of the metal to give maximum stiffness. Frames, particularly for double-hung windows can also be cast in one piece by gravity die casting process enabling the work to be turned out expeditiously provided a very large quantity is required. Many of the windows for the English Aluminium Bungalow of which some 70,000 were produced between 1945 and 1948, were made in this manner. Generally greater care is required in transporting aluminium windows than is the case with steel, in order to ensure that frames do not undergo stresses greater than actual service and that packing is adequate to prevent undue distortion.

The portions of aluminium in contact with masonry or steel work are required to be painted for preventing any galvanic corrosion. Bituminous paint or compounds containing zinc chromate are quite satisfactory. All fixing clips and screws bearing on the frame should necessarily be in aluminium or galvanised or cadmium plated steel. Once installed, aluminium windows require cleaning only be soap and water and compounds like "Vim". The windows of the New Bodleian Library, Oxford, were restored to original condition after 6 years of neglect during the last war by a mixture of light machine oil and furniture wax polish. In the windows of the New Cambridge Library which required large openings for lighting the area containing over one and a half million books, some 28 tons of anodised aluminium has been used. In fact at present most of the large shopping centres in Europe such as Milan, Zurich, Geneva have doors and window frames in aluminium, while its use in America is unprecedented anywhere. Two of the most conspicuous examples are in the United Nations Secretariat Building in New York and the 39 storey aluminium skyscraper built to house the offices of The Aluminium Company of America in Pittsburg.

For ornamental grillework, aluminium in the pure unalloyed state offers considerable scope in use in aesthetic architecture, while its use for rain water goods and pipes requires to be developed. Scaffolding is another branch of building industry, which offers unlimited scope of economy. By virtue of its lightness and long range economy due to offence of maintenance and permanency as compared with the unsightly timber scaffolding, the light metal offers advantages which may not be apparent at first, due to its high initial cost.

Commencing with the production of door and window frames, the industry should slowly start on the development of these auxiliary building necessities in order to cover the market on a bigger scale at a later stage. Initially however the main components of a building especially the roofing side offers a very wide market and requires to be concentratedly widened.

BRIDGES

Steel, reinforced concrete, and timber have upto now been used in bridge construction. With developments in aluminium alloys, and a wider understanding of its properties it is slowly establishing itself as a valuable material for such structures. This is quite evident from the recently constructed bridges in aluminium, such as the Arvida Bridge over the Saguenay River, Canada, having a fixed arch span of 290 ft.; the floating Pontoon bridges constructed by the Corps of Engineers, Army Service Forces, U. S. Govt., the Double Leaf Bascule Bridge over the Wear River in Sunderland, England

having a clear opening of 90 ft.; and the Double Leaf Trunnian Type Bascule Bridge opened on Sept. 30, 1953 at the entrance to the Victoria Dock, Aberdeen, Scotland, having a clear opening of 70 ft. and of quite an unorthodox design.

Although the advantages of using a light material in movable bridges such as bascule, swing, lift, and Bailey, type are self-evident, considerable economy can be achieved in static structures also.

It is common knowledge that as the span of a bridge increases, the dead weight increases disproportionately, till such spans are reached when it becomes a major consideration. It is for this reason that bridges over a mile in span are yet to be evolved for with ordinary materials of construction, and accepted methods of design, their own weight becomes so great that it bears a very disproportionate ratio to the live load and the whole feasibility becomes questionable. It is therefore evident that any material which would have the strength of steel but the lightness of timber would certainly carry the day. Aluminium is one such material, and should with proper investigations, render itself ideal for long span structures. It can be reasonably assumed that in view of the higher cost per pound weight, it would not reveal economies for short span structures in all cases. However in long span bridges the difference in actual cost of steel and aluminium goes on diminishing till a point is reached when an aluminium bridge definitely becomes cheaper than an equivalent steel bridge. It is impossible to formulate exactly where this point is reached as a large number of variables enter into the design such as type of structure, nature of crossing, and site, foundations, loadings and climatic conditions. Calculations made by Dr. Sutter of Aluminium Laboratories of Geneva, have revealed that under certain specified conditions of loading and assumed foundation conditions, a double track railway bridge in aluminium becomes economical for spans of 650 feet and more. This indicates that the minimum economic spans for aluminium are not unduly long and can further be reduced by the use of high strength aluminium alloys, and adoption of advanced theories in design. General broad investigations appear to suggest that for spans of 600 ft. a weight saving of 60–70% results while for higher spans it may be over 80%. When the spans are under 600 ft., as is the case with the recently constructed bridges, the saving is anything between 20–60%.

MODES OF INDUSTRIAL DEVELOPMENT

At present, the utensil and domestic ware industry in India forms the single largest consumer of aluminium. With the increase in the production of the metal, especially with the envisaged Rs. 3 crore (£ 2,14,30,00) scheme for an aluminium factory and a thermal power station near Rewa to harness the rich potentialities of bauxite deposits in Vindhya Pradesh mountains, it is imperative that the structural aluminium industry should be developed to cope with the rising demands. However this phase of the industry in particular and other engineering industries in general can only be set on their correct path through a wide dissemination of the basic properties and inherent potentialities of aluminium and a very exhaustive study of the modern design aspects of these alloys.

In foreign countries, there exist research laboratories and investigation centres, either directly connected with the parent manufacturing concern or independent institutions for the spread of information on all aspects of aluminium technology. Among such bodies are the Research Laboratories of the Aluminium Company of America, and The British Aluminium Company, England; the Research & Development Laboratories of Aluminium Limited, located at Geneva and feeding a group of aluminium concerns; S. A. pour l' Industrie de l' Aluminium, Chippis and Lausanne, Switzerland; Aluminium Research Institute, Chicago; Aluminium Francais; Paris, Beautechnische Auskunftsstelle, Stuttgart, Germany; Instituto Di Scienza Delle Costruzioni, Milan, Italy; the Aluminium Development Association, London; and Centre Technique De l' Aluminium; Paris. Such technical associations exist not only for aluminium but have also been established for the development of other engineering materials as well, such as the Copper Development Association; the Zinc Development Association and the Timber Development Association of England. The Aluminium Development Association (ADA), which represents the central co-ordinating body for research in the whole field of English aluminium industry was established some 8 years ago, with the specific object of spreading on a very wide scale, the knowledge of the properties and applications of aluminium and its alloys and thereby increasing the consumption of the metal in all economically suitable forms. The object is carried out through direct advice to clients, publication of reports and bulletins, showing of films and giving lectures.

The author is of the opinion that India should establish a central disseminating agency on the lines of the ADA, with necessary modifications in its structure wherever justifiable. It is an accepted but lamentable fact, that a vast majority of engineers and technologists of this country, are still not fully aware of the

importance of aluminium in the structural field as they are about steel or other materials of construction such as timber and reinforced concrete. Although considerable spade work will be required to establish such an organisation, it is not beyond the bounds of possibility nor quite a new type of undertaking in this country. The latter aspect is evident from the existence, since the last 25 years, of the Concrete Association of India an organisation which is doing admirable work in the field of concrete technology.

As regards the modern design aspects of aluminium alloys, a careful preliminary study clearly indicates that a very wide structural applications are possible through the use of ingenious ideas and conceptions based on fundamental theories in applied mechanics. Thus the principles of lighter type structure can be achieved in practice in aluminium through the use of space frames such as triangular trusses for bridges, coach bodies, aircraft fuselage, domes for roof, and hipped-plate structures. An indication where precise knowledge is required in designing can be had in the calculation of stresses in an aluminium plate girder. A plate girder with a span/depth ratio under 8, is designed as a panel, while for ratios above this value, it has to be analysed as a beam. The tension field beam, not generally known outside the domain of aeronautics, is an excellent example of the manner in which the basic concepts can be advantageously applied in the structural engineering field. A tension field or semi-tension field beam, is similar to a steel built up girder with the difference that the web of this beam is made of very thin material, which is permitted to buckle or wrinkle under load. The wrinkled web acts like tension diagonals in an ordinary open web truss and creates a tension field. A better known counterpart of tension field beam is a sandwich panel, in which the flanges rather than the web are made of strong sheets. The core of the panel is formed of a low density material like pulp-base products, while the facings are of thin aluminium sheets. The core provides suitable shear connections, increases the relative moment of inertia and also acts in stabilising the relatively thin facings from buckling. Assuming the facings to be of an aluminium alloy of type 24 S. T. and a core material of density 0.01 lbs./cubic inch, it can be shown that in order to resist the same tensile loading, this type of sandwich panel would weigh 37% less than a solid aluminium sheet, while for equal compressive loading, the panel would weigh 21% of the solid light alloy sheet.

Another interesting aspect arises in the riveting of aluminium structures. It has been recognised that the conventional rivet point shapes common in steel construction do not permit aluminium alloy rivets of a size greater than 5/8" in diameter to be cold driven with existing pneumatic hammers. Some point shapes are more easily formed than others, such as flat and conical as compared with the countersunk types. Looking into these factors, a new trend in riveting practice is visible, wherein there is an increasing tendency to favour a small pan point for rivets upto 3/4 inch in diameter and a drilled-end type for large rivets. Further it has been suggested that the grip of the rivet shank in the hole provides adequate resistance to tension under several conditions of loading, a suggestion which if conclusively proved, will undoubtedly form a revolutionary idea of immense practical benefit in the field of fabrication of metals in general and light alloys in particular.

These few examples serve to indicate the wide and ever growing adaptability of structural aluminium in hitherto unchartered fields and the limitless possibilities of its fertile consumption (14, 15). None of these are however possible to be put into the realms of practical engineering unless, the actual production of the alloys is developed on a marked scale. This development can proceed speedily and efficiently provided the already established aluminium industry is correctly guided on its path, and a sound method of disseminating technical information in this field instituted. India, with her vast bauxite resources, can, if properly processed, feed not only its own internal enterprises and the new born shipbuilding and railway coach building industries, but also act as a world supplier of aluminium and its alloys, without having to restrict its exports merely to holloware to the meagre tune of a 1000 tons per annum as at present.

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(Continued on page 22)

Pilot Ovens for Coking of Coals

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IN an earlier paper [1] the limitations of the common laboratory testing methods for the assessment of coking properties of coals have been discussed. It was also shown [2] that heat of wetting of coal which reveals a close relationship with the physical properties of the coke made from the coals is better suited for classifying coals in the order of their cokability.

Physical tests cannot be performed on small quantities of coke. Full scale tests in commercial ovens are no doubt the best means of ascertaining the quality of coke obtainable from a particular coal. But insufficiency of test samples, operational difficulties, high cost for carrying out the commercial test etc. however, make such industrial scale tests generally impracticable.

In early attempts for the direct determination of coke properties, experiments were made by 'bag tests' in which test coals contained in jute sacks or metal boxes were charged with the normal coal in commercial ovens. This was, however, unsatisfactory for various reasons. Later, pilot ovens varying in capacity from one cwt. to two tons, heated either by gas or electricity, have been introduced for a study of the coke properties. These ovens are designed to duplicate a small section of commercial coke ovens simulating all their operating conditions. Some of the pilot ovens, common in use, are described in this paper and their usefulness discussed on the basis of work done on Indian coals.

PILOT OR EXPERIMENTAL OVENS

BM—AGA Test: The U. S. Bureau of Mines[3] in conjunction with the American Gas Association developed an apparatus in which a charge of 85—200 lb. of coals are carbonised in cylindrical retorts (dia. 13"—18") under carefully controlled conditions at temperatures ranging between 500 to 1100°C with equipment for the measurement and recovery of gas and by-product yields.

Electric Oven (Swoboda): The charge[4] consisting of about 400 lb. is filled in a rectangular mild steel retort 44" × 27" × 10". The purpose of the retort is to hold

(Continued from page 21)

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Gas fired half-ton experimental Unit 18" width oven at Jamshedpur.

the sample tightly and to avoid damaging the heating coils. During carbonization, the coking chamber is heated by means of heating coils placed inside the wall at the rear and the front side (movable door) of the chamber. The maximum temperature is maintained around 900°C during a coking period of 9–10 hours. The rate of heating is between 25° to 30°C per hour and the carbonized mass is coked for a further period of 8 hours, at the maximum coking temperature.

After completion of coking, the retort is removed and allowed to coal in the atmosphere. The content (resulting coke) is later taken out by breaking open the retort. The oven enables determination of the relative expansion pressures exerted on the oven walls by different coals during coking by means of suitable pressure measuring device fitted on to the end of the tube supporting the movable wall.

Gas-fired Oven (Russell): The oven[4] chamber is of dimensions 42"×28"×12" with a capacity of 400—500 lb. of coal. The heating walls, made of fire-clay brick, are provided with multiple flues heated by two gas burners on either side with manually controlled valves. The carbonisation is done with wall temperature of about 900°C against a flue temperature of about 1000—1100°C for a period of about 12 hours. The coke is hand raked and hand quenched. The thurst of the charge exerted on the movable wall during carbonisation is capable of being measured by a lever system.

Experimental Oven designed by State Geological Survey, Illinois: The oven[5] chamber, made of silicon carbide tile, has an average width of 14". The coal space of the oven chamber is 36" in length, 35" in depth and holds a charge of about 10 cu. ft. Heating is done through vertical flues on both sides of the oven chamber by means of Globar electric heating units and is provided with accurate control equipment. Provision is also made for recovery of by-products. The coke is raked out manually and hand quenched with water.

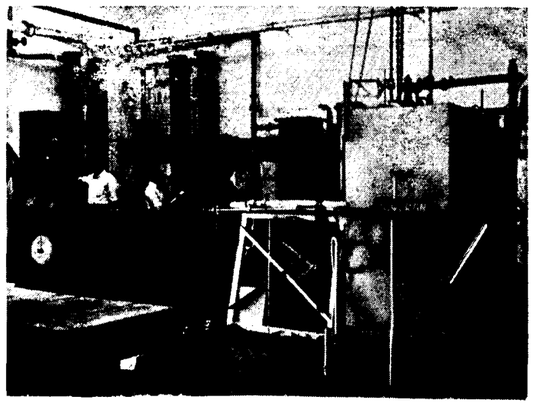
Experimental Oven of the Midland Coke Research Committee: The oven[6], 3' × 3' × 1½', is heated by downward combustion of gas distributed through a series of six flues on either sides the flue temperature being controlled by gas pressure regulators. The oven holds a charge of 500 lb. and the coke is raked out by hand and quenched. A cooling system is often installed to collect the tar, liquor and gas though the oven is principally meant for a study of the coke quality.

1/2 ton Experimental Oven: One of the latest in pilot oven[7] designed by a British firm has the following dimensions:

(1) Width of chamber (parallel walls) 18"
(2) Height from sole to top of charge 3' 6"
(3) Length between doors (inside) 4' 6"

The oven chamber made of silica bricks holds of charge of about 10 cwt. and is heated by eight down burning vertical flues which are provided with controllable dampers for correct maintenance of draught. Valves for control of air and gas, and pyrometers for the measurement of flue and coke mass are provided. The coke is pushed out by a hand operated ram and the doors are raised or lowered by hand operated winches. The quenching is done manually by hose pipe.

Experimental Coke Oven Battery in Spain: In the National Institute of Spain an experimental battery[8] has



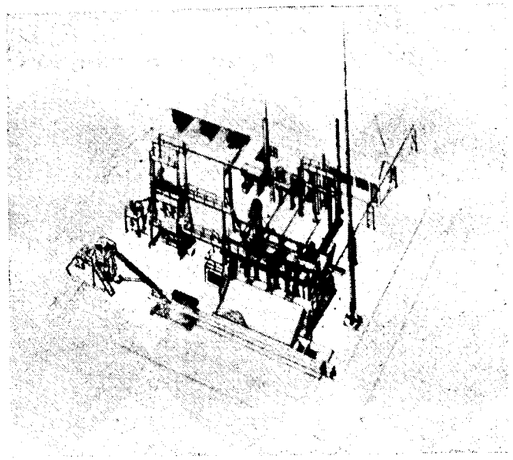
Electric carbonising oven with by-product recovery units at F.R.I.

been lately installed consisting of four ovens having varying width of 12", 14", 16" and 18" respectively. The ovens are of the compound underjet type and each forms an independent unit with separate set of regenerators with auxiliary producer gas unit for heating with lean gas. The constructional details and the heating system are essentially similar to commercial batteries with an efficient and mechanised coal and coke handling system.

There are two separate collecting mines placed on either side of the battery. The larger one is capable of dealing with the gas from all the ovens together while the smaller one may be connected at will to any of the ovens. The installation also includes plants for benzol recovery.

Experimental Ovens in use in India : The Coal Blending & Coking Research (C. B. C. R.) Scheme of the C. S. I. R. and Tatas functioning at Jamshedpur have a gas-fired oven and an half ton experimental oven heated by down burning flues (described above). An electric oven was also in operation some years back. It has since been transferred to the Fuel Research Institute at Jealgora. Another ½ ton experimental oven of the type referred to above is in use at the Indian Iron & Steel Co. Ltd., Burnpur.

Study of only the coke properties is possible with these ovens as these are not provided with by-product recovery units.



Perspective view of the Pilot High Temperature Carbonisation Plant at F.R.I.

The experimental electric oven at F. R. I., lately fitted with complete gas scrubbing units, has been employed for carrying out large number of tests on various Indian coals and their blends.

Some of the results of the work of C. B. C. R. have been published in two reports[7],[9].

GENERAL OBSERVATIONS

Reproducibility of Test Results : It is essential to ascertain the reliability of results from pilot ovens by carrying out duplicate tests under identical conditions on the same coal charges. In Table I are shown the results of duplicate tests done in the three types of experimental ovens. (TABLE I)

Though some variation is observed in the screen analysis of the upper size coke the total percentages on 1½" (blast furnace coke) from duplicate tests are substantially the same. The physical test results of the cokes (Shatter, Micum, Haven, etc.) check well.

Comparison of Commercial and Test Oven Cokes : In Table II are given the comparative results of tests done on the same coals or blends in experimental and commercial ovens. (TABLE II)

Some of the main features are : The physical test values of cokes from electric oven are generally higher than the corresponding values for other cokes. The electric oven coke has a larger initial size with less fracturing of the cokes due to the lower carbonising potential under which tests are done in this oven (heating wall temp. of 870°–900°C). The coke retort is air-quenched and the coke undergoes little handling. In the gas-fired ovens the carbonising potential is much higher, the flue temperature being maintained between 1050°—1250°C and the coke mass undergoes more severe treatment after leaving the oven. Due to shock quenching with water considerable fracturing of the coke takes place resulting in reduction of their size. Generally the apparent specific gravity is the lowest and the porosity percentage is the highest for the coke from gas-fired oven. The coal charged in a commercial oven is subjected to a greater degree of packing with a consequent increase in the bulk density due to the height of the ovens. During filling of coals in the electric oven retorts and their subsequent handling the charge often gets somewhat packed and thus attains a higher bulk density. These factors contribute to a lower porosity in the commercial coke and often in the electric oven coke.

The overall physical properties of the commercial oven cokes compare favourably with the experimental oven cokes. Closer agreement between the results is possible if grain size, bulk density etc. of the coals are maintained identical and correct carbonising conditions for the experimental ovens are established after a series of carefully conducted scaling tests for each type of pilot ovens. It has been found that although the pilot oven results do not sometime check the results of individual commercial ovens they do check satisfactorily average plant results over a period of time. It should be remembered that even two adjacent ovens of a commercial battery do not always yield concordant results for the same charge carbonised simultaneously in two ovens.

Thus, with limitation an experimental oven proves a useful tool in skilled hands for the assessment of coking characteristics of coals and their blends and for a study of the influence of various factors e. g. grain size, moisture content, bulk density, carbonising rate etc. of the coal charges. The scope of utility of these ovens may be further widened by the installation of auxiliary equipment for the recovery and study of the various by-products e. g. tar, gas, amonia, light oil etc.

TABLE I

Duplicate tests in Pilot Oven

Type of Pilot Oven	Gas-fired 12" oven		Electric 10" oven		Gas-fired 18" oven	
Test No.	I	II	I	II	I	II
Properties of coke						
Proximate analysis (air-dried %)						
Ash	24.3	23.8	20.4	20.6	23.0	23.4
Volatile Matter	1.7	1.0	1.2	1.4	1.0	1.2
Screen Analysis (Cumulative %)						
on 4"	56.0	49.3	90.3	80.6	70.8	74.3
on 3"	79.9	70.3	95.3	91.8	87.4	88.9
on 2"	94.0	95.5	97.6	96.7	94.3	93.8
on 1½"	96.9	97.0	98.2	97.3	95.9	95.5
Through 1½"	3.1	3.0	1.8	2.7	4.1	4.5
Physical testing of coke						
Shatter Index						
% on 2"	78.0	76.5	84.6	87.8	86.0	86.0
% on 1½"	92.0	93.0	92.5	94.5	92.0	93.5
% on ½"	96.5	97.5	97.4	98.0	98.0	98.5
Micum Test						
Total %						
on 40 mm.	82.8*	82.5*	77.1	77.9	80.3*	81.8*
Thro.: 10 mm.	10.5	10.0	12.0	11.8	11.8	9.9
Haven Test						
Haven Stability Factor %						
on 1"	56.8	56.8	52.0	55.4	52.0	50.7
Apparent Sp. Gravity	1.01	1.00	1.07	1.10	1.05	1.06
Porosity %	47.5	49.6	46.4	46.8	47.6	46.9

*Breslau Test

TABLE II

Comparison of coking test results from commercial and pilot ovens.

Serial No.	I		II		III		IV		V		VI	
	10" width Electric Test Oven.	18" width Test oven (Gas-fired).	10" width Electric Test oven.	14" width commercial oven (Gas-fired).	10" width Electric Test oven.	12" width Test oven (Gas-fired).	10" width Electric Test Oven.	12" width Test oven (Gas-fired).	18" width commercial oven (Gas-fired).	18" width Test oven (Gas-fired).	18" width commercial oven (Gas-fired).	18" width Test oven (Gas-fired).
Screen Analysis of coke (Cumulative %)												
on 4"	34·3	10.9	81.2	27.1	56.3	53.0	59.3	58.9	58.3	76.7	48.9	56.2	43.6
on 3"	70·3	30.7	93.6	46.6	79.0	75.2	85.6	81.8	79.9	87.8	76.8	82.1	71.4
on 2"	87.9	69.7	98.9	69.9	91.9	91.0	94.0	92.2	87.8	93.6	91.2	93.3	89.4
on 1½"	92.4	82.6	99.4	81.7	96.2	95.6	95.4	94.6	90.8	94.9	94.4	95.5	95.4
Through 1½"	7.6	17.4	0.6	18.3	3.8	4.4	4.6	5.4	9.2	5.1	5.6	4.5	4.6
Physical Testing of coke													
Shatter Test on 2"	58.9	44.8	87.3	67.4	84.0	76.5	87.0	86.0	81.0	87.5	89.9	81.0	78.3
Total % on 1½"	77.6	68.9	94.2	77.0	92.5	88.5	94.0	93.0	93.0	91.5	94.3	90.5	89.8
on ½"	96.4	96.6	98.2	94.1	—	97.0	—	97.0	98.0	96.5	97.7	99.0	98.3
Micum Test on 40 mm.	49.4	48.5	81.9	41.0	82.8*	75.8*	80.3*	77.0*	76.0*	83.2*	84.8*	80.1*	79.6*
Total % Thr: 10 mm.	10.9	8.3	8.6	12.7	—	16.8	—	14.3	15.0	10.6	8.7	10.6	9.0
Haven Test Total %					54.4	39.8	49.3	38.6	56.8	46.0	50.5	48.0	51.2
Stability Factor on 1"	21.1	19.3	61.1	17.9	1.09	1.0	1.05	1.03	1.09	1.07	1.15	1.05	1.10
Apparent Sp. Gr.	0.9	0.891	0.98	—	42.0	47.1	45.3	48.7	42.0	47.7	44.0	47.0	46.0
Porosity %	55.9	46.9	50.2	—									

* Breslau Test

Experimental Plant at F. R. I. : An experimental pilot coke oven battery is under erection at the Fuel Research Institute. The plant consists of three silica oven each 14", 16" and 18" width and of height 3 ft. 11¾ in. and length 8 ft. 11¾ in. The ovens are of the regenerative, compound underjet type (capable of heating upto 1300°C) and they can be stamped charged from the sides and filled from the top by a charging car with adjustable height. The throughput capacity is 3500 Kg. to 3850 Kg. The battery will be completely instrumented and provided with by-product recovery unit with benzole scrubber.

