metkem

JOURNAL

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The Cover :

Photo shows the Billiter Siemens Electrolytic Plant at the Mettur Chemical & Industrial Corporation, Ltd., Mettur Dam

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IN THIS ISSUE

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The views expressed in METKEM are not necessarily those of the Editorial Board.

July—Oct. 1949. R. PARTHASARATHY, Editor.

Metkem

A JOURNAL DEVOTED TO THE HEAVY CHEMICAL INDUSTRY

DEVALUATION

Editorial—

FOR a little over a month now, the topic to the fore has been devaluation. Indeed, as the dust is slowly settling down, now, it is possible for us to get a clearer picture than in the initial days, following devaluation, when excitement was running high

Why the United Kingdom devalued the pound, not even, why India was obliged to keep in step with other sterling countries, need not detain us here, save for a brief mention. We are more concerned with the repercussions of the measure than with the measure itself. Generally speaking, a country devalues its currency, when there is a serious disequilibrium in its balance of payments. Such a disequilibrium had lately been in evidence in the United Kingdom. A similar trend had also been noticed in India. The purchasing power of the Indian currency had long been out of parity with the dollar, and a remedy was clearly called for.

And devaluation was the remedy. Notwithstanding the fact that it was "just what the doctor ordered," there is such a thing as a person having an o v e r d o s e. It is understandable, therefore, why opinion is not unanimous on whether India did well in agreeing to take so high a dose of devaluation as 30·5 per cent. In any case, the patient has gulped down his medicine, and let us watch his chart.

To discard the metaphor, and to continue in plain language: as the bulk of India's transactions is with sterling area countries, her trade can go on with them, largely un-affected, as ever before, in the past. But it cannot definitely be said that increased demand may not put up prices in those countries. Any rise in the prices of essential capital goods and spares in the sterling area will certainly cramp the style of the Indian industrialist.

Again, there are certain luxury and semi-luxury items, drugs and medicines, which have necessarily to be imported from America.

The internal price situation, too, will require careful watching. In his broadcast, the Prime Minister assured the country that there would not be any rise in the cost of living, but, actually, the prices of certain commodities, particularly, drugs, sharply went up, after devaluation.

If devaluation is to help in boosting export markets, it is necessary to prevent any rise in the price of the goods exported, within the country itself. Again, it is extremely difficult for India, completely to cut her imports from the dollar area, or even to reduce them to any great extent. There will be some relief if India does away with her food imports at least from the dollar countries, in 1950, but whether this will be a feasible preposition is open to serious doubt.

The correct answer to India's problem is to be found in increased industrial production.

And the desiderata for increased industrial production are: (1) Capital (2) Labour and (3) Machinery. Even assuming that capital is there, or will readily be forthcoming, let us see how devaluation affects the other two. Contrary to the Prime Minister's assurance, if living costs go up, some increase in wages, will be inevitable. Again, repairs on plant and machinery have been scamped in the past, and replacements are long over-due. Unless the United States will, therefore, extend to Indian industry, some form of special assistance, devaluation will be hitting us very hard, indeed.

Yet another aspect of the problem is Pakistan's decision not to devalue her currency. The result is a state of undeclared war between India and Pakistan. The fixation of parity at the rate of Rs. 144 (Indian) for Rs. 100 (Pakistan) by the Government of Pakistan has rendered it practically impossible for the Reserve Bank of India to arrange for the purchase and sale of Pakistan rupees. To make confusion worse confounded, Pakistan has suspended the Open General Licence in respect of several articles imported from India, including among other things, *vanaspati* and soaps.

It is rather unfortunate that Pakistan does not yet realise that any serious disequilibrium in the economy of India must have serious repercussions on her economy, too. Quite apart from this, she must remember that India must continue to be her chief customer for jute, for several years to come.

It is to be hoped that wiser counsels will soon prevail in that country, and that it will retrace its step.

Let us also hope that Pandit Nehru's visit to America will result in releasing not only a tremendous amount of goodwill for this country, but, also—some dollars.

Youth And This Chemical Age *

by

V. SESHASAYEE

GENTLEMEN :

I am grateful to you for inviting me to deliver the inaugural address of your Association, this year. What special qualifications I have for this honour, I do not know, and I would rather leave the explaining to your Secretary and others responsible for today's function.