In construction and operation the experimental battery will be similar to industrial ovens and will thus prove valuable for assessing the coking characteristics of different coals and their blends under industrial carbonising conditions and also for studying the influence of various operating factors such as, oven width, rate of heating, grain size etc., on coal carbonisation.

Acknowledgement : The author desires to express his sincere thanks to Dr. A. Lahiri, Director, F. R. I. for his permission to publish this paper and for utilizing the experimental results of the work of the Carbonisation Section of F. R. I. and of the C. B. C. R. Laboratory, Jamshedpur, to make the general observations towards the end of this paper.

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MESSAGE FROM THE CHIEF MINISTER, GOVT. OF HYDERABAD

''..Glad to hear that a Quarterly Industrial Engineering Journal dealing with all matters of technical interest to industry is being brought out in September.

It is really a good gesture to appoint on the editorial board of the Journal the Chief Production Engineers and Chief Works Managers of several leading Industrial Units in India, as they are the people conversant with the day-to-day problems confronting the industries and their development which will naturally find a place in this technical publication of much importance to industries. The importance and necessity of the development of industrial engineering need not be overstressed here when once the importance of industries for a country is realised as essential for its economic development.

I send my best wishes for the success of the Publication and trust that everything published therein will be of real use to the industries and for their development''.

Atoms May Revolutionize Food Industry

(By A Special Technical Correspondent)

THE future of atomic food preservation looks so promising that a new plant to process 1000 tons of food per month will be built in the United States. In this plant, which will start operations in 1958, scientists expect to perfect this extraordinary development, considered the most beneficial use of atomic energy ever discovered. If successful, the results will be preservation of food without refrigeration, an advance that will revolutionize food storage and distribution throughout the world.

Progress toward a practical, effective method of "cold sterilizing" food through exposure to atomic radiation has been rapid during the last five years. At the beginning, scientific knowledge was limited almost entirely to two facts: spoilage bacteria in food is killed by atomic radiation, and food so treated does not retain any of the atomic radiation. They did not know how much radiation was needed, how long the preserved food could be stored without refrigeration, what changes would occur in taste, odor and nutrient value of the food. Most important of all, no one knew whether the atomic-processed food would be harmful to human beings.

Through painstaking costly research, most of these uncertainties have been eliminated. The effort has been nationwide in scope, with research conducted by more than 60 universities, industries, foundations and government agencies. Because of the excessively high cost of such research, the United States Army, which also is interested in the benefits of atomic food preservation, assumed responsibility for the financing and co-ordination of this program. Today, thousands of scientists across the nation are co-operating in this tremendous research effort.

The results to date are remarkable. Atomic energy has been found extremely useful in many different ways. Radiation can be used to completely sterilize food so that it can be stored for weeks, months and even years without refrigeration. It can be used to pasteurize, or partially sterilize food, which increases storage life, so necessary in marketing perishables. The sterilizing power of atomic radiation also can be used to permanently destroy food parasites; insects in dry foods, such as wheat, peas and beans, or to prevent sprouting of tubers, such as potatoes and onions.

Several different types of atomic equipment using the waste products from atomic reactors, atomic rays produced by high-voltage machines, and radioisotopes have proved highly effective.

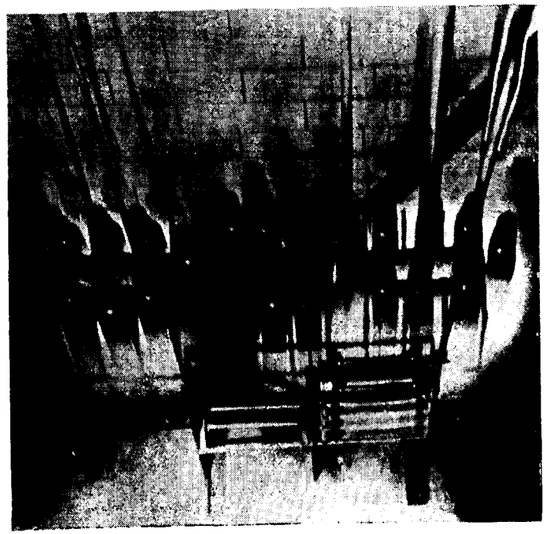
Through eating tests, atomic-processed foods have been found as nutritious as untreated foods and completely safe for consumption by animals or humans.

Though five years of research have brought rapid progress, there still are problems to be solved before atomic food preservation becomes commercially practical. One problem is the bad odor and poor flavor of some atomic-processed foods, which makes them unacceptable. Many "cold sterilized" foods, both cooked and uncooked, taste exactly the same as unprocessed food, such as chicken, pork, beef, fish, bread, asparagus, carrots, sweet potatoes and a great variety of fruits. Poorest results are achieved with dairy products—milk, butter and eggs. Processing must be improved to make these foods palatable.

When this processing problem is solved, other obstacles in the path of large-scale atomic food preservation must be overcome. Effective, convenient methods must be devised for packaging, handling, storage and shipment of atomic-preserved foods. Also the cost of atomic sterilization must be reduced before it can compete with other food processes, such as canning, freezing and chemical treatment. Operation of the new processing plant is expected to solve these problems.

Although the successful development of atomic food preservation will cost many millions of dollars, the expenditure is warranted by the benefits that will be shared by everyone in the world. Important will be reduction of diseases caused by parasites, by bacteria-contaminated food and by the lack of fresh vegetables, fruits and other nourishing foods in many areas. The greatest benefits, of course, will be increased quantities of food and reduction in the need for refrigeration to preserve supplies during shipment and storage.

The vital need for atomic food preservation is pointed up by the results of United Nations surveys, which show that many areas of the world cannot meet the minimum nutritional requirements of their people and that the world population is increasing by 100,000 persons per day.

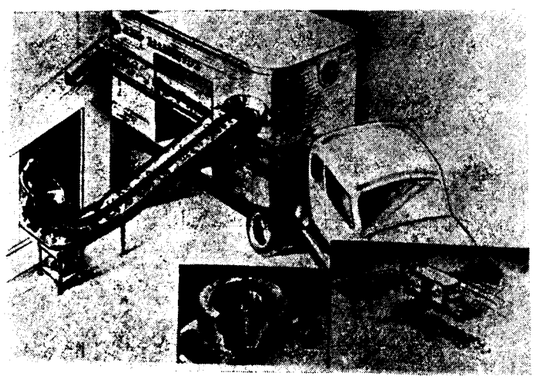


Slightly above these devices which emit atomic radiation, at the bottom of the water pool, cans of food in the group of metal containers are sterilized almost instantly. Without applying heat, cold or chemicals the spoilage bacteria in the food is killed. Atomic processed food can be stored without refrigeration for lengths of time from weeks up to two years.

Exhaustive scientific tests determine the results of atomic-processing of foods. Through five years of such painstaking research, scientists have learned exactly how exposure to radiation affects food. No item of diet is considered acceptable until there is absolute assurance that it has not deteriorated in any respect and that no change has occurred to harm persons who may eat it.

Potatoes properly exposed to radiation do not sprout, wither or spoil for two years. This portable atomic-processing unit can be mounted on a truck and moved into a field, where it can quickly "preserve" an entire potato crop.

Atomic food preservation has been the subject of painstaking research in the United States for five years. Here six cans of food will be exposed to radiation at the bottom of a water pool in order to test atomic preservation of beef hash.



A mobile atomic processing unit designed for large-scale industrial use can "cold sterilize" food crops at marketing centers or in the field at harvest time (lower right insert). As the food is fed into the truck automatically, it moves past an atomic device (bottom center insert) which emits radiation. Upon exposure to the radiation, spoilage bacteria in the food is instantly killed.

Czechoslovakia's Outstanding Contribution to Hydraulic Engineering

By An Engineering Correspondent

NEW DESIGN OF WATER POWER PLANTS

THE Czechoslovak foreign trade corporation for the export of complete industrial plants, TECHNO-EXPORT, can offer complete deliveries, technical assistance, service and experience of the well-developed Czechoslovak industry, scientific and research institutes as well as of special project institutes to prospective foreign customers interested in the construction of water power plants.

A significant advantage and feature of TECHNO-EXPORT is the fact that it is able to undertake quite complexly the whole construction of water power plants. This means that according to the wishes of prospective foreign customers, it can execute all the necessary operations prior to the start of construction, beginning with geological research and the compilation of investment tasks. Further it can execute building and engineering-electro-technical projects, delivery of all complete installations for the operation of water power stations as well as the equipment for the site of the water power plant itself, including even the heaviest building machines.

Due to its outstanding qualified specialists, the Czechoslovak industry represented in this field by TECHNO-EXPORT, is able to undertake the execution of the complete construction of a water power plant abroad, the assembly of all delivered installations, their setting into operation and finally, if necessary, instruction of the attending personnel.

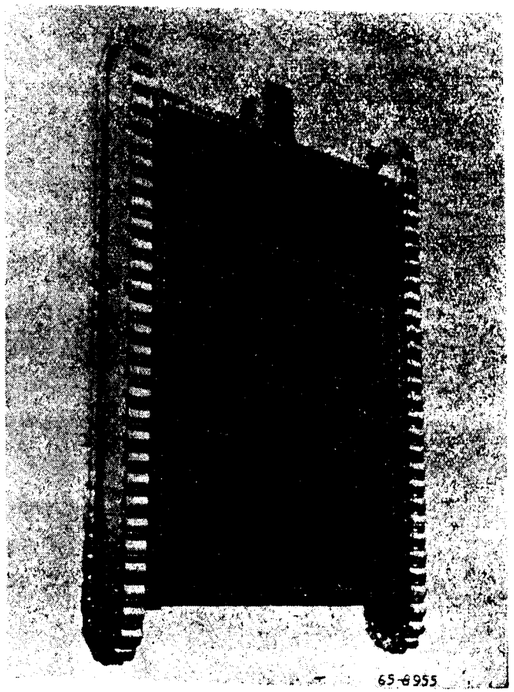


Fig. 2. Trap flood-gate quick-closure table.

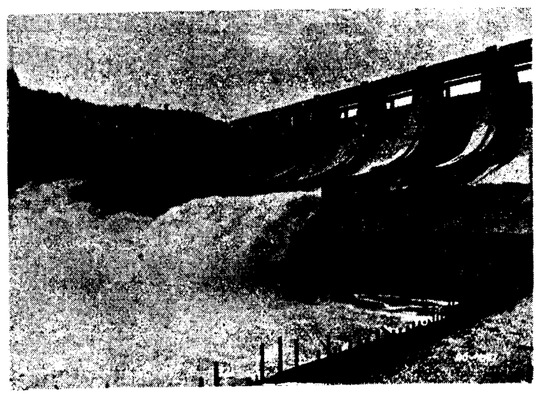


Fig. 1. Slapy Water Power Plant—Action of the overflows.

The present well-developed Czechoslovak industry and designing institutes continue in the traditions of the great and world-famous Czechoslovak foundry and engineering works in the field of water power plant construction, e. g. the Skoda Works in Plzen, the Vitkovice Foundries in Vitkovice, Ceskomoravska-Kolben-Danek in Prague and Blansko, Ignac Storek in Brno and others.

For more than half a century they have been carrying out constructions and delivering engineering and electro-technical equipment for water power plants equipped with Francis or Pelton turbines practically all over the world.

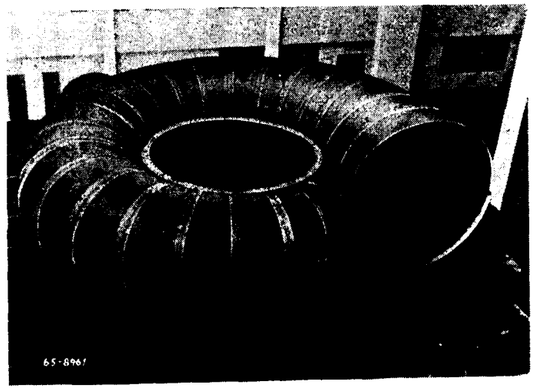


Fig. 3. Welded spiral of Kaplan turbine, 5000 mm. introductory diameter.

The Kaplan water propeller turbines were created in this country in the years 1912–13 as the result of the innumerable number of experiments of Ing. Dr. Viktor Kaplan, Professor at the Brno University, who later became an acknowledged technician of world importance. The first Kaplan turbine in the world was constructed here in Czechoslovakia in the year 1918 by the firm of Ignac Storek in Brno. Another Czechoslovak firm "Ceskomoravska-Kolben-Danek" also took part in perfecting the first Kaplan turbines, which did not prove true on high slopes.

As a result the Czechoslovak works have achieved a foremost position in water turbine construction in the world. In the last ten years, the "Ceskomoravska-Kolben-Danek" turbine firm in Blansko alone has produced turbines of a total output of over 1 million horse power, 45% of which were destined for export.

High-Pressure water power stations, either with Francis or Pelton turbines, did not show progress in principles, but only according to the unit size, this being directly dependent on the water conditions. The Czechoslovak engineering works therefore turned in the first place to the evolution of Kaplan turbines which, because of their features, were becoming victorious over the Francis turbines and were replacing them even in the medium slope field. In the struggle for utilization of Kaplan turbines for higher slopes the Czechoslovak industry has always been in the front. For example, in the year 1938, it designed and constructed for foreign countries five-blade Kaplan turbines of 25100 HP. output per unit for a 38 metre slope. They were installed in the Hone water power plant in Italy and the 38 metre slope was at that time the greatest slope in the world on which Kaplan turbines were operating.

In spite of the delay in technical evolution due to World War II and the many difficulties which are always to be found in pioneer designs, even to-day the Czechoslovak works do not remain behind. They have recently produced a prototype of a Kaplan turbine of 68000 HP. output per unit for the Slapy water power plant for a 58 metre slope fluctuating to 27.8 meters. By this they have achieved a world record in the construction of Kaplan turbines for such a high slope and output.

The Slapy water power plant (Fig. 1), in which three of these 68000 HP. aggregates have been installed, has quite a number of characteristic elements and designs, used for the first time in technical practice. With them it differs from the examples which inspired the Czechoslovak designer of this work, Ing. Libor Zaruba, State Prize Laureate. The Slapy water power plant is built-in into the body of the dam, so that the overflow water is carried over the power station by four reinforced concrete overflow slips. The overflow fields of 4×15 metres width are divided by segments for a height of 8 metres and are able to carry over catastrophic millennial water. The 17° angle overflow oblique slips, ending in toothed breakers on the reflection plane, form the roof of the water power station. The action of these overflows is evident from the Figure. A further interesting, and from the power point of view, welcome result of this design—an overflown water power plant—is a power contribution of up to 11000 KW by the decrease of the lower water in the space under the overflow down to 4.7 metres,

Fig. 4. Foundation flood-gate of 5000 mm. diameter.

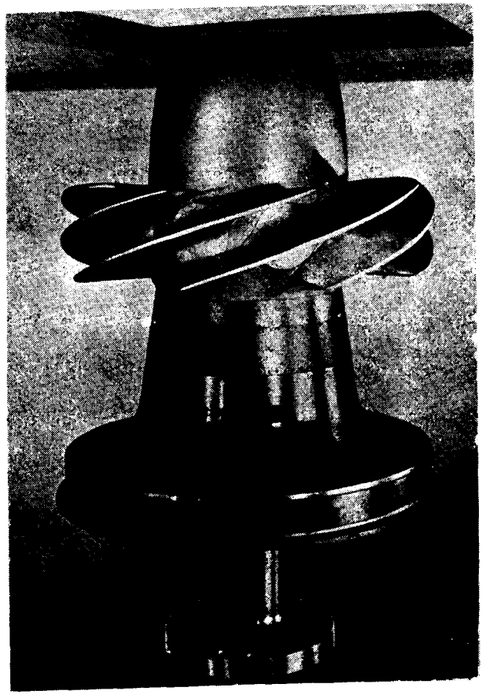


Fig. 5. Assembly of a high-pressure eight-blade 68000 H.P. Kaplan turbine for 56 metre slope.

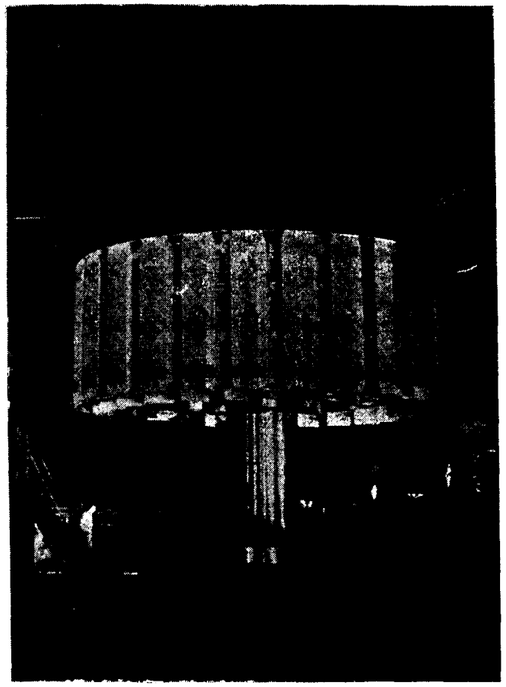


Fig. 6. Assembly of a 60,000 KVA Alternator for 10.5 KV voltage and 230.8 r. p. m.

amounting to a positive increase of slope during the passage of catastrophic water in the river.

Water is led to the three Kaplan turbines by three pressure pipelines of a diameter of several metres which are shut at the mouth by trap flood-gate quick-closures. The tables of the quick-closures are mobile on roller caterpillars and are lifted by oil servomotors.

The welded spiral of the above mentioned turbine of 5000 mm. introductory diameter is visible in the third figure during assembly in the works.

There are two 5000 mm. outflow diameter foundation flood-gates in the dam for carrying-over flood waters and for emptying the water basin of great capacity. These are regulation closures with hollow ærated jets, known also as Johnson flood-gates. One of these great flood-gates is shown in the fourth figure during assembly in the workshops of our turbine industry. At a maximum 56 metre slope this foundation flood-gate lets through 150 cubic metres per second. In spite of its great dimensions this closure body is controlled only by a 20 kW electric motor by means of mechanical transmission.

The 3×60000 kVA installed output water power station is equipped with three high-pressure eight blade Kaplan turbines of 3×68000 HP. output at a flow of 3×100 cubic metres per second. Fig. 5 shows the assembly of these turbines. The rather high revolutions of 230.8 r.p.m. and therefore decreased dimensions of the 60000 kVA nominal output alternator of 10500 V voltage and GD^2 momentum = 3211 square tonmetres have been achieved by using a turbine of this type.

However, the total weight of the rotor amounts to 258000 kg. including the auxiliary generator rotor/for its consumption/and its exciter, which are right on the shaft of the main generating set. The assembly of this rotor Fig. 6. was carried out by means of two connected cranes of 125-ton capacity.

The axial powers of the generating set, due to the weights of the rotating parts and to the hydraulic pull, have a maximum total value of 880,000 kg. They are

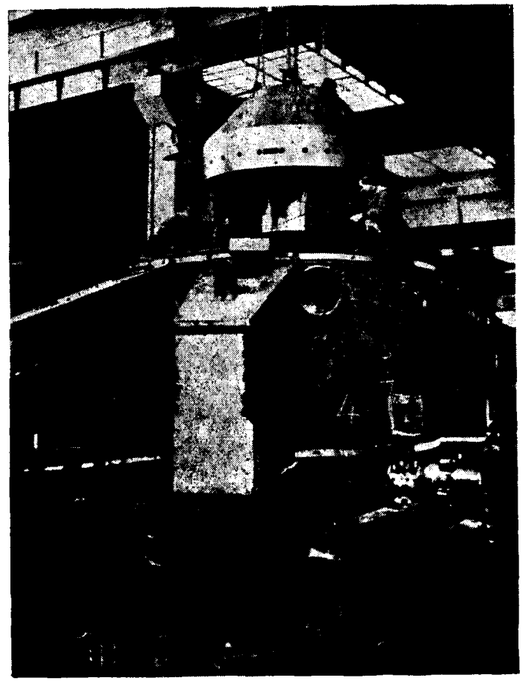


Fig. 7. Hinge construction and axial segment bearing for a load of 880,000 kg.

caught up by the axial segment bearing combined with radial bearing located above the alternator Fig. 7.

It should also be mentioned that another, even bigger water power plant is under construction in Czechoslovakia, in which four great generating sets with ten-blade Kaplan turbines for a slope of more than 70 metres are to be set in operation, the output of each one of them being about two times greater than in the Slapy water power plant.

With this water plant the Czechoslovak industry is ensuring for itself also in the future a foremost position in the use of Kaplan turbines of great outputs even for the highest slopes.

For automatic regulation of the generating set speed in water power plants, the Czechoslovak industry /CKD/

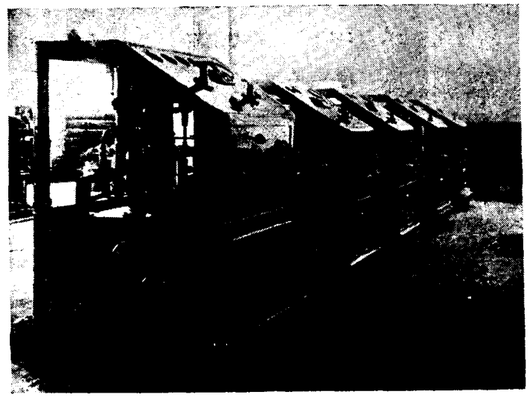


Fig. 8. Automatic hydraulic regulators of modern counter execution.

has been using in recent years solely/excluding the smallest units/its own, well proven construction of hydraulic regulators according to the patent of Professor Ing. Dr. Miroslav Nechleba. A technical specialty of this solution is that for the distant-control transmission of regulation impulses a hydraulic speed responsive element is used which including the proper connection pipeline and measure piston, works as an ideal matterless speed responsive element with all the resulting advantages. The line of modern counter-execution automatic hydraulic regulators is evident in Fig. 8.

Even the largest generating sets of the Czechoslovak water power plants are equipped not only with automatic failure devices which guard the state of the generating set and stop it in case of danger, but also with complete automatic distant-control devices, so that setting in operation as well as normal stopping can be remote-controlled quite automatically by merely pushing a button. The Czechoslovak engineering industry, of course, equips the water power plant with complete installations and instruments.

Certain Aspects of Industrial Management in India

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WE in this country are now engaged in the worthy task of building a new India and ushering in a socialistic pattern of planned prosperity for one and all.

The Second Five Year Plan attaches great importance to training executives in industrial management technique both in the private and the public sectors. The execution of the Plan lays tremendous responsibilities on the engineering fraternity. A review of the certain aspects of industrial management in our country should therefore be appropriate.

WHAT IS MANAGEMENT?

The Chamber's Dictionary defines the world 'manage' as follows: "to guide by use of hand—to have under command or control". The word 'manage' is derived from French 'manege' which in fact means 'managing a horse'. Management thus means effective leadership or guidance. The functions of management amount briefly to the co-ordination of the efforts of men into an effective working organization. However, the main concern of management is and should be what is contained in its first three letters "m-a-n". And it is human relationship in management, particularly in engineering industry in India, that will be discussed in this article.

Shri V. G. G. Nayar

PAYMENT BY RESULTS FOR PRODUCTIVITY OR PRODUCTION MINDEDNESS

It has been accepted on all sides that a better standard of life on a permanent basis can be established only by higher productivity. The main means of achieving this in India as elsewhere, is to evolve a system of payment by results where equitable cash payments are made either on a group or individual basis for actual production. This should preferably be coupled with a fair minimum monthly or daily wage.

Productivity or production-mindedness is indeed an attitude which can be instilled into the workers only through conviction on their part that they are assured of a fair return for the effort they put in. The principle of payment by results is the guiding factor for wage payment even in the Soviet Union where trade unions are supposed to be running the country. Norms and rates for such incentive schemes should be worked out carefully. The system will prove abortive if the workers suspect that the standards and rates will be revised to their disadvantage. The fruitfulness of this system can be supplemented by making special awards for high levels of efficiency achieved by individual workers from time to time.

Recognition of the contribution to methods of improvement by the rank and file is achieved by means of SUGGESTION SCHEMES where decent cash awards can be made for original and profitable suggestions. Such schemes bless both 'him that gives and him that takes'. The management is thus able to use the worker's brain as well as brawn while simultaneously rewarding him in cash suitably.

The right of the employees of an industrial organization to participate in its prosperity is an accepted fact. The system of bonus payments which in fact mean profit sharing is something unique to our country. At present the bonus issue is normally left to collective bargaining. This issue, however, continues to be the highest common factor in all industrial disputes and it is to be desired that Government should bring in suitable legislation to standardise and regulate same.

BUILDING UP EMPLOYEE MORALE

The basic requirement of good employee morale is security—physical, social and emotional. It is only fair to expect that just as a machine is given proper maintenance from time to time the men in the organization should also be studied thoroughly and kept in good working order and human. A worker can no longer be looked upon as a cog in a machine or a mere pay-roll

number. Only if his emotional security is assured and individuality recognized will he have a feeling of 'belonging' to the organization.

Man does not live by cash alone, and management have to devise incentives other than cash to keep employees happy. All of us have a weakness for a pat on the back whether or not we deserve it. Even when it is not possible to continuously encourage people with promotions and increments, a timely compliment or commendation will have far-reaching effects.

Management should create interest in employees in a forthright manner on company matters by developing suitable means of communications. To counter the spate of destructive propaganda being put out by political parties controlling unions, management should in unmistakable terms announce facts and figures and enunciate clear policies relating to the organization through notices house-magazines etc. Their communications policy should be dynamic and deliberate. In due course, employees will thus develop a pride of attachment to the production unit to which they belong.

Management should also provide facilities for employees for displaying and developing their various talents—artistic, athletic and otherwise. Modern management can arrange several competitions, tournaments and athletic activities which help to create a friendly atmosphere and get the best out of men while making them feel more human and at home.

Such facilities, however, are no substitute for fair treatment and promotions for which clear principles and rules should be formulated and enforced. Wages should be fixed on modern wage-evaluation principles. A continuing programme of sound policies and technique and practices is the best answer to the morale problem.

JOINT CONSULTATION

Wherever there is good morale there will be the spirit of co-operation. In fact, co-operation is the essence of morale and co-operation means participation. The Planning Commission are reported to be giving the subject of statutory employee participation in industry serious thought. Some big employers like the Tatas have worked out details of such participation and even entered into working agreements with the unions representing their workers. Industry-wide consultative councils have been working satisfactorily in many industries, for example, the coir industry. It must, however, be mentioned that statutory works committees have not proved to be of much effectiveness in joint consultation. Workers will always actively co-operate with programmes that guarantee security for themselves and their family, which provide them with an opportunity for participating voluntarily. However, whenever a company management changes any policy, procedures or practice affecting the wages and promotional possibilities of its employees, it is always better to take the workers into confidence either through internal consultative councils or through the representative unions. In any case, it is always possible and desirable for the supervisors and even the manager to gather senior employees in individual sections and discuss day-to-day problems with them. The spirit in all such consultations should be fraternalism and not paternalism and the manager should rather act as the captain of the team than the all-knowing boss who makes arbitrary decisions.

THE PLACE OF SUPERVISORY STAFF

Any attempt at establishing human relations in management will be abortive if there is not a well-knit supervisory staff who are always taken into confidence in managerial policy and who are thus trained to form the front-line of management. A satisfied and alert supervisory staff is the best asset of any modern management, whereas, an ill-equipped and ill-contented group can be depended upon to accentuate trouble and pull apart the employees and employers. Meetings of supervisors with top management should be periodically arranged and supervisors should be fully briefed on all matters of policy.

The correct organisational set-up cannot be over-emphasized. Experience has proved that single-line management there one individual has only one immediate boss is the most efficient. At the same time it must be recognized that modern management is a complex task and there needs must be decentralisation and free delegation of responsibilities.

Sensible and strict discipline procedure is a "must" in any engineering organisation employing big groups of people. Discipline properly maintained will only enhance the dignity of the employees and at the same time add to the prestige of the supervisory staff. Discipline should be enforced at different levels and each supervisor or section-head should cultivate sufficient sense of responsibility to tackle lapses of discipline himself rather than just act as a post office of complaints.

Supervisory staff must be treated differently from the rest of the employees and it is desirable to keep them as far as possible out of the orbit of collective bargaining. In any case, it is an accepted practice that they should not belong to the same union as the body of workers.

Much depends on selection of proper men with capacity to fill supervisory cadres. Supervisors and foremen should not only be technically trained but also have

sufficient common-sense to comprehend the fundamentals of the vast science of human engineering.

GETTING ALONG WITH THE UNION

This is indeed the most knotty problem in Indian industry today. Collective bargaining with unions is acceptedly a necessary factor and has to be faced with realism. But judging by some of the primitive methods adopted by trade unions in industrial disputes, one is led to wonder if we are still not in the initial stages of an industrial revolution. Trade union methods in India leaves a lot to be desired. Politics not only dominates trade union psychology, but most trade unions appear to be built round, for and by the political parties. Opportunism — and sheer opportunism — dominates union strategy. It is a pity that we do not have sensible trade union or industrial disputes legislation yet. The proposed legislation which will provide for only a single bargaining units in a single industry will improve matters a lot. Let us hope that the new industrial relations act will enable automatic disposal of industrial disputes in a swift and definite manner, in any case, better and quicker than the currently available hesitant conciliation machinery and slow-moving machinery for selective and discretionary, compulsory adjudication.

Management in this country has to get used to the stark fact that in trade unionism there is no limit to bargaining demands. The declared objective of all trade unions appears to be "more and more and more, now". Even if they say 'yes' for the short run, they only mean 'no' for the long run. Labour leaders are sceptical of any proposals for active co-operation or industrial truce, since, according to them, this strikes at the very basis of their existence. Worker-resentment is after all, the main leadership tool. There are very few honourable exceptions to the general run of purely agitative type of trade unions. Politicos who invariably lead trade unions, are suspicious of any offer of industrial truce for a definite period, since, they are afraid, when all is well and peaceful, their membership may question the very need for a union.

The many-sided advantages to both parties of active co-operation in the common task are, in most cases, lost sight of. Trade unions have yet to show their willingness to shoulder their responsibility and help to co-operate in building industrial organizations whose prosperity or adversity is, after all, equally the workers' prosperity or adversity.

Management have got a definite responsibility in improving this state of affairs. They must do their best to carry the union or unions with them as far as possible and it is not impossible that militancy will, in due course, be converted to active co-operation to mutual advantage. Trade unions have to be given sometime to get used to the democratic and socialistic atmosphere and there is no reason to doubt that in due course they will co-operate better to make the industry stronger and the country richer. At the same time the days are passed when management could just ignore the unions or fight them openly. Trade unions today are sufficiently militant and Government is always there to preserve the union's fundamental rights of free association and agitation.

Perhaps it would help to make trade unions and workers more responsible if engineering industries recruit their workers from the relatively better educated ranks of men of whom there are plently in our country. In any case, there is no justification for being too pessimistic about the future, particularly since the Planning Commission is fully alive to the situation and Government and management will, in due course, initiate necessary remedial measures to bring about a better atmosphere.

The above picture of management may, perhaps, look a bit too complicated. However, no job is too difficult if tackled in a forthnight and scientific manner. Engineers have every prospect of faring better in managerial tasks than non-technical folk by virtue of the former's technical education and capacity for scientific and analytical approach. A good engineer should prove as good at getting the best out of his men as out of his machines.

In a country passing through such tremendous social and economic changes as ours, the task is tremendous and Travancore-Cochin and West Bengal with their extreme political consciousness and its high percentage of educated unemployed—offer a more serious challenge in this regard than other parts of India. But management cannot, ostritch-like, bury its head in the sand and give up the battle. After all, the continuous link and the only party continuously and vitally interested in the business and even for that matter in the employees is management, and it is only management who have, under present conditions, the wherewithal to maintain leadership in constructive co-operation.

The author is sure that the engineering fraternity from whom most managerial personnel for engineering industry will be drawn, will not be found lacking in the capacity for leadership in the onerous task that faces them and that they will play their role properly in the execution of the country's ambitious plans and in the hastening of the birth of the New India of our dreams.

It Pays to Reduce Noise

By A Special Technical Correspondent
"Exclusive to Journal of Industrial Engineering"

HOW SOME FIRMS IN BRITAIN TACKLE THE PROBLEM

THERE is no longer any need to stress the importance of noise as a significant factor in the health and productivity of workers. Regarded as an obscure subject before the war, noise has become an important topic of discussion in recent years wherever welfare officers and production engineers meet.

The main reasons for the comparatively late appearance of noise control on the industrial scene are, on the one hand, the great increase in the amount of noise made by modern manufacturing processes and power plants, and on the other hand the fact that convenient instruments for measuring, analysing and recording noise have only lately become available. It was not until the advent of modern electronics that suitable instruments could be devised to deal with noise on a scientific basis.

Estimates about the amount of damage done by noise and the extent of injury caused to workers vary. British and American sources estimate that between 40% and 50% of workers exposed to loud noise suffer some impairment of hearing, while a Russian survey puts the figure as high as 83% in the metalworking industries. In the United States, where efforts are being made to classify occupational deafness as an industrial injury eligible for compensation, it has been estimated that payments under this heading are likely to exceed even the sums paid out in compensation when silicosis was recognised as an industrial disease in the 'thirties'.

RESPONSE OF THE EAR

The difficulty in tackling the noise problem arises from the peculiar structure and response of the human ear. When sound waves, in the form of alternate rarefaction and compression of the air, strike the eardrum, it is caused to vibrate in sympathy. This movement of the drum is transmitted to the middle and inner ear and is eventually translated into sensations of sound. The characteristics of the sound waves themselves are fairly easy to establish. The amplitude, or height of the waves, determines the intensity of the sound, while the frequency of the waves, or the number of waves occurring every second, determines its pitch. The greater the amplitude, the greater the intensity, and the higher the frequency, the higher the pitch of the sound.

This simple picture is modified by the ear in the act of perception, especially in respect of sound intensity. Similar to the eye, whose pupil contracts in strong light, the ear becomes progressively less sensitive as the intensity of sound increases. The subjective impression of the intensity of a noise is therefore called "loudness", and care must be taken in noise survey not to confuse loudness with intensity which is an objective quantity. Due to the defence mechanism of the ear, its sensitivity falls off roughly logarithmically as the intensity increases.

Noise level is therefore measured in decibels (dB) on a logarithmic scale. In practice this means that if one machine is found to have a noise level of 70 dB, the noise level of two such machines will be 73 dB, not 140 dB. It would require ten similar machines to raise the level from 70 to 80 dB and create an apparent doubling of loudness.

Nor is the ear equally sensitive to all frequencies. Sounds below about 18 and above about 18,000 cycles per second (c/s) cannot be heard at all by most people. Between those limits lies the audio frequency range, but within this range itself the response of the ear also varies. Two American workers, Fletcher and Munson, have investigated the response of the ear to varying frequency at different noise levels, and their findings are shown in Fig. 1, known as the "Fletcher-Munson

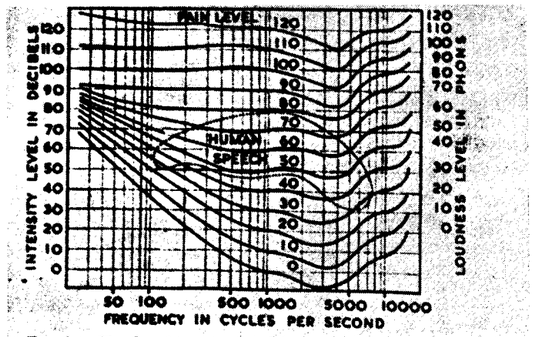

Fig. 1. Fletcher-Munson equal loudness curves, showing how the sensitivity of the human ear changes with varying frequency at different sound levels.

curves." It will be seen that at low noise levels the ear is considerably more sensitive to sounds around the middle of the audio frequency range, much less to sounds approaching the limits of the range. At very high noise levels, the response is almost even over the entire frequency range.

MEASURING NOISE

Any instruments used in noise investigations must obviously be capable of reproducing the special subjective characteristics of the ear, otherwise the readings obtained cannot be directly related to human reactions which are, after all, the point at issue. Recent advances in electronics have made this possible, so that a modern sound level meter, like that shown in the illustrations, is a fully portable instrument the reading of which is closer to the average of a group of human observers than the difference between individual observers.

The sound level meter can be plugged into an audio-frequency analyser, which shows how much of a given noise occurs at any selected frequency, so that a "frequency spectrum" can be prepared. For the study of transient phenomena, such as impact noises and reverberation in offices and lecture halls, a high-speed level recorder is available which can be plugged either into the sound level meter, for recording rapid changes in the overall noise level, or into the frequency analyser, for recording changes of any selected frequency.

Sounds are caused by the vibration of some solid body being transmitted to the surrounding air—sound is, in fact, sometimes referred to as air borne vibration. In the study of noise vibration measurement therefore plays an important part, and the microphone of the sound level meter can be replaced by a vibration probe and an adapter, which renders the meter suitable for measuring vibration. (Where vibration measurements are of primary importance, the use of a special vibration meter is recommended. This has a wider frequency range, and gives certain small improvements in the accuracy of vibration measurements).

All these instruments are portable and simple to operate. With the exception of the recorder, they are powered by dry batteries, so that they can be used anywhere. The makers claim that with a little experience anyone can carry out a useful noise survey on which measures for silencing offices or factories can be based.

FACTORY NOISE

The sources of noise in a factory are obvious. Some machines are noisier than others, and some operations are inherently noisy and cannot be completely silenced. Much can, however, be none about such things as transmission shafts and belts, open gears, worn of damaged bearings, bad exhausts and fans, vibrating guards and cowlings, all of which are prolific sources of noise.

The object of a noise survey is to establish which of these is responsible for the loudest noise, because only by silencing the loudest source first can the best results be achieved. Let us assume, for instance, that there are 11 machines in a workshop. Ten of these operate at a level of 60 dB, but the eleventh has a noise level of 80 dB. Their combined noise level will be less than 81 dB. Even if the ten less noisy machines were completely silenced at great cost and effort, the noise level would only drop to 80 dB, giving a noice reduction of less than 1 dB. On the other hand, if the noisy

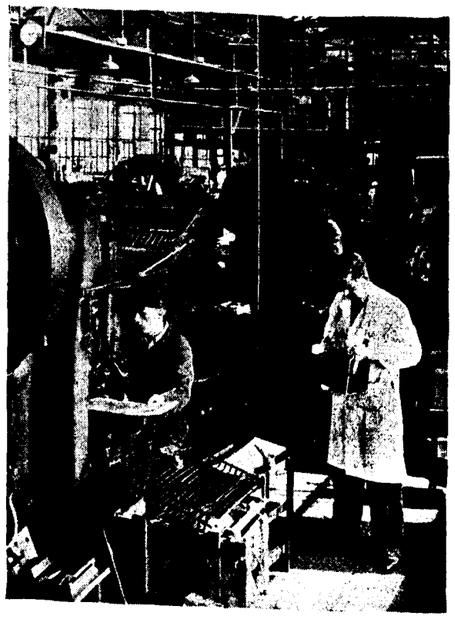

Fig. 2. A survey made with a Dawe sound level meter showed which were the noisiest machines in this press shop. By grouping them together and screening them off, the noise level in the rest of the shop was considerably reduced while special measures could be taken in the small area.

machine is fitted with a simple sound-absorbent hood so that its noise level is reduced by 6 dB, this would bring the overall noise level in the workshop down to about 75 dB which, in view of the logarithmic nature of the decibel scale, represents a reduction in the apparent loudness of over one third.

Fig. 2 shows a sound level meter being used in a press shop where considerable relief was obtained by silencing only three out of many presses. Because of the difference in the design and age of the presses used, some were found to be much noisier than others. The three worst offenders were located. They were then thoroughly reconditioned before being grouped together in a corner and screened off from the rest of the workshop. The use of acoustically absorbent materials in the new area effected a marked reduction of noise level even here. The result was a dramatic improvement in the working conditions and in labour relations.

NOISE IN OFFICES

Anyone who has tried to carry on a conversation while several typewriters are clacking away will know that office noise can be very disturbing too. In addition, factory noise and street noise can make matters even worse. In his "Memories" Sir Alfred Herbert writes that "In the room....the acoustics were so bad that it was almost impossible to carry on a conversation. A great improvement was made by hanging heavy curtains to the window."

Carpets, curtains and similar draperies are, in fact, among the best means of cutting down noise in offices. They not only reduce the transmission of noise from outside, but also help to dampen noise from sources inside the office. Bare walls and floors reflect sound almost completely and tend to "bounce" it from surface to surface, which makes it sound worse than it is.

A typical example of this occurred recently when workers complained that a canteen, which had only just been built, was too noisy for comfort. For this survey, the sound level meter was used in conjunction with the high-speed level recorder, which showed that such noises as the clatter of cutlery on the hard tables had a very long reverberation time and resulted in what is best described by the word "din".

One of the biggest banks in Britain has decided to modernise its many branches because the increasing use of office machinery has made it difficult for the staff to talk to clients over the counter. This bank has its own noise consultant who works in close co-operation with the architects and builders. The general aim is to segregate the staff using typewriters and accounting machines from those who do not, by partitioning or by rearranging the entire layout of a branch.

SIMPLE SOLUTION

A simple solution of dealing with a noisy press is illustrated in Fig. 3, in which the dotted line indicates the position of an office which the firm concerned wanted to erect for the floor manager. Noise readings were taken in the area concerned, in which a large and very noisy press was located. The decibel readings were chalked on the floor and equivalent readings joined by a line. This gave the equal loudness contours shown at the top of Fig. 3.

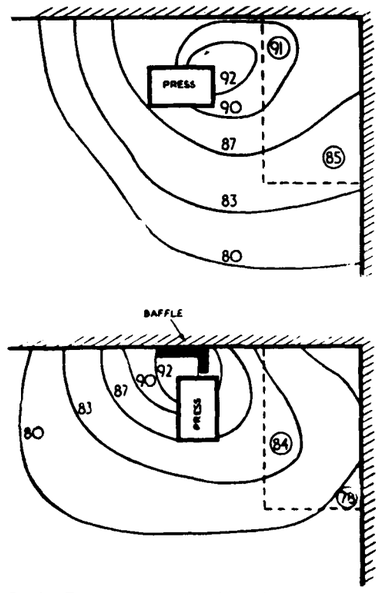

Fig 3 Top a press was found to make a lot of noise in the area indicated by a dotted line, in which it was proposed to erect an office Bottom by turning the press through 90° and providing a simple baffle, the noise in the same area was considerably reduced. The figures are noise levels in dB.

It was found that the proposed office would cover the area of maximum noise emanating from the drive of the press. The press was therefore turned through 90 degrees and a simple baffle mounted on the wall near the drive. The noise survey was then repeated and, as can be seen from the bottom of Fig. 3, the noise in the proposed office area had been considerably reduced.

The use of double-skinned partitions and double-glazed windows in the construction of the office further reduced the noise to an insignificant level.

The example illustrated in Figs. 4 and 5 is taken from the printing industry. One of the machines used is the Monotype caster, which makes type as required. The text to be printed is first typed out on a keyboard similar to a type-writer, which punches a pattern of holes into a roll of paper. This roll is then fed into the caster, which forces molten lead into appropriate matrices, thus casting the required text letter by letter.

This process is inherently noisy and one printing firm, having decided to invest in this equipment, was worried about the effect the noise would have on the operators in the printing shop. A survey showed that the sound level near the existing presses was about 90 dB, while that of the caster was almost 100 dB. Experiments with sound-absorbent boards confirmed that these would be effective in reducing noise at the characteristic frequencies of the caster. The booth was made double panels lined with glass wool, mounted in an angle iron frame.

When the work was completed another survey showed that, even with the door open, the both had reduced the noise level of the caster below that of the presses in the vicinity, while with the door closed and the presses running, the caster could not be heard at all.

The respective noise levels are indicated diagrammatically in Fig. 4 while Fig. 5 shows the completed booth. The caster can be seen inside the booth at the right, the keyboard operator is at the left (protected against noise from the presses by a hinged screen), while the operator in the centre can be seen taking readings on a sound

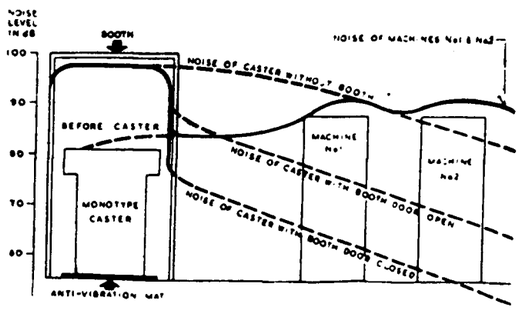

Fig. 4. Diagram of various noise levels showing how a sound-absorbent booth prevents the noise of one machine from disturbing operators in other parts of the workshop.

Fig. 5. The booth housing the Mono caster (right) and the keyboard (left), which was designed and made by the firm itself at a cost of less than £ 140. The operator at the centre is taking a noise reading on a Dawe sound level indicator.

level indicator. The same man was responsible for the construction of the booth, which was made by the firm's handyman. The whole work cost less than £ 140, including the cost of labour, and has proved entirely successful.

NOISE FROM OUTSIDE SOURCES

A recent case in Birmingham shows that many noises, which we tend to accept as inevitable, can be reduced if an effort is made and if the problem is approached in the right way. Contractors working on a building site in the centre of Birmingham had to drive piles to prevent the sides of a deep excavation from caving in. The steam-operated pile driving hammer was so noisy that offices in the area quickly protested.

At a meeting with the contractors it was agreed that while pile driving was essential, the contractors should make every effort to reduce the noise caused by it. Noise readings were taken of the hammer to establish a reference level. Various silencers and mufflers were then tried out, comparative readings being taken. Eventually a simple "skirt", made of asbestos cloth with glass wool, was found to reduce the apparent loudness of the noise by almost one half, without interfering with the operation of the hammer.

With the constantly increasing speed and power of modern machinery and equipment, noise levels must be expected to rise, unless determined steps are taken to keep them within reasonable limits. Many industries

(Continued on page 41)

"Weathering Studies on House Paints" Part-I

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(Exclusive to "Journal of Industrial Engineering", Bombay)

INTRODUCTION

THE failure of a paint film is a complex phenomenon involving physical and chemical changes in the pigment, vehicle, and the film as a whole. These changes are brought about by such factors as time, temperature, amount and distribution of light energy, moisture in its different forms etc. The deterioration of the paint film can be brought about either by exposure out of doors or in the laboratory by resorting to accelerated weathering. The natural weathering, of course, requires a lot of time and recourse, therefore, has to be taken to accelerated weathering tests. However, the similarity of failure in accelerated weathering to out-door exposure is a subject which has been much debated.