To be candid, gentlemen, I am neither a Chemist, nor an Engineer nor a Technician. But, if an excuse has to be found for the "greatness" that is now being thrust upon me, it is perhaps this: I am a businessman, profoundly interested in technological developments. Without doing much violence to truth and by stretching a point somewhat, I suppose, I can lay claim to being called a Business Technologist.

Be that as it may, I must, once again, mention that I am deeply grateful to you all for this honour and will regard it as but the tribute of Chemistry and Chemical Engineering to Industry. If this function serves to throw into relief the close ties that bind technology and industry, my presence in your midst would have been justified.

CHEMICAL PROGRESS ABROAD

We, in this country, are not the inheritors of a great industrial tradition. But, in Great Britain, where industrial civilization goes back at least to a century and more, the closest liaison has been maintained between chemistry and industry. Sir Humphrey Davy's discovery of the safety lamp is but an off-shoot of his researches into flame and explosion. And a new era might be said to have begun there as elsewhere from the year 1880, when H. B. Dixon came out with his work on the rate of explosion and ignition temperatures of various explosive gases. Not only did chemists in Britain make permanent contributions to our knowledge of inorganic chemistry, but they were, indeed, the founders of the heavy chemical industry. Davy's

*(*Inaugural address to the Association of Technologists, A. C. College of Technology, Madras, on Aug. 22*)

discovery of the alkali and alkaline earth metals, Graham's work on the phosphates, the discovery of thallium by Sir William Crookes — all constitute an impressive record of achievement. The first step towards the fertiliser industry was taken when the discovery was made that the recovery of ammonium salts from ammoniacal liquor was possible. S. B. Lawes who invented superphosphate in 1842 must be regarded as the real founder of the fertiliser industry. All this I mention only to emphasise how close is the bond of friendship between the Chemist and the Industrialist.

From the primeval man to his modern counterpart, two basic needs have always had to be met—namely, food and shelter. As we became a little more civilised, we developed a third need—clothing. But for advance in all three, we have to look to industrial chemistry.

Role of Industrial Chemist

To take up food first: Soil is pre-eminently the medium for the growth of crops, but centuries of cultivation have left it almost totally depleted. Without fertilisers, both organic and inorganic, it is practically impossible to infuse new life into soil, and make good Mother Earth give us of her best. We require fertilisers like bonemeal, superphosphate, ammonium sulphate, compost, green leaves, etc., for increasing agricultural production. Our food depends not merely on fertilisers, but on insecticides, refrigerants and preservatives and it is to the chemist that we have to turn for assistance.

For clothing, again, the principal raw material may be cotton, but without chemicals for cleaning, sizing, bleaching, calendering and other processing, the textile industry will be helpless. If chemicals are required in the processing of natural fibres, artificial fibres like rayon and nylon are wholly chemical. And there are chemical treatments again for making fabrics waterproof, and resistant to shrinkage and creasing.

Again, in the matter of shelter, or housing, cement, lime and steel are among the principal construction materials we need. Once again we have to look to the chemist and the chemical engineer. The preservation of buildings, furniture etc., depends upon paints and finishes, products of the chemist's ingenuity.

Indian Youth—Good Material

In brief, modern civilization is practically inconceivable without the industrial chemist. In a nascent nation such as ours, he has before him wonderful opportunities—not only for bettering his own lot, but for contributing to collective happiness.

Your future, therefore, is reasonably well-assured and there should hardly be any cause for regret regarding the avocation that you have adopted for yourself.

Indeed, ever since 1941 when World War II high-lighted our industrial

back-wardness, the dearth of scientific and technical man-power has been keenly felt. There is an explanation—rather—an excuse for this. In a country whose population is 320 million, the ordinary literacy percentage is hardly 20. Naturally enough, a high proportion of the population, nearly 70 per cent makes, or tries to make a living, from agriculture. Now that colleges like yours are slowly coming into being, the bottleneck of technical personnel is being eliminated. It is really lack of opportunities, I feel, that is at the bottom of this shortage. To give you a personal example: in 1944, some of us went to U S. and U. K. when we set about the business of establishing a fertiliser factory in this part of the country. The foreign experts whom we consulted should have said enough to dampen the enthusiasm of the most ardent of any body of visiting businessmen, and perhaps less intrepid souls than ourselves should have lost heart. Not we, however, gentlemen, because we had faith in you, in the youth of this country. We knew as much by instinct as by experience that in Indian youth we had a wonderfully resilient material that would not only stand up to the roughest wear and tear, but would come up to the highest standards ever achieved anywhere else in the world.