Three features are sought in accelerated weathering, viz.

(i) uniformity of conditions

(ii) speed of failure and

(iii) similarity to out-door exposure.

Out-door conditions are so variable that uniformity cannot be obtained. An accelerated weathering unit can provide uniform conditions, the unit can also provide speed of failure. Thus the first two features can only be had in accelerated weathering units.

In general accelerated weathering tests are of value for top coats [1] only. Changes in colour and appearance, gloss and chalking can be reproduced and a correlation is possible.

The systematic study on accelerated weathering was started in 1918 by Nelson [2] and his collaborators. Since then a vast amount of literature on this subject has been published. There are as many points of view as there are articles ranging from rejection to satisfaction. Schuh and Theurerer [3] emphasize this by stating, "After many years it is now being realized that the search for a universal accelerated weathering cycle is futile". Jolly [4] makes the same point stating, "A standard apparatus involving one cycle only cannot be expected to yield reliable results for all classes of paint".

In India it has been observed, that the failure of paint films in outdoor exposure is mainly due to colour fadation, loss of gloss and chalking. It was thought possible to correlate these changes with those obtained by accelerated weathering. It was with this object that the present study on natural and accelerated weathering of paints has been undertaken, using two cycles for accelerated tests under different conditions.

PREPARATION OF THE PANELS

The present paper deals only with three blue paints from one of the firms and forms a part of the detailed study which is being carried on in this Institute on as many as 38 samples in 15 different shades from different firms. The present paper gives the data on natural and accelerated weathering of these three paints only, is presented here.

7"×6" panels from 16 BG M. S. sheets, were used. The panels were rubbed with hard emery paper and freed of rust, grease etc. No special treatment was given to the substrate. A four coat system, as given below, was employed :

(Continued from page 40)

have already shown that it can be done, and have found in the process that it pays to reduce noise.

Increase in output and improvement in quality resulting from noise abatement more than made up for the expense involved in reducing the noise. While it is usually impossible to put a monetary value on improvements in labour relations, reduction in labour turnover and in the incidence of sickness and absenteeism, their importance is obvious and the marked effect of noise reduction on these factors of industrial management can be unexpectedly high.

(a) One coat primer white lead (IS : 103–1950)
(b) „ under coat Eau-de-Nil (to IS : 111–1950)
(c) Two finishing coats.

} each being about ¾ mil thick.

(i) Royal Blue (IS : 125–1950)
(ii) Oxford Blue (IS : 124–1950)
(iii) Azure Blue (IS : 117–1950)

The painting of the panels was done indoors and each coat was allowed to hard dry and then rubbed down with fine emery paper. The first top coat was wet rubbed using water proof emery paper No. 200/220. After the second top coat was hard dry, the panels were allowed to mature for eight days under laboratory conditions.

At the end of this period quantitative colour and gloss measurements were carried out and the panels were exposed in a special exposure stand (see Fig. No. 1) on the terrace of the Institute building at an angle of 45° facing south. Monthly observation were made in respect of colour, appearance, gloss, chalking, checking & cracking etc. For this examination half of the panel was first softly cleaned with cotton, wool and then cleaned with a wet swab. The outdoor

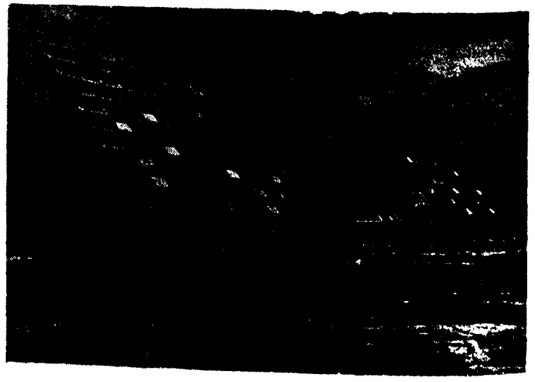

Fig. 1. View of the Exposure Stands.

exposure was started on 25th April 1955, and the painted panels were exposed in duplicate. The graphs showing the loss of gloss are shown in Fig. No. 1. The chalking and checking effects are given in Table No. 1.

SUMMARY OF RESULTS (NATURAL WEATHERING)

Gloss : A drastic fall in the value of 60-Deg. Specular Gloss was observed in the case of panels painted with Royal Blue paint; after one month the values dropped down to about 1/10th of the original values. Reduction of gloss to about ¼ and ½ of the original value was observed for Oxford blue and Azure blue paints respectively. The loss of gloss has been graphically shown on Fig. No. 2.

TABLE NO. I—SOME DATA OF NATURAL WEATHERING

Paint.	*Failure in respect of*	*Age of the film (months)* 0	1	2	3	4	5	6	7	8	9	10	11	12
Royal Blue	60-Deg. Specular Gloss %	100	11.4	9.1	6.8	6.8	6.8	6.8	6.8	6.8	4.6	4.6	6.8	—
	Chalking	—	—	S	S	E	E	E	E	E	M	M	E	—
	Checking	—	—	—	S	—	—	—	—	—	—	—	—	—
	Alligatoring	—	—	—	—	S	M	M	M	E	E	E	E	—
Oxford Blue	60-Deg. Specular Gloss	100	37.5	13.8	5.0	3.8	3.8	3.8	3.8	7.5	5.0	5.0	5.0	—
	Chalking	—	—	E	E	E	E	E	E	E	M	M	E	—
		No checking or cracking.												
Azure Blue	60-Deg. Specular Gloss	100	33.3	16.7	9.5	9.5	9.5	9.5	9.5	14.3	9.5	9.5	9.5	9.5
	Chalking	—	—	E	E	E	E	E	E	E	M	S	E	S
		No checking or cracking.												

Key : S – Slight ; M – medium ; E – Excessive.

N. B. Gloss is expressed as the % of the initial gloss.

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Fig. 2. Loss of gloss curves.

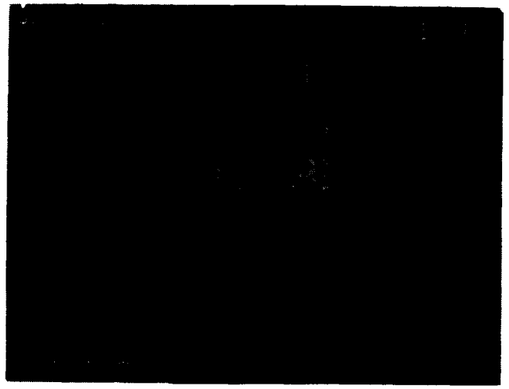

Fig. 3. Royal Blue Paint, N.W. 11 months. (1 Ce) - Control.

Chalking : After two months pronounced chalking was noticed in panels painted with oxford blue and azure blue paints, whilst those painted with royal blue paint showed only slight chalking. At the end of the 4th month of exposure all these three paints exhibited pronounced chalking. This rate of chalking, with an occasional exception, continued throughout the 12 month exposure in all these three cases with the result that the first coat (¾ mil thick) was washed off at age 7 months in case of panels painted with Oxford blue. In the case of Royal blue, the two finishing coats (each ¾ mil thick) were washed off in most places (the under coat becoming visible) at the end of the 11th month. The slight increase in the % gloss may represent the gloss of the exposed underlying finishing coat. Fig. Nos. 3, 4 & 5 indicate the failures at the end of the test.

Checking & Cracking : Panels painted with royal blue paint only exhibited this type of failure. At first this defect exhibited itself in the shape of fine checking, and alligatoring became evident at the end of the 3rd month. A further increase in the pattern was noticed in the 7th month and the alligatoring got magnified (see Fig. No. 3) with very well defined boundary lines at the end of the 7th month. This was specially noticeable in the top portion of the panel. The boundary lines had enlarged and at some places they extended right though the two coats, thereby exposing the under coat.

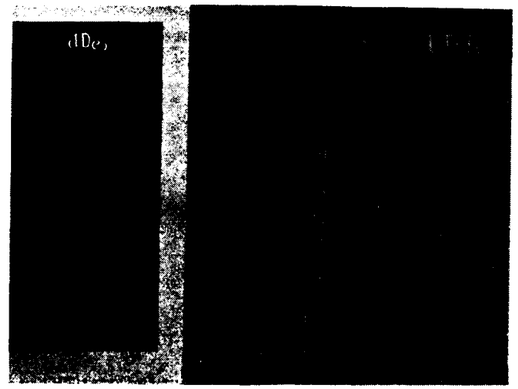

Fig. 4. Oxford Blue Paint, N.W. 11 months. (1 De) - Control.

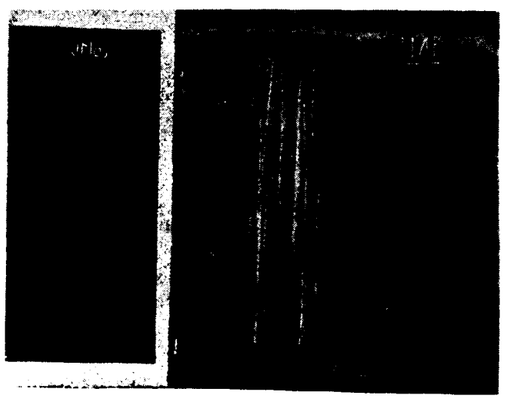

Fig. 5. Azure Blue Paint, N. W. 11 months. (1 Me) - Control.

Colour : All the three colours presented a very poor appearance after the second month of exposure and at the end of the 4th month all the three colours faded drastically. Fig. Nos. 3, 4, 5 along with the respective control panels indicate the extent of colour fadation.

ACCELERATED WEATHERING

A twin arc Atlas Weatherometer manufactured by Atlas Electric Devices Co., U. S. A., was used. Solid and cored carbons were used. The arcs, protected by special pyrex globes, were operated for 20 hours a day at 15–17 amperes and 130–145 volts, A. C. Alternate wetting and drying cycles viz. 102–18* and 17–3 were employed. 6″×2¾″ panels from 20 BG M. S. sheets, were used for the various tests. A four coat system consisting of a white lead primer, dark grey undercoat (to IS : 111—1950) and two finishing coats was adopted. The thickness of the various coats was the same as in Natural Weathering. The painted panels were allowed to mature for one week under laboratory conditions, before exposure in the Weatherometer. The panels were subjected to each cycle for 100 and 200 hours at both 65°C and 45°C (black panel temperature i. e. the temperature of the paint film). Quantitative colour and gloss measurements were carried out before and after exposure. The panels were also examined for chalking, checking, cracking etc.

SUMMARY OF RESULTS

The results of failure of the paint film in respect of gloss, chalking, checking & cracking and general appearance using cycles 17–3 and 102–18 are summarised in Table Nos. II and III respectively. From Table No. II it is seen that the effect of the 17–3 cycle becomes more pronounced at higher temperature (65°C). At a lower temperature exposure for a greater number of hours is

TABLE No. II—SUMMARY OF THE RESULTS OF ACCELERATED WEATHERING USING 17–3 CYCLE.

Paint	*Cycle 17–3/100 hours exposure/ Temp. 45°C. (1)*	*Cycle 17–3/200 hours exposure/ Temp. 45°C. (2)*	*Cycle 17–3/100 hours exposure/ Temp. 65°C. (3)*
Royal Blue.	General appearance – quite good. Gloss – reduced to 76% Colour – No appreciable change. Chalking – slight. Checking – fine checking.	General appearance – inferior to (1). Gloss – reduced to 49% Colour – Not much change, lighter than (1). Chalking – slight. Checking – fine checking throughout the surface; alligatoring in isolated places.	General appearance – very bad. Gloss – reduced to 14% Colour – faded appreciably. Checking – fine checking at isolated places. N. B.—First finishing coat could be washed off with a wet swab.
Oxford Blue.	General appearance – hazy & bad. Gloss – reduced to 33% Colour – faded slightly. Chalking – medium. Alligatoring – at isolated places.	General appearance – bad. Gloss – reduced to 5.7% Colour – faded appreciably. Chalking – slight. Checking – fine checking throughout; alligatoring at isolated places.	General appearance – very bad. Gloss – reduced to 6% Colour – faded drastically. Chalking – excessive. Alligatoring – fine, throughout. N. B.—First finishing coat could be washed off with a wet swab.
Azure Blue.	General appearance – hazy & bad. Gloss – reduced to 25% Colour – faded appreciably. Chalking – medium. Alligatoring – fine, throughout the surface.	General appearance – bad. Gloss – reduced to 11% Colour – faded appreciably, inferior to (1). Chalking – excessive. Checking – medium. N. B.—First finishing coat could be washed off with a wet swab.	General appearance – very bad. Gloss – reduced to 6.5% Colour – faded drastically. Chalking – excessive. Checking – at isolated places. N. B. —First finishing coat could be washed off with a wet swab.

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* Cycle 102-18 :—102 minutes of light only followed by 18 minutes of light along with water spray. The whole cycle goes on repeating. Similar explanations apply for 17-3 cycle.

TABLE No. III—SUMMARY OF THE RESULTS OF ACCELERATED WEATHERING USING 102–18 CYCLE.

Paint.	*Cycle 102-18/100 hours exposure/Temp. 65°C*	*Cycle 102-18/200 hours exposure/Temp. 65°C*
Royal Blue	General appearance – bad Gloss – reduced to 29.5% Colour – faded Chalking – slight Checking – fine checking	General appearance – very bad Gloss – reduced to 10% Colour – faded appreciably Chalking – excessive Checking – fine checking throughout, alligatoring at a number of places.
Oxford Blue	General appearance – very bad Gloss – reduced to 6.1% Colour – faded Chalking – excessive Checking – fine checking throughout	General appearance – very bad Gloss – reduced to 9.5% Colour – faded drastically Chalking – excessive Checking – fine checking throughout, alligatoring at isolated places. N.B.—First finishing coat could be washed off with a wet swab.
Azure Blue	General appearance - very bad Gloss – reduced to 11% Colour – faded appreciably Chalking – excessive Checking – medium N.B.—First finishing coat could be washed off with a wet swab.	General appearance – very bad Gloss – reduced to 15% Colour – faded drastically Chalking – excessive Checking – medium N.B.—First finishing coat could be washed off with a wet swab.

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necessary to accelerate the failure. It can also be inferred that the 17–3 cycle if carried out for a longer duration at higher temperature (65°C) may bring about further deterioration. For the 102–18 cycle (Table No. III) it is seen that the effect of the length of exposure is revealed only in respect of chalking. Figure Nos. 6, 7 and 8 show the intensity of colour fedation, effects of chalking for the royal blue, oxford blue and azure blue paints respectively. (In each figure the panel at the extreme left in the top row is the control and the others are panels from various tests.)

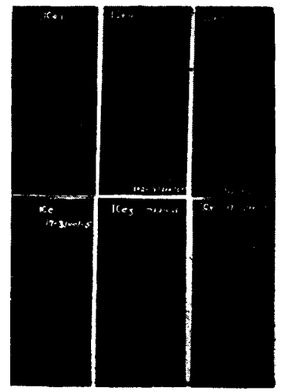

Fig. 6. Royal Blue Paint, A. W. Different conditions. (ICe) - control.

COMPARISON OF THE TWO CYCLES

At the outset it may be mentioned here that it was not found possible to maintain the film temperature at 45°C when using the 102–18 cycle. This may probably due to the longer interval between successive water spray treatments. The lower temperature (45°C) for the 17–3 cycle could be easily maintained by installing a cooler in the room. In a 100-hour exposure both the cycles afford equal length of exposure to light and water spray, i. e. 100 hour and 3 hours respectively. The difference in the results produced by the two cycles lies only in the intensity and frequency of thermal shocks. From Table Nos. II and III it will be seen that thermal shocks, at smaller intervals in between, are more effective. Other points of comparison can be clearly seen from Table No. II and III.

CORRELATION BETWEEN NATURAL AND ACCELERATED WEATHERING

An anamolous behaviour has been noticed in the case oxford blue and azure blue paints. Under Natural

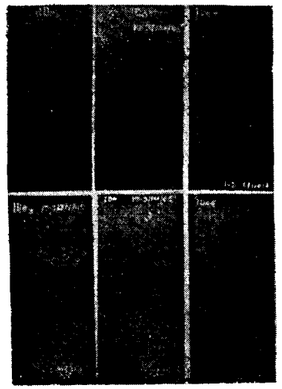

Fig. 7. Oxford Blue Paint, A. W. Different condition. (IDe) - control.

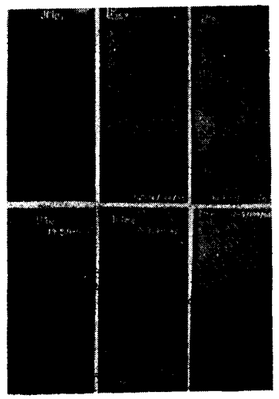

Fig. 8. Azure Blue Paint, A. W. Different condition. (IMe) - control.

Weathering these paints did not show any checking, cracking or alligatoring throughout the 12 month exposure. In accelerated Weathering these paints show failure due to checking and slight alligatoring in some cases. The royal blue paint under Natural Weathering fails due to checking and alligatoring. So far it has not been possible to reproduce the same alligatoring pattern in accelerated weathering tests. The fine checking produced in the early stages of Natural Weathering, however, could be reproduced in accelerated weathering (see Table Nos. II & III). The acceleration in this case, may be worked out as 1 : 10.

The work carried out so far in the detailed study under-way indicates that a correlation, in respects of failure of the paint film due to loss of gloss, chalking and colour fadation, is possible. For these three blue paints an approximate acceleration in respect of gloss and chalking can be arrived at. For gloss the acceleration works out to from 1 : 6 (royal blue) to 1 : 22 (the remaining two shades) and for chalking it is from 1 : 11 to 1 : 14 for all the three paints.

In conclusion it can be said that the 17–3 cycle appears to be more promising in bringing about acceleration of failure. From a review of literature[5] it is seen that darker shades have been found to be more durable. The blues, selected for the durability study are fairly dark (the royal blue in particular) but their durability is found to be very low as compared to other paints under investigation. This is also the case with the blue paints manufactured by another firm.

In India the failure of paints is mostly due to chalking, colour fadation and loss of gloss. A review of the literature[5] shows that these effects can be correlated with the results of accelerated weathering tests. The present work also indicates that a correlation between the Natural and accelerated weathering is possible in respect of chalking and loss of gloss. The authors realize the need of undertaking an elaborate study on the subject of durability of paints and a detailed study is in progress at present. Of course it is too premature to arrive at any definite conclusions at this stage. However, when the present study is completed it may be possible to draw some general conclusion.

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Standardization of Textile Materials Used in Telecommunications

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INTRODUCTION

ENGINEERING materials and textiles occupy as important a place in telecommunications as food and clothing do in human life. Cables, wires and cordages which invariably form the nervous system of any telecommunication circuit are generally clad with one or the other type of textiles.

USE OF TEXTILE MATERIALS IN TELECOMMUNICATIONS

Textile materials are widely employed as wire coverings for mechanical protection and electrical insulation of conductors. The ideal textile material for electrical insulation should not only have high insulation resistance but should also be sufficiently strong to withstand the stresses and strains of manufacturing process. Chemical neutrality, moisture resistance, flame resistance, and resistance to attack by insects and fungi are also desirable. The material should be chemically stable and free from impurities which, under adverse conditions, would tend to corrode conductors.

COTTON

Of all fibres, cotton is most widely employed in the manufacture of cables, wires, cordages and cords. It is used particularly for coverings, braidings, and certain bindings of telephone cords. Cotton yarn is also used as a protective covering for enamelled winding wires. Cotton braid is generally treated with some compound or the other to make it resistant to, say, moisture, heat, weathering or acid fumes.

Nowadays fabric-covered wires are generally surface-treated with several coats of cellulose acetate lacquer with a view to make the surface firmer and reduce and stablish the conductance and capacitance losses and render the fibre almost independent of humidity changes.

Repeated boiling of cotton in distilled water increases its insulation resistance considerably; the resistance is further increased by treatment with calcium sulphate, followed by washing. Hence washed cotton is preferred to ordinary cotton for telecommunication purposes.

Mercerized cotton yarn and glazed cotton yarn are also used for telecommunication purposes; the latter possesses high resistance to abrasion.

Acetylated cotton yarn known commercially as 'Cotopa' is used as an insulating material for all types of cables and wires owing to its insulation resistance. Cotopa and other cellulose acetate yarns used for telecommunication purposes have to be neutral to litmus and free from water-soluble salts. The acetylated yarn is fairly resistant to mildew and to the effects of sea atmosphere.

MOLESKIN

Moleskin, a thick leathery fabric of the type of fustain (twilled cotton cloth) is used for clothes of moulders and plumbers and for wiping hot pasty metal round a pipe joint. It is impervious to sand and is not easily penetrated by splashes of molten metal.

FLAX

Flax fibres are spun into threads, to produce flax or linen yarn which is beeswaxed and used for the bindings of telephone cords. Linen cloth is used in the manufacture of 'Empire Cloth'.

HEMP

Ropes of Manila and Italian Hemp are used by the Indian Posts and Telegraphs Department.

JUTE

Jute, when suitably treated, has proved completely successful for submarine cable coverings.

SILK

Silk has greater insulation resistance than cotton. It is mostly used for the insulation of fine wires. It is preferred to rayon as it has better abrasion resistance.

Its insulation resistance is improved by washing it in a suitable acid solution.

Silk is washed with an acid solution having a p^H value of 3.8 to produce isoelectric silk. Silk is little used on thicker wires because suitable rayons are nowadays available.

WOOL

Wool braiding has the very valuable property of not permitting the spreading of a flame. Its fumes appear to possess fire-extinguishing properties. Wool, unfortunately, is subject to attack by clothes-moth. It is still used in large quantities on wiring in situations where the risk of fire constitutes a hazard. Nowadays all wires in which wool is one of the coverings are moth-proofed by suitable treatment.

Three types of insuwools and insusilks have been developed with high insulating properties. These are produced by: (i) treating yarn with tannic acid, (ii) acetylating the yarn, or (iii) acetylating yarn treated as in (i).

RAYON

Artificial silk is used for insulation of various types of wires (except thinner ones) as a substitute for or in combination with natural silk It has somewhat better electrical characteristics and gives uniform insulation. It has relatively high ignition temperature and is water and oil-resistant.

NYLON

The dielectric strength of nylon is much superior to that of silk or cotton. Its moisture regain and hence the electrical leakage is very low as compared to other fibres. The abrasion resistance of nylon is of a very high order being 10 times that of viscose rayon and 21 times that of acetate rayon. Nylon yarn possesses desirable properties to make it an ideal insulating material for wires and cables as also in braiding of switchboard cords and cordages.

INDIAN STANDARDS INSTITUTION

The Indian Standards Institution have already prepared standard specifications for various type of cloths and also formulated important methods of tests. It is suggested that work on formulation of standards for cotton, silk, jute and synthetic textile materials for telecommunication purposes for use as coverings over wires, cables, cordages and cords, giving requirements in respect of such characteristics as insulation, dielectric strength, abrasion resistance, inflammability etc. under Indian climatic conditions be taken up early. Standards for jute and hessian coverings for underground cables and for moleskin cloth for moulders and clothing for wiping of lead-sheathed joints may also be formulated for the benefit of consumers like the Posts and Telegraphs Department.

ACCEPTANCE TESTING OF TEXTILES FOR TELECOMMUNICATION PURPOSES

All supplies, after delivery and before acceptance, have to be examined and tested to see that they comply with the requirements prescribed in the relevant specification of the contract. This examination and testing is termed " Acceptance Testing". In such a testing, the number of tests to be carried out is reduced to a minimum by adopting an appropriate sampling procedure.

The principal physical characteristics for which textile yarn is tested are:

(i) its freedom from knots, thickenings, breaks, loadings adulteration etc.

(ii) its fastness to light and water,

(iii) its count

(iv) its tensile strength covering breaking load and elongation, and

(v) its abrasion resistance.

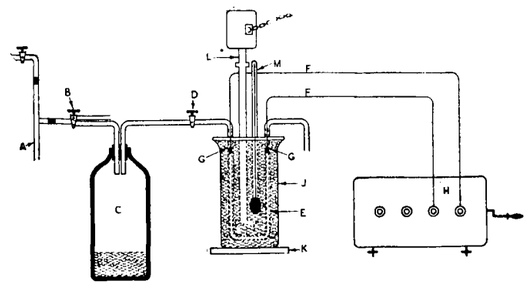
The yarn is also tested for such chemical characteristics as water-soluble matter, inflammability, resistance to attack by micro-organisms etc. The methods used for testing these characteristics are well known, and for quite a number of those the ISI has already laid down standards. It is suggested that a standard method of test for determining abrasion resistance of yarn may be laid down for the benefit of consumers like the Posts and Telegraphs Department.

Apart from these, the yarn is subjected to an electrical test, the specific conductivity test. It may be worthwhile to give here details of the specific conductivity test; these may not be known to the common run of textile technologists.

In this test, 5_g of textile material with 100 ml. of distilled water is placed in a clean 500 ml. glass-stoppered bottle and agitated on a laboratory shaker till

equilibrium is attained. Usually the shaking is continued for one hour. In case of grey cotton yarn which wets out with difficulty, the yarn is cut into short lengths before testing and agitated for 2 hours.

A diagram of the apparatus to be used is shown below. On the extreme left is an ordinary water



APPARATUS FOR DETERMINING THE SPECIFIC CONDUCTIVITY OF THE AQUEOUS EXTRACT OF TEXTILES.

vacuum pump A provided with a device for sucking up the extract. Next to this is a two-way tap B for releasing the pressure without sucking back when a series of tests are completed, followed by a vessel C which collects the extract after each test. Tap D controls admission of the water extract into the conductivity cell E; leads FF of the cell are connected from the electrodes GG to the " Megger" H: J is a large beaker containing colourless liquid paraffin surrounding the cell; K is a small hot-plate for adjustment of temperature to a standard figure when required; L is a mechanical stirrer and M is a thermometer.

A portion of the extract is sucked up into a special conductivity cell having a constant of 6000—7000. The resistance between the two electrodes in the cell is measured by a standard pattern " Megger" calibrated from 2—1000 megohms. A " Megger" having an accuracy of about ± 3 percent is sufficiently accurate for all textile purposes as the specific conductivities of water extracts of a number of successive samples of yarn taken from the same cheese or cop vary even in the best cases by about ± 10 percent of the mean value.

The pressure in the vessel C is first lowered by means of a vacuum pump, and the cell flushed out two or three times with distilled water. The cell is then flushed two or three times with the water extract to be tested and finally a reading taken; a fresh sample is then drawn up and again tested, and finally a third. There should be no detectable difference between three readings. All necessary precautions should be taken not to allow even the slightest contamination of electrolytic matter. The glass apparatus used in this test should be of resistance glass. Distilled water having a specific conductivity greater than 5 micro-mhos at 25°C should not be used in this test. Direct electrical leakage along the outside of the tube should be reduced to an extremely low figure or preferably eliminated completely by following guard ring principle.

The specific conductivity of the extract is then calculated as given below:

$$\text{Specific conductivity of extract (in micro-mhos)} = \frac{\text{Constant of Cell}}{\text{Observed resistance (in megohms)}}$$

This gives the specific conductivity at the temperature of the test, but as the specific conductivities of all liquids vary with temperature, it is desirable that all comparisons be made at a standard temperature; the temperature recommended for this type of test is 25°C. For most routine purposes it is sufficient to use a bath at room temperature and apply a temperature correction to the specific conductivity values obtained. For measurements made at temperatures between 15°C and 35°C and the specific conductivity is corrected to 25°C as given below:

$$\text{Specific conductivity at } 25^\circ\text{C} = \frac{C}{1 \pm 0.02t}$$

Where

C is the specific conductivity measured at a temperature which is t°C different from 25°C.

0.02t is taken with the plus sign when the measurement is made above 25°C and with minus sign when made below 20°C.

In case of acetylated yarns, special tests are carried out; these include test for determining stability, free acidity and percent combined acetic acid.

ACKNOWLEDGEMENTS

I am grateful to the Additional Chief Engineer, P & C, Jabalpur for permitting the publication of the above article in this Journal. The article is mainly based on my detailed article " Place of Textiles in Telecommunication", published in " Telecommunications" Journal Vol. 3 Nos. 1 and 2 of 1953 of the Indian Posts and Telegraphs. I am also thankful to the Indian Standards Institution for having given me an opportunity to read this paper in the ISI Chemical and Textile Standards Convention held at Bombay during the month of January, 1956.

DIESEL DUMPER - DR 50

By A Special Technical Correspondent

NO sooner had World War II come to an end than Hungary started clearing away the vestiges of war and began the work of reconstruction at a very high speed. New factories were built, new towns were springing up around them, new methods of production—such as open-cast mining—came into existence. This feverish activity called for the introduction of modern constructional machinery, including efficient means of transport for conveying bulk materials such as earth, gravel, stone, capable of operating even on grounds where the average types of lorries cannot operate for lack of space or in consequence of rough surface conditions.

These were the motives behind the decision taken by the famous H. S. C. S. tractor Works in 1949 to start upon the manufacture of dumpers, and so the DR 50 diesel dumper of 4½ cu. yds. capacity and 6 tons payload was designed. Hardly had one year elapsed when, in autumn 1950, the prototype units were tested on the construction work of the Budapest People's Stadium, one of the finest sports grounds of Europe, which has since been completed with accommodation for 100.000 spectators. Other dumpers were tested in quarries and open-cast mining sites.

The job of the designers was facilitated by the fact that a suitable type of engine was at their disposal. This was the exceptionally sturdy and efficient 85 HP, 4-stroke diesel engine of the 3.5-ton Csepel lorries, which with slight modifications could be adapted to the special requirements of dumpers. The 85 HP performance attained at 2200 r.p.m. was too high for dumpers, which, according to the initial calculations, required only 50 HP at 1500 r.p.m.

On grounds of the experience gained with the prototype the necessary modifications were made, and in January 1952 the works started on serial production. There were many difficulties to overcome and problems to solve before large-scale production could be put into running order, the more so as vehicles of this kind had never before been manufactured in Hungary, nor in any European country—save for one—in spite of the long tradition possessed by many of them in the automotive industry. The first series of 250 units justified expectations on the whole, but after a period of operation certain shortcomings became apparent: the single-disc clutch, which had given good service with trucks, did not stand up to the strain of continual haulage of heavy loads; furthermore, the rear hub proved liable to breakages on rough terrain.

The designers made thorough studies as to the cause of these faults and accomplished the necessary modifications within a short time. The single-disc clutch—by very slight change of the components applied so far—was transformed into a two-disc clutch. The rear hub was strengthened by applying ribs to the steel casting. These modifications have immediately been carried out in the serial production as well, and to-day, three years later, thousands of DR 50 dumpers are being operated by day and night, under heavy working conditions, almost without interruption in Hungary and in many other countries of the world, from Spain to China.

Let us now proceed to analyze the construction of the DR 50 dumper and to detail its advantages over tipper trucks equipped with a hydraulic tipping mechanism.

As mentioned before, the DR 50 dumper is driven by a water-cooled diesel engine type Csepel 413, displacement 5.3 litres, output of which has recently been raised by the manufacturers from 50 HP to 60 HP at 1600 r.p.m. The torque of the engine is transferred by means of a two-disc clutch to the gear-box forming a single unit with the engine itself. The gear-box has 3 forward speeds and one reverse, but an additional double-shift transfer case is inserted between the gear-box and the final drive enabling the operator to mesh high-road or terrain ratios. This means that the dumper DR 50 has altogether 6 forward and 2 reverse speeds. These gear ratios ensure the greatest economy and the highest possible running speed under the most varied working conditions.

The rear axle is made of steel castings and is fastened by bolts direct to the gear-box. The engine, gear-box, and rear axle thus form—similarly as with tractors—a single and rigid unit, which can be considered the backbone of the dumper. The final drive reduces the revolution in two ratios and increases the torque in proportion. The first reduction is by means of a spiral bevel gear-and-pinion, as is normally the case with lorries, and a differential with four planetary gears. The two axle shafts forking off on both sides of the differential end in spur-gears representing the sun wheels of the two epicyclic gear trains located in the rear wheel

hubs. Three planetary gears revolve in these gear trains around the sun gears, rolling along the inner side of the rear axle. Pins fixed on the edge of a disc act as shafts of the planetary gears. The rear wheels are driven by this disc, the shaft of which is connected with the wheel hubs by means of grooves. Due to this a high reduction ratio can be obtained by means of comparatively small gear wheels without exercising an excessive strain on them.

Two leaf springs placed transversally above each other form the front axle of the DR 50 dumper. The middle of the two spring leaves is fixed to a longitudinally mounted fulcrum pin, so that—apart from the elasticity of the leaf springs—the entire front axle may turn around a central point and adapt itself even to the roughest terrain, while the front of the dumper will not leave its horizontal position to any considerable extent. The stability of the dumper is thus greatly increased.

Regarding further characteristics of the DR 50 dumper, the dumping body is certainly worthy of mention. The dumper holds the materials to be conveyed in a dumping body of 4½ cu. yards capacity. The most important feature of the dumping body is the instantaneous gravity tipping which means that, when fully loaded, the cradle tips automatically and discharges its load as soon as the fixing mechanism is released. No hydraulic or mechanic tipping gear is required. This is one of the most essential advantages of the dumper over tipping lorries.

Another important feature of the dumper is the double steering wheel and the driver's seat that can be swivelled round the stearing column through 180°. On narrow paths where there is no room to turn, the dumper will travel backwards with the tipping body in the front and —due to the twin steering wheel and the swivelling seat the driver may still face the direction of travel. This arrangement will greatly reduce operation time and increase safety.

Why use a dumper if a tipping lorry of similar capacity can as a rule be purchased at a more moderate price? This is a question that will arise frequently, and is to be decided by operating conditions. For long-haul jobs on good roads preference will of course be given to lorries which have a higher speed. On the other hand, at all places where bulk material is to be conveyed over a comparatively short distance on bad roads or on rough terrain and loading is effected by an excavator, dumpers will certainly be more suitable. The same is the case where the earth-moving or mining work is being done in deep or narrow pits where lorries are unable to turn.

Continued on page

For building sites that lie beyond inhabited areas, for civil engineering projects and quarries, where, in most cases, there are no built roads, dumpers are generally required.

The exceptionally sturdy build, the comparatively small size, the large-size rear wheel, the easy manœuvrability due to the short wheelbase, the simple design and operation are features which make for better economy and longer service life than tipper lorries can offer.

The completely enclosed construction of the engine, the sump made of strong steel casting, the gear-box and the differential casing afford the constructional parts protection from damages. All component parts of the dumper are easily accessible, so that maintenance is possible even at places where no regular repair workshop can be found. The low speed of the engine and the simple but robust design of all constructional parts guarantee long service even under the roughest operating conditions. The special air filter equally contributes to the long troublefree service of the engine.

Experience made with thousands of dumpers have proved that the exceptionally hard duties which dumpers generally have to fulfil are liable to cause untimely wear and tear to lorries, even to those of the best quality. Besides, lorries often fail to reach working sites, where dumpers—due to their special construction and size —travel without the slightest difficulty.

The ability of the dumper to go under the excavator shovel or other loading device without reversing, and the fact that emptying does not take more than 2—3 seconds give rise that to a saving of 2 or 3 minutes per hauling cycle as a minimum. In the case of a haul distance of 200 yards comprising 80 hauling cycles per working day, this will accumulate to 3—3½ hours compared to the performance of an up-to-date tipper lorry.

Dumpers will travel on soft boggy terrain without boards being put down or the mud being filled up with twigs. Lorries as a rule cannot operate under conditions. Even where terrain conditions do allow of the use of tipping lorries, the vehicles have to stop somewhere near the point of discharge, reverse, and back up to the very spot where the load is to be emptied. This often necessitates the driver to twist himself into an awkward position by opening the door and attempting to look over his shoulder, which is both dangerous and wasteful, since it calls for extra labour. Furthermore, the rear driving wheels may sink in and the

Efficient Use of Steel in India

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AS an essential material for most industries and for all industrial expansion, steel occupies a place of special importance in the industrial economy of a country. Conservation of steel and efficient use of available resources are, therefore, matters of considerable interest to all countries. The extent to which efficiency in the use of steel can be achieved depends on the basic properties of the material and the knowledge and application of satisfactory procedures for the design and processing in the manufacture of steel products.

The paper deals with certain aspects relating to efficiency in the production and utilization of steel in India including both, immediate and long-term objectives. The subject of steel conservation is of particular interest in India at the moment, since the success of our programmes for industrial expansion greatly depends on sufficient steel being available for the various projects.

MATERIAL

The first requirement for the efficient use of steel is that the material must be available to the user in a condition and in the form in which it can be efficiently used. At present steel is available in India as structural sections, bars, plates and sheets. The qualities of the steel which affect their use are the chemical and physical properties and their shape.

As regards physical and chemical properties the mild steel produced in India is generally satisfactory and conforms to national standards. But, an appreciable percentage of the present steel production, even for structural use, is available in the market in a quality known as 'untested' steel. The chemical and physical properties of this steel are not guaranteed. In the absence of this guarantee the user is forced to 'play safe' and consequently utilize the steel inefficiently. The remedy for this position is to attempt to have, as much as possible of the steel produced, conforming to the present national standards. The small percentage of material which may of necessity not be to the standard, should also be made available to the user with their physical and chemical qualities tested and certified.

Expansion of welding in fabrication of steel has an important bearing on the increase of efficiency in use of steel particularly in structures. The weldability of steel is closely related to its chemical properties and the proper expansion of welding is possible only if the user has the guarantee that the steel available to him is suitable for the purpose. The standard specification for mild steel issued by the Indian Standards Institution attempts to cover this aspect by specifying the properties for welding quality steel and giving it a separate designation.

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vehicle get bogged down when the slow tipping gear imposes an additional weight on the wheels. Restarting is very difficult in such cases.

On the other hand, dumper tyres, having large surfaces and carrying a comparatively small specific load, will prevent the vehicle from sinking on boggy ground. The exceedingly short wheelbase facilitates turning without manœuvring even narrow places. Further advantages of the dumper are the complete absence of delicate tipping gears that require continual attention and are subject to damages; a design much sturdier than with lorries; ability to withstand instantaneous shock loading (by excavators); the ability of the driver to face the direction of travel without discomfort and thus to see with safety the actual place of loading or discharge. Besides these features, maintenance of the dumper—in the usually very hard operating conditions—is much easier than with lorries, and, in addition, dumpers are of far longer duration than lorries.

Dumpers have, of course, to do very hard job and only exceptionally sturdy vehicles if easy maintenance will fully answer these requirements. In the design of the DR 50 dumper the requirements outlined above have been taken into consideration and a great number of these vehicles operating on a variety of sites have in recent years proved that modern conveyance cannot do without dumpers.

The hot rolled structural sections namely beams, channels, angles, etc., now produced in India are generally in agreement with the British Standard Sections of U. K. The standardization of such sections in U. K. and other countries has so far been mostly only a rationalisation of the products produced by various mills without any serious attempt being made to study and improve the performance qualities of the products. Since such standard sections should be capable of being produced in all the mills of the country, the standards are based on the limitations of their mills including those having equipment installed many years ago. We have in India three mills which are at present producing structural sections but the present production in these mills is small when compared to the targets for the next five years and more so when compared to the targets for the next ten or fifteen years. This increase will be achieved through the expansion of the existing mills and the putting up of new mills. There are indications that the existing mills in their present equipment are capable of producing sections of higher 'efficiency properties' than the sections now produced. The new steel mills would be able to go even further in this matter. Therefore, we have the freedom to redesign and standardize a series of hot rolled sections which have properties of higher efficiency and allocating to each mill products which they could efficiently produce.

In formulating the new standards for hot-rolled structural sections the properties and proportions of our sections have to be studied on the basis of the principles of shape engineering and each section made as efficient as possible. These sections have then to be arranged in series which would reduce to a minimum the inevitable wastage arising out of the fact that a restricted number of sections have to meet an unlimited variety of requirements.

A recent development in metal engineering is the extensive use of cold-formed light-gauge sections. These sections are cold-pressed or cold-rolled from strip steel of thickness varying from 8 gauge to 18 gauge. When used in purlins, girts, light trusses, framing and many other assemblies, they yield savings in weight of steel varying from 20 to 40 percent. The saving in cost is somewhat less, but they are undoubtedly more economical than the hot-rolled sections for many types of use.

As in the case of cold-formed sections the use of steel tubes in certain types of structures yield considerable economies both in weight of steel used and in cost. The use of tubes for structural and general engineering purposes has not progress so far, since the indigenous production of the material started only recently. But the two mills recently installed have enough capacity to supply the present needs of the country. The design and construction procedures for using tubes are different only in certain details from those using hot-rolled sections. Standard specification and codes of practice for tubes and for design and construction practices for structures and assemblies using tubes would help to popularize steel tubes as a structural-material in India. Since welding is an essential procedure for using tubes, this aspect has also to be covered by suitable standards, specifications and codes of practice.

DESIGN AND FABRICATION

An important item in any scheme for steel conservation is the formulation and implementation of satisfactory codes of practice for the design, fabrication and construction, in steel. In formulating these codes every effort has to be made to make them as modern and progressive in approach as possible; at the same time keeping in view the important aspect of safety.

The use of welding in the fabrication of steel work opens many avenues for economy and efficiency in the use of steel. Omission of rivet and bolt holes, making connections more compact and doing without gusset plates, providing greater freedom in structural design, permitting use of lighter sections, etc., are some of the more obvious advantages. The extent of saving in steel due to welding will vary for different classes of assemblies and depend on how efficiently the design has utilized the advantages available through welding. It may generally be mentioned that the savings in weight may vary from 10 to 30 percent. The reasons why welding is not at present more widely adapted in our country are, lack of information among design and fabrication engineers, lack of confidence in the technique of welding, paucity of trained personnel, apathy of established fabrication, and to some extent, the lack of confidence in the weldability of our steel and a lack of understanding of the qualities of Indian electrodes.

It is necessary to establish in India suitable national specifications for materials used in welding, and codes of practice for welded designs, welding procedures, weld inspections, training and testing of welding operators etc. It would also be helpful if elementary types of handbooks for the use of welders, inspectors and welding supervisors and more advanced type of literature for the use of welding engineers and designers are made available in India.

STEEL ECONOMY PROJECT OF THE ISI

The need for conservation of steel and efficient use of available resources had received considerable attention from the Planning Commission even from the very early stages of the First Five Year Plan period. Increase in production capacity in the country was envisaged, but even of greater importance was the taking of urgent measures for the conservation of available resources. The expert committees of the Planning Commission came to the conclusion that 20 to 25 percent of steel consumed by the structural steel industry in the country could be saved if higher efficiency procedures were adopted in the production and use of steel.

India produces at present about 15 lakh ingot tons of steel. According to the present plans, this production is to be stepped up to 60 lakh tons. The importance of avoiding wastage would also increase with this increased production. The estimated saving (on a conservative basis of 20 percent) on the steel meant for structural use, which is about one-fourth of total production, would be about 3 lakh tons, which at the rate of Rs. 300 a ton, would amount to Rs. 9 crores a year. The Planning Commission, therefore, recommended to the Government of India that the Indian standards Institution should take up a Steel Economy Project, and prepare a serious of Indian Standard Specifications and Codes of Practice in the field of steel production and utilization.

The aim of the 'Steel Economy' project is to establish a rational and efficient series of standardized hot rolled steel sections, and to formulate national codes of practice for the efficient design and construction of various types of steel structures. To encourage the development of welding as a fabricating medium, standard specifications and codes of practice for materials, processes and procedures connected with welding are being formulated. The project aims at popularizing the use of cold formed light gauge sections and tubular steel constructions—entirely new fields for India—through standardization of typical light gauge sections, and the formulation of standards for materials and for design and construction practices with these materials.

Draft standards for the more important structural steel sections have already been circulated by the ISI to all interested parties in India and abroad for eliciting comments. The basic code for the use of steel in general building construction has been formulated and is under print. The work on a number of specifications and codes of practice for welding materials, procedures and processes has also been completed. On various other items referred to in previous paragraphs, the work is in progress.

In the work on the Steel Economy Project, advantage is taken of the technical data and information available in India and in foreign countries. It was, however, found that on many subjects Indian data is inadequate, and the data and information available from outside sources is not directly usable due to widely different conditions prevailing in this country. Also, on certain problems practical experience and experimental data are either not available altogether, or, when available, are incomplete. Need has, therefore, been felt for experimental investigations being undertaken in India on a number of problems.

These investigations have also another equally important aspect related to the dynamic application of engineering technology. Apart from the usefulness of experimental research in the formulation of specifications and codes, the investigations would have a healthy effect on the development of structural engineering in the country. An important factor for the proper understanding and application in India of modern design and construction practices is the creation of confidence among the construction and design engineers, and also among the organizations which employ them. In the field of structural engineering, particularly as related to steel, the technical education as now available does not provide adequate facilities for experimental research. The fund of basic knowledge which would be created by the research engineers, when freely made available to the practising engineers and to the industry in general, would be an important aid to the implementation of a Steel Economy Programme.

CONCLUSION

Conservation of steel and efficient use of available resources of this material are matters of national importance. Through the co-ordinated effort of individual technologist, organizations and of the Government, it is possible to achieve appreciable results in this matter. The work which the ISI is, at present, doing towards steel economy gives an indication of the possibilities in this direction.

Some aspects of the Indian Patent System of interest to the Industrialists

By C. S. Pai, *Examiner of Patents.*

INTRODUCTORY

THE commercial value of any industrial product depends upon a large number of factors, such as its utility, cost of production, attractiveness of appearance and the reputation established in the trade. Industrialists therefore make constant efforts to utilise these factors to gain competitive advantage over their rivals. Advantages in respect of utility and cost of production may be gained by the adoption of "Inventions" leading to a new manner of manufacture; advantage in respect of attractiveness of appearance may be secured by the adoption of a new or original "designs" for the shape, configuration or ornamentation of the vendible product; and advantage as regards reputation in the course of trade may be gained by adopting and popularising a suitable "trade mark" for marketing the product. A recognition of the importance of the rights in respect of use of inventions, designs and trade marks has led to the enactment of special legislation for the protection and regulation of such rights.

While "trade marks" are protected under the Trade Marks Act, 1940, for the administration of which a Trade Marks Registry has been established at Bombay, "inventions" and "designs" are protected under the Indian Patents and Designs Act, 1911, for the administration of which a Patent Office has been established at Calcutta. Patents granted under the Indian Patents and Designs Act are operative in the whole of India except the State of Jammu and Kashmir. Patents obtained in foreign countries are not operative in India and there is nothing known as world patent.

This article is confined to certain aspects of the Indian Patents and Designs Act, which for brevity will hereinafter be referred to merely as the Act.

PATENTABLE INVENTIONS

An "invention" which can be protected under the Act must be a manner of new "manufacture" which expression may include any art, process or manner of producing, preparing or making an article, as well as any article prepared or produced by manufacture. While an apparatus for manufacturing an article is obviously an "article of manufacture, in the case of a "process" or "method", it need not necessarily be a process or methd of producing an article. Thus, for example, a burglar alarm is a manufacture under the definition, but a method of catching a thief is not a method which comes under the scope of the definition of manufacture, as it is not a method of producing or preparing an article. An accounting machine or its improvement is a manner of manufacture; but a new system of keeping accounts, even if it be found to be revolutionary and useful in industry, will not be considered to be a manner of manufacture as defined under the act.

For a manufacture to be "new", the conditions that are generally to be satisfied are that (a) it should not have been publicly known in India; (b) that it should not have been publicly used in India; and (c) that it should be the outcome of the exercise of inventive ingenuity, having regard to what was already known or already in use on the date of the patent. An interesting point that should be noted here is that ordinarily the public use of the invention even by the inventor himself in a public manner may be fatal to the novelty of the invention unless the application for patent for the said invention was filed before the invention was publicly used.

Although it has been held by Law Courts that the use of the invention by the inventor himself for experimental purposes will not make the patent invalid, the safest course for an inventor is to protect himself by filing an application at the Patent Office with the least possible delay. This will not only safeguard the inventor to a great extent from the risk of prior publication or prior use of his invention, but also safeguard him from being forestalled by any other inventor with regard to the applying for the patent.

Another interesting point to be noted is that inventions from abroad which have not been publicly known or publicly used in India can form a proper subject matter for a valid patent. The importer of an invention into this country, or the one who has received an invention in the form of a communication from abroad into this

country, can be treated as the true and first inventor for the purpose of obtaining a patent in India. However, it should be borne in mind that if any person has made an application for a Patent for such an invention in the United Kingdom, Australia, Canada, Ceylon, New Zealand, the State of Eire, the Union of South Africa or Pakistan, he or his legal representative or assignee, alone or jointly with any other persons may, by applying for the Indian patent within one year from the date of his earliest foreign application, obtain for his Indian patent the same date as the date of filing of his said foreign application; in other words he can obtain "priority" for his Indian patent, upto a maximum of one year.

A glance at the inventions for which patents are generally granted will show that patents are granted not only for pioneer inventions, but also for improvements or modifications of known inventions. Quite often a single article is covered by a large number of patents. For an invention to be a new manufacture it should involve an "inventive step", having regard to what is known or used prior to the date of the patent. It is almost impossible to have a general rule to define this "inventive step". In one case it was heid that mere usefulness was not sufficient to support a patent. It was pointed out that patents, though useful, for making in one piece, articles previously made in two or more pieces have generally been held invalid; whereas in another case it was held that a new combination may be the subject matter of a patent although every part of the combination, *per se* is old. The new article is not the parts themselves but the assembling and working of the parts together. Mere simplicity is not necessarily an objection to the subject matter of an invention, although matters of ordinary skilled designing or mere workshop improvements are not inventions.

PROCEDURE FOR PATENTING

Any person who is in possession of an invention may apply for a patent for it, either alone or jointly with others. If the "inventor" is not a party to the application for patent, proof must be filed as to how the applicant or applicants have derived their title from the inventor. As mentioned already, the "importer" or the "communicatee" of an invention from abroad is entitled to call himself a true and first inventor, even if the invention was not actually invented by him.

With an application for a patent should be filed a specification, which may be either a Provisional Specification describing merely the nature of the invention, or a Complete Specification describing and ascertaining the nature of the invention and the manner in which it is to be performed.

The protection afforded by a patent will depend to a large extent on the skilful drafting of the specification, which is a highly specialised art, and applicants, may preferably seek professional help of experienced Patent Agents for drafting their patent specifications.

If an application was filed on the basis of a Provisional Specification, its Complete Specification should be filed normally within nine months from the date of filing the application. An extension of time by one month from the said nine months period can be obtained by filing a special application for that purpose.

Every application in respect of which a Complete Specification has been filed is officially examined and if it is found in order, it is "accepted" and its acceptance is notified in the Gazette of India. If, however, any application officially examined is found to be unacceptable, the objections to its acceptance are communicated to the Applicant who is given an opportunity either to rectify the defects pointed out by the Examiner of Patents, or clarify to the satisfaction of the latter whereby the objections may be waived.

Every application and the specification filed in respect of it is treated as a confidential document until it is accepted; but in the case of an application for a patent claiming "priority" as explained hereinbefore, the application and the specification will become open to public inspection after the expiry of the eighteen months from the priority date claimed for the patent, even if the application has not been accepted within the said period of eighteen months.

Within four months from the date of the notification of the acceptance of an application, any person can enter a Notice of Opposition to the grant of a patent on the said application. The Opposition may be based on certain specified grounds including (i) that the invention was obtained from the Opponent or from someone from whom the Opponent claims a title to the invention; or (ii) that the invention was publicly used or publicly known in India prior to the date claimed for the patent; or (iii) that the nature of the invention or the manner of performing it has not been fairly described.

Applications which have not been opposed become mature for sealing a patent at the end of the said period of four months, and patents in respect of them are sealed on the filing of a request by the Applicants. If any opposition is entered in respect of any application, it is investigated by the Controller, who decides whether the patent applied for should be granted, or should be refused or should be granted subject to any particular conditions he considers fit to impose.

As a rule, every patent is sealed as of the date of the application filed in respect of it. An exception to this general rule is, however, made in the case of patents claiming "priority" which are sealed as of the date of the earliest foreign application, instead of being sealed as of the date of his application for the Indian patent.

THE PATENT

On sealing a patent, on the patentee i. e. the person who for the time being is entered on the Register of Patents kept under this Act as the grantee or proprietor of the patent, is conferred the exclusive privilege of making, selling and using the invention throughout India and authorising others so to do. This exclusive privilege is not a life long privilege. Its term is limited only to sixteen years, that too, if the patent is kept in force by payment of the prescribed renewal fees. If the renewal fee is not paid the patent is ceased, and it is open to any one to take advantage of this situation and make use of the invention. Even though the Act provides restoration of lapsed patents under certain circumstances it is subject to certain provisions for the protection of persons who may have availed themselves of the subject matter of the patent after the patent has ceased.

A patentee may make a petition to the Central Government at least six months before the time limited for the expiration of a patent with a prescribed fee, praying that his patent may be extended for a further term. The Central Government may either dispose of the petition itself or refer it to a High Court for decision. In practice such extensions are not given as a routine but a patent for an invention of meritorious nature which has not been sufficiently remunerative may be extended for a further term of not more than five or in exceptional cases ten years.

STEPS TO BE TAKEN BY MANUFACTURERS TO AVOID INFRINGEMENT OF PATENTS

A patentee can institute legal proceedings against any person who, during the continuance of a patent, makes, sells or uses the invention protected by it without a licence from the patentee and try to obtain a permanent or at least an interim injunction restraining the infringer from continuing infringement. He may also claim for compensation or damages and delivery or destruction of the infringing articles.

Quite often it is a problem for a manufacturer to know what steps he should take to safeguard his interests without coming into clash against the interests of a patentee, if any, in the field in which the former is interested. In case the manufacturer knows the patentee, he can come into agreement with the latter on reasonable terms for working the patent. In case he is not aware, nor had reasonable means of making himself aware, of the existence of the patent and if the patented article is not marked by the word patent or patented accompanied by the number and year of the patent in India, the infringer is exempted from liability for damages and is treated as an innocent infringer. But a plea of innocent infringement will not affect the proceedings for an injunction by the patentee. In the case of a manufacturer who has a costly initial outlay and a huge manufacturing programme of an article, he may not be able to take such a risk of injunction and should proceed to find out the up-to-date patent position in his own field before he embarks on the manufacture. In order to ascertain the patents in a field of industry one has to make search through Indian Patent literature i. e. the Annual Journals of the Patent Office, Inventions (Consolidated Subject Matter Index, Name Index and Chronological Lists), Printed Specifications, Abridgments of Specifications and Weekly Notifications published in Part III, Section 2 of the Gazette of India. These publications are available for inspection of the public, free of charge, at more than twentyfive "Inspection Centres" all over the country including the Patent Office. The Patent Office does not undertake to do search on behalf of the public to supply a list of patents in a particular field. Help may be taken from Patent Agents in this regard. Having obtained the serial numbers of Patents in a particular field, it may be ascertained from the Patent Office whether the patents are in force. In respect of the patents in force an extract from the Register of Patents may be also obtained, which gives useful information regarding the patentee, the term of the patent and any other matter entered in the Register of Patents. Having obtained this information expert opinion may be sought, preferably from a Patent Agent, as to the validity of the patents in question as well as to the scope of patent protection in relation to the intended manufacture. In case the Patents are found to be interfering with the projected manufacture one may consider the possibility of buying the patent outright or getting licence from the patentee on agreeable terms. But when the patentee is not agreeable to come to a settlement on reasonable terms the possibilities of obtaining a "compulsory licence" in respect of the patent under certain conditions specified in Section 22 and Section 23CC of the Act may be explored.

Provision has been made for certain rights of the Government under section 21 of the Act. Section 23A

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ALL ABOUT STANDARDS

WATER CLOSETS

THE Indian Standards Institution has issued a specification for Enamelled Cast Iron Water Closets, Railway Coaching Stock Type.

The use of sanitary appliances, such as water closets, wash basins, etc., is very extensive in the country and specifications at present being followed by large-scale consumers like the Public Works Departments, Railways, etc., to meet their requirements are generally based on practices followed in the U.K. and U.S.A., which have been found to lack detailed descriptions of the articles. This position has, to some extent, handicapped Indian manufacturers to meet the requirements of users satisfactorily. Recognizing this unsatisfactory position, the Indian Standards Institution has drawn up a series of six specifications for sanitary appliances and fittings, and the standard on water closet is the first of the series to be published by the ISI.

The standard lays down the requirements regarding material, dimensions, workmanship, method of manufacture and finish for enamelled cast iron water closets of the type generally used in the coaching stock of the Indian Railways.

This standard has been prepared by the Sanitary Appliances and Water Fittings Sectional Committee of the ISI, on which are represented important manufacturers like the Mysore Stoneware Pipes & Potteries Ltd., All-India Pottery Manufacturers' Association; Government departments like the D. G. S. & D., C. P. W. D.; and other interests concerned.

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SAVING STEEL THROUGH STANDARDIZATION

Draft Standards for Structural Sections

The Institution has circulated for comments three draft Indian Standard Specifications covering Rolled Steel Sections. These drafts lay down the nominal dimensions and basic geometrical properties of beams, channels and angles in the metric system.

The re-design and standardization of structural sections in India is an important part of the Steel Economy programme which the ISI is implementing on the recommendations of the Planning Commission and at the request of the Government of India. The present production of structural sections in India is generally based on British standards established more than 20 years ago. Improved techniques in steel production developed in recent years and a greater appreciation of the aspect of efficiency in the use of steel have made it necessary that the present production standards should

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provides endorsement of a patent on application by Governments, with the words "Licence of Right". Patents can be revoked on public grounds, under Section 25, by the Government. Revocation of a patent may be obtained on petition to or on a counter claim in a suit for infringement before a High Court on grounds specified in Section 26 of the Act.

It is worthwhile for the manufacturer to take advantage of lapsed patents. On lapsing, a patent becomes dedicated to the free use by the public. Manufacturers should keep in touch with the Patent Office publications which might enable them to negotiate terms with the patentee of useful inventions. He may also keep a watch over applications for patents which would interfere with his manufacture and enter timely opposition to the grant of patents on such applications.

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be replaced by higher efficiency standards. Structural sections could be improved through a better disposition of the material in the sections, re-arrangement of sections into series and also through rationalizations in the numbers. The programmes for the installation of new steel mills in the public sector and for the expansion of the steel mills in the private sector, and the decision of the Government of India to change over to the metric system of weights and measures have made it imperative that the Indian standards for structural sections should be made available as early as possible.

The draft Indian Standards for beams, channels and angles are circulated by the ISI together with an explanatory memorandum, [Doc: BDC 7(291)], bringing out briefly the considerations governing the decisions of the ISI committees in the formulation of these standards. The comparative statements given in this memorandum show that the new sections to be standardized for production in India could, in many cases, increase the efficiency in the use of steel from 10 to 15 percent.

In formulating these standards, the Sectional Committee responsible for their preparation, had on its committees, representatives of Government and private organizations & institutions in India, who are connected with various aspects relating to production and use of structural sections. Apart from these three standards, other structural sections on which standards are under preparation by the Sectional Committee concerned, include hot rolled tees and bulb angles, cold-formed light-gauge sections, tubes for structural purposes, special sections, etc.

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SANITARY APPLIANCES

The Institution has issued a Specification for General Requirements of Enamelled Cast Iron Sanitary Appliances.

The commonly used enamelled cast iron sanitary appliances are bath tubs, water-closets, wash basins and commodes. On account of the strict hygienic and sanitary requirements which these appliances should satisfy, the enamel has to be free from flaws and must be finished so as to provide an even and glossy surface for smooth flow of water and easy cleaning.

The standard lays down requirements regarding the base material, tolerances and dimensions, warpage and finishing. Tests for enamel which include abrasion, acid resistance and alkali resistance have also been specified in the standard.

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RESISTANCE SPOT WELDING

The Indian Standards Institution has circulated for comments, a draft Indian Standard Code of Practice for Resistance Spot Welding for Light Assemblies in Mild Steel. In recent years, considerable development has taken place in the field of welding, and this code is meant to serve as a guide to the industries using the resistance welding process in the fabrication of light mild steel assemblies. For a particular weld design to be efficient, safe and satisfactory, the designer should be conversant with the possibilities and limitations of the welding processes which are available for use. It is only in recent years that sufficient information and data regarding resistance welding processes has become available to give designers the necessary confidence to use resistance spot welding in assemblies where strength and safety are of importance.

This Code is one of a series consisting of more than a dozen standard specifications and codes relating to welding, under preparation as a part of Steel Economy Programme of the ISI. In formulating this Code, the Sectional Committee responsible for its preparation had on its committees, representatives of Government and private organizations and Institutions in India, connected with various aspects relating to welding and cutting of metals.

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DRAFT REVISION OF REINFORCED CONCRETE CODE

The Indian Standard Code of Practice for Plain and Reinforced Concrete for General Building Construction (IS : 456–1953) is being revised. The proposed additions and modifications to be introduced in the Code have been circulated to all interests inviting comments.

The Cement and Concrete Sectional Committee has take note of the rapid development of concrete technology in the country and while considering the issue of a reprint of IS : 456–1953 felt the necessity to include certain points which had been raised while applying the Code to practical situations. The revised Code will include new sections on composite columns and distribution of concentrated loads on slabs and staircases; the figures for preliminary compression strength

test for ordinary concrete have been introduced, and the Section on Bond and Anchorage has been re-arranged and modified. The information given in Appendix H on live loads and wind loads has been proposed to be deleted from the Code, as a separate Indian Standard Code on Loading Standards is being published.

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BUILDING STONES

The following six draft Standard Methods of Carrying out Strength Tests on Natural Building Stones prepared by the Building Stones and Bricks Sectional Committee, which is composed of important producers, consumers and technologists, are now being widely circulated inviting comment.

(1) Method of Carrying Out Strength Tests on Natural Building Stones

(2) Method of Test for Determining Specific Gravity and Porosity of Natural Building Stones

(3) Specification for Petrographical Examination of Natural Building Stones

(4) Method of Test for Water Absorption of Natural Building Stones

(5) Method of Carrying Out Weathering Test for Natural Building Stones

(6) Method of Carrying Out Durability Test for Natural Building Stones

Stone forms one of the most important building materials in India due to its availability, strength, durability and adaptability for a variety of architectural features. There are a number of types of stones occurring in different parts of this country and, before they are used in the buildings, it is very essential to ascertain their properties in order to determine the location in which each of them could be used from structural considerations. With this in view, Indian Standard Methods of Testing Building Stones have been formulated. It is hoped that these methods of testing would prove useful and form a basis to classify the stones for the different purposes for which they are required and would also enable the correct use of each type of stone for the location for which it is suitable.

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ZINC

The Indian Standards Institution has circulated for eliciting comments the draft revision of IS : 209—1950 Specification for Zinc, which was published as a tentative Indian Standard in 1950. Two important changes have been made in this revision. The number of grades of zinc used for general purposes covered in the standard has been reduced from 7 to 4 and a provision has been made for chemical analysis of the material. The draft specifies the chemical composition and other requirements of the following four grades of the material.

(1) Zn 99.95 is used for anodes for electro-galvanizing and the manufacture of deep drawing quality non-ferrous alloys.

(2) Zn 99.00 is suitable for hot dip galvanizing and the manufacture of non-ferrous alloys.

(3) Zn 98.50 is generally used in the manufacture of pigment for paints.

(4) Zn 98.50B is specially meant for use in the manufacture of dry batteries.

High purity zinc suitable for zinc base die casting has been covered in a separate Indian Standard which was published in 1955.

NEW MANAGING DIRECTOR FOR HINDUSTAN STEEL

Mr. P. G. Bhagat has been appointed Managing Director, Hindustan Steel, Private Limited, Calcutta, *vice* Mr. S. N. Mozumdar, who has proceeded on leave preparatory to retirement, says a Press note issued by the Ministry of Iron and Steel.

Mr. Bhagat at the time of his retirement from Government service in 1951, was holding the post of Director-General, India Store Department, London. Before joining the Hindustan Steel, he was General Manager, Turner Hoare and Co., Ltd., Bombay.

ENGINEERING NOTES & NEWS

NEW EQUIPMENT FOR THE INDIAN IRON AND STEEL PLANT

We paid a visit to the central designing bureau of the Chief Administration of Machine-Building Plants of the USSR Ministry of the Iron and Steel Industry. Several dozen designers were bent over their draughting boards. All their thoughts and wishes were concentrated on supplying the iron and steel plant now under construction in India with the most up-to-date equipment.

It took Fulmakht, Krutisov, Shukis, Zhikh and others only slightly more than eight months to complete the main blueprints for a number of machines. The technical documents for the production of a belt conveyor for loading open-hearth furnaces, machines for oiling casting moulds, grinding mills of various designs, skip hoists, etc., have been already issued.

We were shown in the experimental shop a model of a greatly improved stationary rotor car dumper for the simultaneous unloading of two coupled open-cars with ore or other materials at the blast-furnace trestle. Engineer Sinkovsky, the senior designer, explained the advantages of the car tumbler for India as compared with those now functioning in the Soviet Union.

The new type of a car tumbler is 75 tons lighter, its intricate cable and block system of tumbling over the cars has been replaced by a tooth gear, the hook clamps in cars changed to upper planks and, finally, the manufacture of car dumpers has been made much simpler and their exploitation qualities improved.

Engineering thought probed still further: in order to free the locomotive and its crew from the necessity of servicing the dumpers it is planned to design a special bogie to haul the cars and place them in the dumper, which will make it possible to draw up simultaneously as many as 10 cars with a carriage capacity of 20 tons each. The bogie is placed between normal-gauge tracks and can freely pass under any kind of car. The bogie is operated by remote control.

In the same shop we saw a new model of stripper for pushing ingots out of the casting moulds. Its advantage over the machine now in use is greater pushing force—400 tons as against 280, and an improved oiling system for the stripping mechanism and its control. The new design will make possible surface repairs, which will considerably improve the working conditions under high temperatures.

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JET AUTOMOBILE

The first experimental sample of a turbo-jet automobile has been produced at the Gorky Auto Plant.

It has a stream-lined body. During preliminary tests it registered a speed of 200 kilometres per hour. It is believed that on special roads this car is capable of developing a maximum speed of more than 500 kilometres an hour.

The motive power of the car somewhat differs from the conventional automobile. The engine here is not connected mechanically with the wheels. The latter are only necessary for rolling. The car is propelled by the gases emitted at high speed from the jet nozzle.

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MOTOR SHIP WITH UNDERWATER WINGS

A group of Krasnoye Sormovo engineers, headed by P. Alekseyev, has designed a passenger motor ship with a cruising speed of 60 kilometres per hour.

A new principle has been applied to this ship: underwater wings. At low speed the ship will operate as usual. But with its speed increasing, a considerable lifting power will be developed on its carrying wings located under its hull. The ship will rise above the surface of the water and only its wings, propeller, rudder and partially the props by which the wings are fastened to the hull, will remain submerged.

A motor ship of this kind possesses high manoeuvreability and stability. Sailing at moderate speed the vessel will not feel any sharp shocks, while the motor ship itself practically produces no waves.

By order of the Ministry of the Inland Water Transport of the RSFSR the Krasnoye Sormovo works has this year already built and tested the first experimental model, a 30-passenger launch with under-water wings.

Sormovo's engineers and management consider that it is quite possible to produce a whole serious of vessels with under-water wings: passenger motor ship, sea launches for coastal lines, and others.

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SIGNING OF THE AGREEMENT BETWEEN "AEROFLOT" AND THE PAN AMERICAN WORLD AIRWAYS IN MOSCOW

An agreement on commercial co-operation in civil aviation was signed in Moscow on August 24 between the Central Civil Aviation Board under the USSR Council of Ministers (Aeroflot) and the Pan American World Airways Incorporated, an American company, following negotiations which proceeded in a friendly atmosphere.

The agreement was signed on behalf of Aeroflot by N. A. Zakharov, Deputy Head of Aeroflot, and on behalf of Pan American World Airways Incorporated by John Shanoon, Manager of the Atlantic Department.

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CLIMATE OF BHILAI REPRODUCED IN KHARKOV LABORATORY

A special tropical climate laboratory has been set up at the Kharkov Electrical Equipment Plant to study what insulation materials will be most reliable in operation in the conditions of India. In this laboratory a climate similar to that in Bhilai where the Soviet Union is building a steel works is created artificially. The temperature and humidity are very high.

Here we are testing experimental models of electrical machines and appliances in conditions resembling the tropics, engineer Mikhail Kushchenko explained.

In one of the laboratory chambers insulating materials are tested for resistance to fungi.. About three thousand samples of such materials have already been tested. After long investigations the Laboratory workers have found a type of insulation which meets all requirements of machines operating in a tropical climate. Electrical machines with such insulation have already been put out by the plant for Pakistan, Burma and Viet-Nam.

The laboratory has been organized after a visit by a delegation of Indian specialists a year ago. They studied in detail the work of the plant which is the main supplier of electrical equipment for the rolling mills of the Bhilai iron and steel works. The head of the delegation said then that the high quality of the electrical machines was beyond doubt. They had won a high reputation in number of countries. He asked however to pay special attention to insulating materials in view of the specific climatic conditions in India.

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METALLURGICAL EQUIPMENT FOR INDIA

Machines produced by the South-Ural Machine-Building works in the city of Orsk are employed at many large metallurgical plants of the Soviet Union. They may be seen at the "Azovstal", "Zaporozhstal", South-Tagil and Magnitogorsk metallurgical giants.

The trade mark of the Orsk machine-builders is also known abroad. The Orsk-made coke pushing machines, coal-backing wagons, door-detaching machines are used at the Anshan Metallurgical Works in China. A powerful Orsk-made pushing machine is also used at Novaya Guta in Poland. Lately Rumania has been supplied with hundreds of tons of rolling equipment. Every machine is the embodiment of the latest achievements of science and technique.

The manufacture of metallurgical equipment for the Republic of India is occupying a place of honour among the orders which are being carried out at the South-Ural Machine-Building Works. During their visit to India the Soviet leaders emphasized in their statements that the Soviet Union desires to see India as a powerful industrial state, as one of the great world powers and will help India to achieve that goal. For Soviet people word and deed go hand-in-hand. And in a very short time the South-Ural Machine-Building Works received orders for India's Industry.

Designers were the first to get busy with these orders. That was in the autumn of last year. The specific conditions of work, a number of unusual points of departure off-times required a new approach for the solution of the problems involved.

Last December the Engineering Council of the Works discussed a new type of wagon-tipper for the metallurgical plant in India. The design was presented by chief designing engineer, Ussenko calls for a combined wagon-tipper for unloading bulk material from both closed and open wagons was produced for the first time.

In one hour the machine unloads up to 15 wagons of material. It is interesting to note that to unload one ton of material by the wagon-tipper eight times less electric energy will be expended than by the wagon-tippers of the English firm "Strachen and Hanshaw".

A new automatized coke pushing machine has also been produced for the metallurgical works in India.

Another important order will be carried out at the coke-machine department of the south-Ural Machine-Building works.

The chief of the department, Marchenko, pointing to a huge bowl being assembled by a team of workers, said:

This ladle is being manufactured for the Bhilai Metallurgical Works which will hold 270 tons of molten steel.

Now, serial production of these 270-ton ladles has been organized and all difficulties are over, but there were many of them. For instance, methods for the designing of such ladles were unknown. However, scientists came to the aid of works' engineers. With their assistance a method was elaborated according to which engineers Kuryanov and Korop completed all calculations. It is interesting to note that the designers succeeded in lessening the weight of the ladle while improving its design. The results of their work can already be seen. The 270-ton ladle which will be shipped to the Republic of India weighs approximately the same as the 240-ton ladle.

Other orders for India are also being successfully carried out. And there are quite a number of them. Rolling mill units, a door-detaching machine, a coal-loading wagon, skips, a highly productive crusher, trough cars must be designed and manufactured. A number of designs have already been turned over for production. Now the technology of processing various details of these machines is being prepared at the works.

The ties between the Orsk machine builders and the metallurgists of India are strengthening. Recently engineer I. Dobroscok, the chief designer of the South-Ural Machine-Building Works, returned from a trip of India. He spent more than a month in the Republic of India, studying the necessary data for the carrying out of the orders received. A representative of the machine-builders visited the metallurgical works operating in Delhi and Calcutta. He recalls the Indians whom he met with great warmth and is pleased of having had the opportunity of visiting India.

Under all conditions a designer remains a designer. While in India, I. Dobroscok examined modern equipment being supplied by the West-European States and the United States of America, comparing the level of foreign and Soviet technique. The Orsk machine builders confidently declare that the machines they shipped to India are more modern and better than those of other countries.

I. Dobroscok related:

I examined in detail the English "Wellman" coke pushing machine, and the West-German "Karl Still" coke pushing machines. The planning of the furnace charge is automatically accomplished by our pushing machine, thus being an improvement over these makes.

On the coal-unloading wagon of our design special trap-door detachers are mounted, while on foreign wagons the trap-doors are removed by hand.

The Orsk machine-builders hope that the equipment they supplied to India will work faultlessly for many years to come.

SCOPE OF JAPANESE CO-OPERATION

Mr. Shinchi Takasugi, President of the Mitsubishi Electric Manufacturing Company and leader of the Japanese delegation, explained the scope for development of trade between India and Japan when the delegation visited the Andhra Chamber of Commerce and the Southern India Chamber of Commerce, Madras.

Mr. Takasugi, speaking at the Andhra Chamber of the aims and objectives of the mission, said that the mission was organised by the largest associations of Japanese industrialists like the Japan Machinery Federation and the Federation of Economic Organisations. The Japanese Government had patronised the mission and encouraged them because they thought that for the prosperity and happiness of the people of India and Japan it was desirable to improve the economic relations between the two countries.

He said they studied India's Five-Year Plan, which had impressed them very much. Japan could give her assistance and collaborate with India in the speedier industrialisation of the country as envisaged in the Five-Year Plan. It was a fact that India had achieved a tremendous lot already and Mr. Takasugi hoped that in the course of the years to come she would be one of the most industrialised countries in the world with her tremendous amount of natural resources and manpower.

Japan, Mr. Takasugi said, was very anxious to find out how best, as an industrial nation, she could participate in India's developmental activities. With a view to studying and discussing the scope of co-operation, this mission was organised, he said. He said that the heavy industry field was controlled directly by the Government and the private enterprises controlled the medium and small-scale industry field. There were already more than 20 factories in India operated with the engineering collaboration of Japan. This, he said, was one of the most appropriate patterns of collaboration between Indian and Japanese industries. He hoped that this mission would become a stepping stone for better friendship and for further improvement of economic relations between India and Japan.

Mr. Takasugi's speech was translated into English by Mr. Yamaki, Personal Assistant to the leader of the delegation.

Recent Scientific Research Progress in Mellon Institute

The Mellon Institute is an endowed non-profit corporate body for conducting comprehensive investigations on important problems in the United States of America in the pure and applied natural sciences, for training research workers, and for providing technical information adaptable to professional, public and industrial advantage.

Here we give below an extract of some important research activities conducted at the Institute recently of considerable interest to Industry.—EDITOR

THE EXPANDED PROGRAM ON POWER RECTIFIERS

THE Multiple Fellowship on Power Rectifiers, supported by the Syntron Co., Homer City, Pa., has enhanced its activities on the development of selenium power rectifiers. Studies of a fundamental nature have been made on selenium rectifier-plate aging. The use of probe measurements to determine the potential profile of the plates has proved to be a valuable technique in finding the regions which contribute to aging. The changes in the characteristics of the various regions have been followed through accelerated aging cycles. The properties of various metals in contact with selenium have been examined to arrive at a basis for the selection of proper metals to be used in the construction of rectifier plates. Aging of selenium metal contacts has been studied also.

An investigation of a possible procedure for the quantitative analysis of trace impurities in selenium was carried out with the Department of Research in Chemical Physics. This study yielded a set of standards covering a wide range of concentrations for the most prevalent impurities.

Research was undertaken on the preparation of highly refined silicon and on the building silicon processing equipment. The major piece of equipment constructed was a furnace to grow single crystals in a vacuum or in an inert atmosphere with independent pulling and rotation of the seed crystal. Equipment has been obtained to measure characteristic properties of silicon crystals to determine their purity and suitability for use in the fabrication of rectifiers and transitors.

CHEMICAL RESEARCH AIDS PROGRESS IN ELECTRONICS AND WATCH TECHNOLOGY

The Watch Technology Fellowship of Elgin National Watch Co., Elgin, Ill., is engaged in friction studies and problems related to the lubrication of fine instruments. The development of new watches by the Donor and the expansion of its interests in the field of electronics resulted in the need for an increased emphasis on polymer research by the Fellowship. New resins with specialized properties are sought and evaluated for use in applications arising from continued progress in the technology of miniature electronic and horological instruments.

FORTY YEARS OF RESEARCH ON HEAT INSULATION AND HEAT TRANSMISSION

The year 1955-56 marks the fortieth anniversary of continuous research on heat insulation at the Institute. The Insulation Fellowship was founded in 1916 by the Magnesia Association of America. The Philip Carey Manufacturing Co., Cincinnati, Ohio, one of the four member companies of this Association, assumed sponsorship of this activity in 1922, and has maintained it continuously since that time. The Roofing Fellowship, which was started in 1922 by the same Donor, was combined with the Insulation Fellowship in 1931.

The Multiple Fellowship on Insulation and Roofing has aided the Donor materially in the development of new products and the improvement of present production. Since its birth, considerable time has been spent gaining basic information on the heat transmission from all types of bare and insulated surfaces encountered in industrial practice. Much attention has been accorded to vapor transmission. Liberal contributions have been made to the engineering literature on heat insulation and heat transmission. The Fellowship has cooperated with various agencies in the development of test and material specifications for insulating and vapor-proofing products.

THE BROAD SCOPE OF STUDIES ON SULFUR

For a period of twenty-five years the Multiple Sulfur Fellowship has been serving The Texas Gulf Sulphur Co., New York, N. Y., in many important ways. Engineering, technical service, fundamental research, and development are woven strongly into the pattern of this group's activities. The development of sulfur cements and the commercial production of brimstone from sour natural gas in the largest plant of its kind in the world at Worland, Wyo., highlight the past activities of this group.

Currently the Fellowship has continued its investigations in the fields of sulfide and sulfur ores, gypsum, sulfur dioxide, Frasch mining, and sour gas for the recovery of sulfur-bearing substances. Preliminary economic analyses of processes studied in these fields, now underway, are expected to help determine those methods which merit further consideration.

THE STABILIZATION OF BENTONE–WATER DISPERSIONS

Since this concludes the twentieth year of operation for the Multiple Fellowship on Lead of the Baroid Division, National Lead Co., Houston, Tex, it seems of interest to review some of the achievements of the past, as well as to discuss the current activities.

Much emphasis, from the beginning of the Fellowship, has been put on organic complexes of bentonite. A study of the interaction of organic ammonium salts with this clay led ultimately to the development of the "Bentones", now used extensively in the compounding of paints and non-soap greases. The exchange of a large organic cation, such as the diocta-decyl dimethyl ammonium ion, for a sodium ion on the clay surface results in a stable clay-organic complex which, contrary to the original properties of the clay mineral, is now organophilic and hydro-phobic. This organophilic nature of the reaction product is the basis for its utility in gelling oils to greases and in controlling the thixotropy of oil-base paints. The role played by the Fellowship in this work included research and development through the pilot-plant stage and supervision of the early plant production. J. W. Jordan, Senior Fellow during this period, is now Director of Research and Development, Baroid Division, and many of the Fellowship personnel at that time are also located at the Houston laboratory.

During this twentieth year, the Fellowship has been concerned with the system, montmorillonite-water, and the effect of various additives on the properties of this system. Several promising lines of approach have been developed which should lead ultimately to increased knowledge of the subject. Some work has been completed on a problem relating the rate of decay in the birefringence of clay mineral sols the flow properties of this sols. One program of considerable practical and theoretical interest, now temporarily postponed, involved the determination of the surface area of dispersed phase in dilute dispersions of montmorillonite in water. Enough work was completed to indicate that solution-absorption technique, using suitable absorbates, could serve as a route to the desired method.

PRACTICAL APPLICATIONS IN STRUCTURAL CLAY PRODUCTS MANUFACTURE

The Clayworking Multiple Fellowship, sustained by the Hanley Co., New York, N.Y., and Pittsburgh, Pa., is completing its fifth year of research and development investigations on the technology of structural clay products.

A practical method has been worked out to permit a study of the flow-line characteristics of the clay-water mix as it is processed in the auger and extrusion machine. The details of this method have been conveyed to the Donor's production staff as a means of providing it with a tool which will permit a better understanding of die-balance problems in actual production operations.

Research on the methods of measurement of consistency properties of clay-water mixes has continued. Considerable success has been achieved on the determination of optimum water content for proper extrusion of these mixtures by use of the "Brabender Plastograph". An apparatus has been designed and constructed to measure the force-deformation characteristics of green clay bars under transverse shear. The pertinent information obtained from these studies includes the yield point, extensibility, and rupture point. These data are combined to give a relative plasticity or consistency index. An attempt at correlation of this index with that obtained from the "Brabender Plastograph" is planned for use in process control at the Donor's plants.

Laboratory work on the frictional characteristics of clay-water mixes as related to auger and extrusion processes has been progressing favourably. Appropriate apparatus has been designed and constructed for use in measuring comparative frictional forces on cores of various metals inserted in the die of a laboratory extrusion machine. Forces are measured by use of strain gauges and recorded continuously.

A comprehensive study of certain surface defects in fired brick and tile has been concluded successfully. This work involved a survey of the plants' operating procedures and an evaluation of various ways of eliminating the causes of these defects. Extensive laboratory investigations were conducted in the areas of particle-size control, firing rates, and percentage requirements of additive to the clay mix.

A program on evaluating the various ceramic properties of clays from new sources of supply has been completed in co-operation with the Donor's plant staff.

A study of the variations in the composition of clays and shales, which may be responsible for significant changes in ceramic properties, has employed use of the Fellowship's facilities, including differential thermal analyses, plasticity evaluation, x-ray studies, extrusion properties, and drying and firing characteristics.

THE SLAGGING OF REFRACTORIES AND MORE INFORMATION ON CASTABLES

One of the principal factors affecting the life of refractories in industrial furnaces is the destructive action of slags. Because of its importance, much consideration has been given to this problem and to methods of testing which might offer a clue to slag action in industrial furnaces. Slag tests are urgently needed which might predict more reliably the behavior of specific slags on given refractories.

To assist in understanding many of the slag problems, the Multiple Industrial Fellowship (Refractories) of The Refractories Institute, Pittsburgh, Pa., has prepared an annotated bibliography on slag tests for refractories covering the period 1941–54, which brings up to date an earlier review by the Fellowship. The selection of articles in this project was based on the publication of original data and information resulting from laboratory or service tests, as well as comprehensive reviews and publications of an interpretive nature. Since the action of slag on refractories involves a broad field of subject matter, it seemed worth while to include papers closely related to the subject, such as those on surface tension and viscosity of slags, wetting of refractories by slags, pertinent equilibrium studies, and contact reaction between various refractories. This bibliography has been submitted for publication because of its general interest to men in the refractories field.

A castable refractory is one of the many types of refractory materials available to furnace builders. This product is supplied to the trade as a hydraulic-setting mix requiring only the addition of water prior to application, in much the same manner as ordinary concrete. During the installation of a castable, it is desirable to develop its optimum strength, and this factor is primarily dependent upon the addition of a critical amount of water. The common practice at present is to judge the water content in a batch by the consistency during mixing, and the only procedure for checking consistency is rather crude. Experience has shown that tests used to measure the consistency of mixes having related properties are not applicable to castables because of the great variety in working properties exhibited by the many kinds of castables manufactured for specific uses. These properties have to do with the coarseness, plasticity, water-holding ability, and related characteristics. Therefore, work has been under way on the Fellowship to develop a suitable consistency test for this product.

During the preliminary work, much information was acquired about the specific behavior of commercial castables. In the course of the development of a procedure, over 30 brands of castables were used. The consistency test, as finally developed, shows every promise of being suitable for use in arriving at the proper amount of water for the mix, within the required limit of 0.5%. Furthermore, the method is applicable to the great variety of castables on the market.

The test procedure involves filling an inverted truncated cone with approximately five pounds of the mix, after which it is allowed to drop through a second, similar cone in the upright position. In doing so, the castable is forced through a circular opening smaller in diameter than the molded material. From that orifice, the castable is free to fall a short distance to a plane surface on which it flattens to form a disc, the diameter of which supplies the index to the consistency.

The test procedure shows considerable promise, and is of particular interest at this time in completing the work of standardizing the method of preparing test brick from castables for use in evaluating the properties of this refractory. Furthermore, the consistency test may well find use in the field during the installation of castables in furnaces. Final approval will, of course, be dependent upon extensive trial by interested parties and the incorporation of any modification that seems to be desirable.

SOME DYNAMIC PROPERTIES OF GLASS

The Glass Properties Fellowship, sponsored by Hazel-Atlas Glass Co., Wheeling, W. Va., has completed five years of research on the mechanical properties of glass. During the early part of this period the Fellowship program was concerned with an investigation of the visco-elastic properties of glass. Two instruments were developed for studying elastic modulus; most of the data collected were associated with simple two and three component glass systems.

The first of these instruments was designed to arrive at the variation of elastic modulus with temperature. In this apparatus a glass rod, supported as a cantilever beam, is vibrated at its resonant frequency. Knowledge of this frequency and the dimensions and density of the specimen permit calculation of the elastic modulus. Determination is made with constant stress condition within the audio-frequency range. Relaxation processes may be calculated from the plot of frequency against amplitude of vibration.

The study of dynamic elastic modulus under constant strain conditions constituted the second experimental phase of this part of the Fellowship program. The instrument developed was capable of operation over a wide range of temperatures, and also used a cantilever-strained rod. In operation, actually two rods were used, one at ambient temperature and one at the elevated temperature. Transducer signal from each of the two rods were beat against each other and the amplitudes balanced. Interesting studies of relative elasticity, phase-angle lag, and relaxation time were made. This apparatus operated at a frequency range below the auditory spectrum.

During the past year and a half the attention of the Fellowship has turned toward surface properties and condition and their influence on the mechanical strength of glass. Since mechanical strength, of all the physical properties, appears to be most sensitive to surface condition, it seemed to quite natural to use its value as a parameter for sensing subtle change in surface condition. The initial task in this project, the development of suitable apparatus for determining mechanical strength by bursting circular plates by hydrostatic pressure, has been completed. Work is now in progress on improving and controlling test-procedure detail so that the usual 35% co-efficient of variation of the test value may be reduced substantially. In the meantime, methods for studying surface conditions are being surveyed. Any technique that will disclose microscopic and submicroscopic surface detail and structure is of interest, and will be seriously considered.

IMPROVED FINISHES FOR THE PORCELAIN-ENAMEL INDUSTRY

The twenty-second year of the Ceramic Chemicals Fellowship, maintained by the O. Hommel Co. of Pittsburgh, Pa., has been devoted to improvement in porcelain-enamel finishes. The major current objective has been the development of cover-coat enamels with improved alkali resistance for use on sheet steel. Such enamels are used extensively as durable finishes for home appliances and sanitary ware. For the advancement of this study, new testing and processing equipment has been obtained, and research efforts have included enamel compositions, preparation, and processing variables. Accelerated tests with alkaline solutions have been employed to determine the comparative life expectancy of enamels in service. Tests have also been made to evaluate the color, stability, reflectance, and acid resistance of new enamels since higher standards for all properties are constantly being sought. Progress has been made in this work, and more knowledge of the effects of various components of porcelain enamels has been gained.

Extensive work has been done on the expansion of porcelain-enamel glasses. Test procedures have been improved and additional equipment obtained to increase the accuracy and efficiency of this work. The co-efficient of thermal expansion has been determined for many enamel glasses and the information gained has been used to advantage in coping with problems in the industries. A thorough knowledge of the expansion characteristics of an enamel is important in controlling the properties of finished products and in obtaining greater durability and freedom from defects.

Of a somewhat more fundamental nature has been the work on thermal analysis of porcelain-enamel glasses. This investigation was undertaken with the aim of studying the endothermic and exothermic reactions which occur in an enamel during the firing cycle. Of chief importance is the crystallization of the opacifying agent, titanium dioxide. The number, size, and crystalline form of the titanium dioxide crystals are important considerations controlling the color and reflectance of the fired enamel.

PROBING THE ACTION OF BONDED AND LOOSE ABRASIVES

The effect of grinding with abrasives upon the physical and mechanical properties of surfaces was pursued along three general lines by the L. Leslie Byers Memorial Fellowship (Grinding Wheels), sustained by the Grinding Wheel Institute and the Abrasive Grain Association, Cleveland, Ohio. Efforts were continued to correlate grinding conditions with residual stresses and with fatigue life, experiments aimed at finding simple and practical means for relieving residual stresses in ground parts were initiated, and a program to study the surface-stress effects of abrasive tumbling was undertaken.

In cross-feed surface-grinding tests, it was found that residual stresses, induced in a hardened ball-bearing steel when the abrasive wheel and the work-piece were flooded with dilute solutions of a nitrite-type rust inhibitor in water or with 2.5% emulsions of miscible oils in water, were not significantly different from those obtained when the wheel was operated dry. Under otherwise identical conditions, use of grinding fluids consisting of mineral and fatty oil blends resulted in higher compressive stresses in the immediate surface of

the steel. Certain of the latter fluids were also effective in reducing the peak tensile stresses at subsurface levels.

Preliminary experiments on relief of grinding stresses were encouraging. For example, a peak tensile stress of 75,000 lb. per sq. in. in tool steel, ground in the as-quenched condition, was reduced to 25,000 lb. per sq. in. by holding the ground specimen five minutes at 420°F and quenching in oil at room temperature.

Stresses resulting from abrasive tumbling of tool steel were found to be highly compressive at the immediate surface and to decrease to zero at a depth of a few thousandths of an inch. Both the magnitude of the compressive stress and the thickness of the stressed layer increased with the abrasive size for particle diameters ranging from 0.1 to 1.5 in.

Now completing its tenth year, the Fellowship has, since its beginning, developed techniques for measuring residual surface stresses, demonstrated that grinding stresses are at least biaxial, that they are confined to a shallow surface layer, and that they may be either tensile or compressive. During this period it has contributed seven papers to the literature of grinding and stress analysis.

ZIRCONIUM CHEMICAL COMPOUNDS

The research and development program of the Multiple Zirconium Fellowship, supported by The Carborundum Co., Niagara Falls, N. Y., was directed toward the preparation and study of the chemical and physical properties of compounds which might add to a better understanding of the fundamental chemistry of zirconium. Several interesting organic derivatives have been prepared. Electrolysis in non-aqueous media was investigated as a possible means of producing a metal zirconium plate.

Gas chromatographic techniques were applied to the problem of analyzing the off-gases from the pilot plant for the direct chlorination of zircon ore in a fluidized bed.

ANALYSIS AND MECHANIZATION OF INDUSTRIAL OPERATIONS

This Multiple Fellowship (Information Processing) of The Carborundum Co., Niagara Falls, N.Y., is conducting research studies on industrial operations and information-processing activities. The objectives are to simplify present practices and to make accessible timely-derived operating data and other information by mechanization of the information-processing activities for use in quantitative decision making, determination of policy and objective planning and control of the company operations.

The flow of information through the organization has been analyzed, a complete mechanization program outlined, areas for initial mechanization selected, and a detailed work program formulated. A comprehensive information-processing system, utilizing commercially available computers, communications systems, and other devices, has been designed. Methods of compression and coding of information for machine handling have been recommended. Problems of capture of source data are now under study.

As the mechanization program progresses, more opportune and complete data become available for use in the continuing analysis of the company's operations. This evaluation of activities is proceeding concurrently with the mechanization study. Investigations have been completed on salesmen's compensation plans, the optimum sales program, economic manufacturing lot-size, optimum package size, optimum depreciation of capital equipment, geographical distribution of production in multiple plant operations, and factory loading. Research is continuing on the general programming (long-range planning), forecasting, scheduling, and inventory management problems.

Members of the Fellowship presented nine lectures at the Bureau of Business Research, University of Pittsburgh, on information processing and on the analysis of industrial operations. Two additional papers were given in this general field before members of the Harvard Graduate School of Business Administration and at the Econometric Society annual meeting, New York, N. Y., December 30, 1955.

METALLURGICAL RESEARCH ON HIGH-STRENGTH STEELS FOR PRESSURE VESSELS

The principal work of the Multiple Fellowship (Metalworking) of the Scaife Co., Pittsburgh, Pa., has involved the development and use of ultra-high strength steels for rocket motor bodies. All phases of metal forming, deep drawing, ironing welding, heat treating, and testing have been investigated to produce thin-wall pressure containers having a minimum 0.2% offset yield strength of 190,000 lb. per sq. in. Steels of this strength level exhibit hardnesses in the range of Rockwell C-44 to C-46. Special requirements for inherent cleanliness and surface finish were found to be important not only from the deep drawing and welding aspects but also from the final requisite of high-pressure testing. Surface preparation and protection for ultra-high strength steels were studied to show the resulting physical effect of certain finishes and treatments on tactical performance.

COMMERCIAL APPLICATION OF WELDING INVESTIGATIONS

The Chain and Welding Multiple Fellowship, sponsored by the McKay Co., Pittsburgh, Pa., has made numerous contributions which have assisted the maintenance of the donor's position in the field of arc-welding technology. The commercial announcement of a new low hydrogen-iron powder electrode was the direct result of welding research Performed at Mellon Institute during the past year. Close contact with the Donor's research group has proven to be of great value in realizing optimum practical benefits from the long-range program of the Fellowship.

A SCIENTIFIC APPROACH TO THE PAINTING OF STEEL STRUCTURES

Five years of intense activity by the Steel Protection Fellowship, sustained by the Steel Structures Painting Council, Pittsburgh, Pa., resulted in many advances in the economical protection of steel structures by means of paint. The publication of the two volumes of the "Steel Structures Painting Manual" by the Fellowship gives to the public the first encyclopedia of authoritative information on good painting practices for steel and the first presentation of specific recommendations and guides for such painting. Research at Mellon Institute on cleaning and painting, along with close collaboration and co-operation from technical representatives of the industries and other associations, makes it possible to recommend the proper surface preparation, pretreatment, type of paint system, and mode of application of the paint. A simple number system has been adopted to specify necessary requirements in the painting of a steel structure. The painting manual and the specifications received enthusiastic acceptance from users and highly favourable reviews from the technical press in this country and abroad.

Considerable basic research on fundamental problems, such as anchor-pattern profile, blast cleaning, inhibitors, and cleaning agents, was done in the laboratory. Extensive field and service testing confirmed the validity of procedures and methods advocated by the Steel Structures Painting Council. Numerous tests were started on railroad bridges, highway bridges, chemical plants, steel mills, and water tanks. Effective painting systems based on phenolic, vinyl, and colorinated rubber types of synthetic resins have been developed for use on railroad structures severely attacked by brine drippings. An inexpensive shop paint for steel fabricators resulted from the laboratory research program. Field tests show that savings in paint costs will be substantial to the fabricators.

Paints of high quality for exposed steel have been developed with the aid of the various companies and governmental agencies which made the basic contributions. A co-operative field testing program, in which the Fellowship serves as an impartial adviser, inspector, and clearing house for paint tests, enables the exchange of research information with considerable saving by eleminating test duplication.

Highlights of the past year include: the appearance of the "Steel Structures Painting Bulletin" for the dissemination of information regarding research findings and the latest developments in the painting of steel; the development of solvent-cleaning techniques, the use of emulsion and diphase cleaners for steel structures; laboratory evaluation and field testing of synthetic resin paints for railroad bridges that cannot be thoroughly cleaned; completion of the low cost, shop paint test and anchor-pattern profile test; initiation of programs on weathering versus shop cleaning, painting of rusty steel, cleaning and painting of welds, evaluation of Steel Structures Painting Council paint systems.

During the past year five papers were issued in technical journals and eight talks given on the cleaning and painting of steel. A manuscript has been prepared for inclusion in a new materials handbook.

The Engineering Foundation, representing five basic engineering societies, has joined the supporters of the Painting Council in recognition of its accomplishments.

BUILDING MATERIAL RESEARCH ACTIVITIES

During the thirty-eighth year of uninterrupted research for its Donor, the H. H. Robertson Co., Pittsburgh, Pa., the Multiple Fellowship on Protected Metals has continued its contributions to the development of the unique list of products with which the Robertson name is associated.

Additional work has been carried out on structural products, such as "Galbestos", "Q-Floors", and "Q-Panels". Intensive co-operation with the plant laboratory has produced a solution to the long-standing problem of light-colored coatings for "Galbestos". It is expected that color will extend greatly the fields of

application of this unique building-covering material. During the last several years attention throughout the building industry has been focused on the need to avoid combustible materials when providing a vapor seal for roof decks. Robertson "Q-Deck" is an excellent answer to this requirement with its large impermeable areas of steel and its ingenious system of joining. A detailed study of vapor transmission has demonstrated that "Q-deck", as ordinarily assembled, provides an adequate vapor barrier for usual occupancy. Methods for sealing the joints have been found for cases where the building occupancy is expected to produce abnormally high humidities. Studies of heat transmission through "Galbestos" have been made, and methods for providing fire protection for light-weight steel construction are under constant study.

The successful development of the "Stypol" resins has made it necessary to plan additional production capacity, and the Fellowship has co-operated with the engineering department of the Donor in the design of a new plant. The "Stypol" process of applying a light-weight, moistureproof envelope to electrical and electronic equipment has gained acceptance by the military, particularly in aircraft and missile devices where savings in weight and space are especially important. These new techniques are finding increasing use in industrial and commercial equipment, such as power transformers for television sets, ignition coils for outboard motors and power lawn mowers, and field coils for electric motors. Advantages gained are improved moisture resistance, better resistance to dielectric failures at high voltages, and lower operating temperatures. The development of "Stypol 100S", reported last year, has led to the addition of corrugated translucent plastic panels, called "Stypo-Light", to the Donor's list of products.

IMPORTANT ACCOMPLISHMENTS HAVE RESULTED FROM ORGANIZED AIR-PURIFICATION CONTROL ACTIVITIES

The Multiple Fellowship on Air Purification was established in 1951 by the Air Pollution Control Association (APCA) for the purpose of increasing the knowledge and practice of air-pollution control. Five years of effort have been expended by this Fellowship in serving as a recognized clearinghouse for air-pollution control information. The Donor (APCA), an international organization whose membership includes subscribers from eight countries (industrialists, equipment manufacturers, control administrators, governmental agents, research and educational personnel, and civic bodies) is justifiably proud of this recognition and of the wide sphere of activities of the Fellowship.

APCA has more than quadrupled its membership during its tenure at Mellon Institute, and the Association's financial income for the same period has increased 15 times. The Association has an annual meeting which brings together recognized authorities to discuss mutual problems. Semiannual technical conferences are held in sections of the country remote to annual meeting locations to present technical papers before other segments of the organization, and sectional meetings are held each year to serve the particular requirements of these groups.

Technical committees have been set up within APCA to advise, to issue reports, manuals, or standards, and to establish those reports which eventually serve as authoritative sources of information on important problems in the air-pollution field. Of 18 such committees now working, one has already submitted a report which is now before the Association for consideration. In the next year many more reports are anticipated.

The following publications are issued by the Association: *Journal of the Air Pollution Control Association*, a technical quarterly publication; *APCA Abstracts*, a monthly publication summarizing current literature on air pollution; *Proceedings of the APCA*, the complete publication of all papers presented at annual meetings; and *APCA News*, a news bulletin issued eight times a year, which covers pertinent and timely information on air pollution.

While the Fellowship personnel do not engage in research, the Association has been responsible for initiating and co-ordinating the following projects for its Donor members and technical committees: development of an optical device to measure smoke, minimizing the possibility of human error; construction of a light-scattering machine to evaluate and record electronically the level of air pollution at a given point; preparation of domestic incinerator standards of emission acceptable to control officials and development of a unit to meet these standards; work on a standardized procedure to evaluate dust-collector operation; and development of an instrument to evaluate and record plumes of effluent (other than black smoke) electronically. Other projects are under consideration currently for Mellon Institute which are not sufficiently well defined for presentation at this time.

Greater demands are being placed on this Fellowship for advisory services to Federal, state, and local governmental agencies, civic groups, legislative bodies and committee, control official, and advisory bodies on air pollution. Demands for group conferences are also increasing from industrial, technical, educational, and other interested groups.

NEW CONCEPTS OF NATURAL SEDIMENT AND TASTE-AND-ODOR PRODUCING SUBSTANCES

The enlarged scope of the Multiple Fellowship (Water-Pollution Abatement), sustained by the American Iron and Steel Institute, New York, N. Y., was reflected during its eighteenth year in the variety of research studies undertaken.

Surveys of equipment for recovering suspended solids from blast-furnace gas-washer water were made at four steel mills. These studies proved the statistical reliability of the sampling program developed at one mill last year. All companies operating blast furnaces in the Ohio River Valley used this technique to evaluate the performance of their dust-recovery installations. The data are being processed statistically.

Statistical analysis of data collected during development of a sampling method for gas-washer water showed that the best estimate of the ratio of non-settleable to total suspended solids was 0.076. This figure varied only slightly among the five mills at which intensive surveys were made. By definition, only non-settleable suspended matter can overflow from a clarifier, but some regulatory agencies have expressed concern over the effects of such material on stream biota. So-called non-settleable solids will eventually settle under quiescent conditions, and their effect on a clean-water organism (Tubificidae) was determined. The dust washed from blast-furnace gas was found to be inherently non-toxic, and smothering of these tiny warms became marked only when the depth of dust exceeded about three-fourths of an inch. Since the normal feeding region of Tubificidae is near the water-solid interface, and since non-settleable solids would not deposit from flowing water, it may be assumed that such material is not normally deleterious to benthic organisms.

An investigation of natural sediment in streams was begun last year. Statistical analysis of data from a number of streams showed that sediment load is a direct function of drainage-basin area. The physical characteristics of watersheds appear to be much less important than volume of runoff from rainfall. This is shown by uniformly high correlation co-efficients relating sediment loads to stream-discharge rates. This study led to the development of an empirical equation for predicting sediment loads in terms of discharge rates. Natural suspended matter should be taken into account in evaluating the performance of water-clarification equipment; in one instance half the suspended matter in a clarifier overflow was attributable to natural sediment.

Biochemical research on tastes and odors originating in the natural decay of animal and vegetable matter has a number of facets: the compounds themselves, their precursors, their quantitative determination, their taste-and-odor potentials before chlorination and after, their rate of dissimilation by bacterial attack in streams, and their elimination at water-purification plants. Most of these aspects of a complex problem are being studied concurrently.

Research in this field is hampered by lack of analytical methods of high specificity and accuracy. Progress has been made with paper chromatography as a method for differentiating phenolic compounds. Gas-phase chromatography will be used to provide quantitative data on particular substances. Once the most odorous natural compounds have been identified, it will be possible to develop methods for eliminating them at waterworks.

Statistical analysis of data collected by the steel industry in a two-year phenol survey of the Monongahela and Ohio Rivers showed high correlation co-efficients for phenol loads versus stream flow-rates, especially for streams draining wooded and agricultural watersheds. This finding suggested a method for predicting phenol loads and concentrations at any selected point. There was no correlation between load and temperature.

In a study of odor thresholds of pure phenolic compounds it was observed that isomers have greatly different thresholds, and that phenol has a relatively low odor potential as compared with some phenolic substances. When thresholds have been run on these compounds after chlorination, it will be possible to narrow the field to those substances which are the real troublemakers in public water supplies.

Another study of a stream carrying mine water confirmed an earlier finding that moderate amounts of ferrous iron do not deplete dissolved oxygen in streams. In this case ferrous iron fell to 17.5 from 80 ppm in a thousand-foot stretch of shallow, sluggish stream, while dissolved oxygen increased to 5.2 from 0.8 ppm.

Six technical papers were given before professional groups. One U. S. patent was issued to the Fellowship in 1955. Fourteen conferences were held with the Steel Industry Committee and its subcommittees. During the year Fellowship Members conferred with representatives of eight steel mills and eight manufacturers of other products. There were 27 public relations activities, largely consisting of work with professional organizations. Engineers Joint Council appointed the Senior Fellow Chairman of a Board of Review to reconcile recommendations on national water policy since 1949.

IMPROVED PROCESSES AND PRODUCTS IN THE COAL-CHEMICAL INDUSTRY

The Coal Chemicals Multiple Fellowship, maintained by the United States Steel Corp., Pittsburgh, Pa., has continued its program of developing and improving recovery and refining operations on coal chemicals during the twenty-second year of its operation. This work has included investigations both of products now sold and of potentially new substances.

An extensive program has been initiated on means of upgrading pitches from the coke plants of the Donor so that they will meet various commercial specifications. This investigation has yielded data on the types and quantities of pitch products that can be produced at the various plants.

Analytical methods for a number of coal-tar components have been developed or improved in co-operation with the Departments of Research in Analytical Chemistry and Chemical Physics. These procedures were essential to the pursuance of the various recovery and evaluation studies.

An investigation has been made of the chemical outlets for pyridine in order to add to the general knowledge concerning the utilization of this raw material. Reports have been issued on the uses of pyridine in research and in the industries.

USEFUL RESULTS FROM RESEARCH ON CHEMICAL PROCESS WASTE WATERS

Improving waterways adjacent to coal-chemical plants is still a major objective of the Multiple Fellowship on Effluents Treatment, sponsored by the Koppers Co., Inc., Pittsburgh, Pa. The scope of the investigations has included effluents-treatment and disposal problems at by-product coke works, coal-tar processing, wood preserving, and chemical manufacturing plants of the Donor. The work on these problems has involved collecting samples of in-plant and outfall waste waters and of the receiving waterways, and applying to the samples appropriate physical, chemical, biochemical, bacteriological, and microscopic analyses. The Senior Fellow served as adviser while the experimental work was conducted by the effluents group at the Verona Research Center of the Donor during the first part of the year. Later this group was transferred to Mellon Institute for a continuation of its program. Following the exploratory investigations, the Fellowship conducted research on methods for the treatment and disposal of the liquid wastes so that the plants' outfall effluents would be satisfactory to the state or interstate agencies concerned with water-pollution control. The Fellowship has co-operated on programs for improved in-plant housekeeping. The cumulative advantages of all these efforts have been still further diminutions of any contaminants in the effluents flowing from the Donor's plants.

Chromatographic procedures for the determination of phenolic derivatives in waste waters are receiving intensive study. Satisfactory chromatographic qualitative tests have been developed for phenol, several of its alkyl derivatives, and the dihydric phenols. Quantitative procedures are being evolved for the dihydric phenols in certain plant waste waters.

The Fellowship has co-operated with three of the task groups of the American Society for Testing Materials to improve methods of analysis for certain substances which often occur in industrial waste waters. A Member of the Fellowship is Chairman of the ASTM Task Group on Phenolic Compounds. He presented on May 25, 1955, a paper entitled "Applications of Chromatographic Methods for the Determination of Phenols in Industrial Waste Waters", at the luncheon conference of the Plant Waste-Disposal Subcommittee, Operating Section, American Gas Association. The Senior Fellow is a member of committees and subcommittees of five national societies or associations whose activities are directed toward the abatement of air and water pollution. Four additional papers were contributed by the Fellowship at meetings of important national and state technical organizations in the industrial wastes field.

MONOMERS FROM COAL

The Multiple Monomers Fellowship of Koppers Co., Inc., Pittsburgh, Pa., has been studying the preparation and reactions of alkyl-and alkenylaromatics. New olefinic monomers were translated from the laboratory to the pilot plant, and their application in new polymers was tested. Metal complexes of azo dyes were synthesized and evaluated as light-stabilizing agents. Low-temperature crystallization techniques for the purification of organic compounds were developed. Other subjects studied were: the synthesis of 1-phenoxy-ethyl acetate from vinylphenyl ether; the preparation of benzofurans by dehydrocyclization of o-alkylphenols; the isomerization of disubstituted benzenes; the separation of positional isomeric dialkylbenzenes by alkylation-dealkylation; the rate of dehalogenation of methyland dimethylstyrene dibromides; and the catalytic N-alkylation of aniline.

THE UTILIZATION OF ANTHRACITE AND ITS WASTE PRODUCTS

The Anthracite Fellowship, sponsored by the Reading Anthracite Co., Philadelphia, Pa , was established to study methods of utilizing anthracite and the waste products which are produced during its recovery and utilization. In the course of the production of marketable anthracite, a considerable quantity of low-grade fuels which still contain a high percentage of carbon are discarded as refuse. The economical consumption of these materials depends to a large extent upon the value which may be placed on the inorganic mineral content of this refuse. An extensive program is being conducted to determine if the mineral constituents may be recovered by smelting or chemical treatment, and if the ash or refuse, itself, may be used for the manufacture of other valuable products. The Fellowship has investigated the possibility of producing valuable alloys by the electrosmelting of these waste materials, and has been able to develop alloys with unusual characteristics.

The relatively high ash content of fuel-grade anthracite is a deterrent to its use in certain specialized markets where the inorganic constituents might contaminate the final product. Experimental data are being obtained to determine the feasibility of deashing anthracite by chemical methods and to ascertain any structural changes which may occur in the anthracite as a result of such treatment.

SOME ASPECTS OF NATURAL GAS TECHNOLOGY

The Multiple Fellowship (Natural Gas) of The Peoples Natural Gas Co., Pittsburgh, Pa., has virtually completed its study of natural gas odorization, 14 odorizing stations having been designed and placed in operation. Equipment best suited for the purpose has been standardized. One new odorant soon to be produced must be evaluated.

Experimental work with plastic pipe for natural gas usage has been initiated, the smaller sized pipe having been chosen for service lines and 4-in. diameter plastic pipe for field installation. The larger pipe is buried in various types of soil and fill frequently encountered in western Pennsylvania. Approximately one million cubic feet daily of rich natural gas at 20 lb. pressure and at 100°F. is passed through the plastic pipe which has been equipped with various standard fittings, likewise of plastic material. Inspections will be made at intervals of both interior and exterior pipe surfaces.

A broad bibliographic study has been started by the Fellowship on natural gas substitutes, not manufactured primarily at intervals for alleviating peak load requirements from natural gasoline, propane, and butane as at present, but rather from a high-energy source, bituminous coal to be used in continuous production. Adequacy of gas supply ten years from the present dictates such procedure. Of the greatest importance are the cost of such a substitute gas having approximately 900 Btu. per cu. ft., for example, and its interchangeability with natural gas in all proportions. In such future planning, even the use of high-temperature atomic reactors has already received some attention.

BASIC RESEARCH ON THE CARBON BLACK MOLECULE

The Carbon Black Fellowship, maintained by the Columbian Carbon Co., New York, N. Y., is investigating the chemical and physical properties of carbon black in order to gain a better understanding of the fundamental nature of this substance and to extend its uses in the industries.

In order to detect the effect in various applications of small changes in the chemical composition of carbon

black, a reliable practical procedure was developed for its ultimate analysis. The apparatus used for this analytical work was installed later in the research laboratories of the Donor.

Initial studies have involved a series of reactions to determine the effect of various chemical reagents upon active sites on the carbon-black particle surface. The results of such research are expected to yield information on the specific reactions which carbon blacks undergo in their many industrial applications. Data of this type can then be used as a clue to the control required during manufacture to produce carbon blacks for specific applications.

FUNDAMENTAL INVESTIGATIONS IN PETROLEUM CHEMISTRY

The Multiple Fellowship on Petroleum (Gulf Research and development Co., Pittsburgh, Pa.) has been operating continuously for forty-four years at the Mellon Institute. Its research activities are divided into three general types.

During 1955 the organic geochemistry section continued work with increased emphasis on the fundamental aspects of crude oil correlation; in the organic chemistry section, the knowledge gained from a study of the role which the oxides of nitrogen play in the formation of engine deposits provided new insights into the nature of deposit formation in engines, and opened new channels for further research; in the catalysis section, new microcatalytic techniques and equipment were developed and applied successfully to the continuing catalytic research programs; and increased effort was applied, with the co-operation of the Radiation Laboratory of the University of Pittsburgh, to a study of the effects of radiation on petroleum and its fractions.

"TRACTAMOUNT" ROLLER PRODUCTION LINE INAUGURATED

"Roads are the arteries of the nation on which depends the prosperity and future of a country", said Mr. M. M. Naik-Nimbalkar, Minister for Public Works, Government of Bombay, recently while performing the Inauguration Ceremony of the KAMANI-TWOSE 'Tractamount' Roller Production Line at the Works of Kamani Engineering Corporation Ltd. at Kurla. He stated that though the country was lagging behind in the matter of road mileage and communications, it had made great strides after the advent of independence.

Earlier, welcoming the guests who included U.K.Trade Commissioner in Bombay, Mr. D. N. Khurody, Milk Commissioner and other businessmen of Bombay, Mr. P. R. Kamani, Managing Director of Kamani Engineering Corpn., explained in brief the activities of the organisation which included among other import activities, manufacture of non-ferrous metals, transmission towers, zinc oxide, etc.

Major D. T. Brown, Technical Consultant of E. V. Twose Ltd., England, who are collaborating with the company in the manufacture of the 'Tractamount', expressed confidence that the 'Tractamount' would play a decisive role in road construction work in the new India. He also made the announcement that a new type of roller with a weight of 6 to 8 tons was under design in England.

A demonstration of the 'Tractamount' Roller proved to the audience that the procedure of mounting the tractor and preparing the roller for work took less than eight minutes. The 'Tractamount' Roller will convert a standard four-wheeled tractor into a road roller of approximately 3½ to 6 tons. The tractor is reversed up on to the strong frame of the chassis by means of special ramps provided. The tractor's hydraulic lift is used to jack up the tractor so that the rear wheels are clear of the frame. The drive is taken from the tractor by means of heavy duty chains through sprockets bolted to the centres of the two rear wheels. Chain guards are then quickly fitted to both sides. Steering is effected by means of a special steering column placed down by the steering wheel of the tractor.

At present, the manufacturing programme is to produce 12 rollers per month and it is hoped that in about three years' time, 100 rollers would be manufactured per month.

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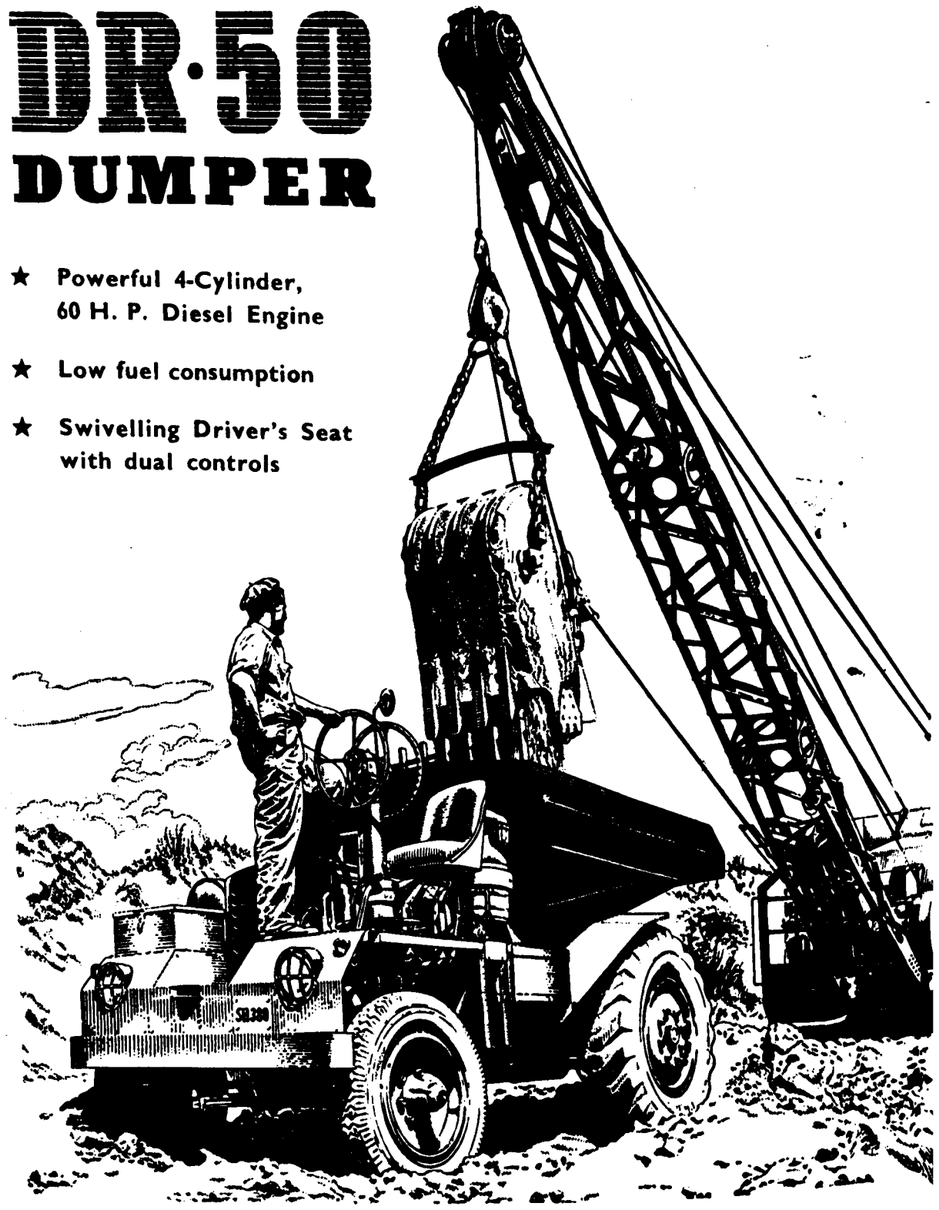

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