First, the experts said that wood was no substitute for coal for gas production. We said we would take the chance; they, however, preferred to call it "risk".

Then they said that we lacked the technical "know-how" and that we needed an army of technicians and a battery of specialists to put our boys through their paces. We replied gently but firmly that we did not require too many specialists and that our boys could be trusted to run a plant after some training—and in any case they did not require training extending over a period of five to ten years. The experts shook their heads dolefully, but they were wrong for once, for, I am glad to be able to report to you to-day that the fertiliser factory at Alwaye is almost entirely in Indian hands, and capable hands at that. Most complicated processes of chemical engineering have been mastered by our boys in less than half the time that foreign experts thought was the minimum.

So, when it comes to ability or technical competence, our young men are certainly not inferior to those of more advanced countries. But, I fear, however, our men have still one or two things to learn from America and Europe.

Prestige Complex

Many of our boys still suffer from what may only be described as a "prestige complex". They do not like to soil their hands; some of them would not even roll up their sleeves! At the risk of repeating a platitude, may I say that there is really nothing undignified about any kind of work? College education, even specialised technical education, does not confer a sort of general immunity on anyone from doing manual work. Some one defined philosophy as "small print, big words and no readers". Let it not be said of our technical education that it is mostly unpronounceable words, retort-breaking in the laboratories and some drill bits in the workshops! I think, therefore, that our technical graduates must set the new fashion of doing such work as has hitherto been considered *infra dig*. They will then be setting a very fine example, indeed, for men, who may not have had the benefit of a college education.

Another lesson that we should learn from the West is their close devotion to duty. 'The institutions they serve are their own; they should put forth their honest best and they should not for a moment relax until the job on hand was finished'. This is the attitude they adopt in other countries. I think that it will take a few more years for our boys to develop this New Outlook, but as industrialization advances, I am sure, that this will be developed.

NEED FOR RIGOROUS ECONOMY

But in a factory, hard work and technical efficiency alone will not do. We have to look first, second and last to economies in production costs. In a country of such backward economy as India, the importance of this cannot be exaggerated. We are a very poor nation. We cannot afford many things. Our production costs must be the lowest in the world, if we have to survive in this highly competitive age. And it is costs that we are up against, at every turn, first, erection, then, raw materials, transport, service, labour and finally supervision and management. You cannot therefore keep too watchful an eye on your employer's purse.

Talking of economies, I feel that I must refer to a growing evil in this country which if not checked in time is likely to assume unmanageable proportions later on. I refer to the tendency to mass or concentrate as large a number of technical personnel in as few industries as possible. True, the number of industries available in India is by no means large, but it will be a waste of scientific manpower for a high proportion to get itself absorbed only in a few industries. The end in view should always be to produce the maximum results with the minimum number of men. My American friends have often deplored this tendency of some of our industries having more personnel than was really necessary. I leave it to you, gentlemen, to think this out for yourselves. For a factory product to be able to reach the vast masses of India, it is not enough if only the cost of raw materials was low; there should be no waste of manpower. Indeed, it would be a double waste as, for one thing, such power was being engaged in a place where it was perhaps not really necessary; for another, this had to be paid for.

CO-OPERATIVE ENTERPRISE

This naturally raises the question of what these young men should do. Before I touch upon this, I would like to refer to one fundamental issue that all industries have to face—namely, capital. "The life of nations as of individuals" as a writer remarked in a recent article, "is made up of challenges and the fatal thing is to decline them". The challenge to industries comes mostly from capital or lack of it, and our survival largely depends upon our accepting the challenge. What is capital any way? It is accumulated wealth invested in a business for the production of more wealth. In the last analysis, it simply represents savings invested in a business, and in a poor country like India, unless every one of us made a sincere effort, there will hardly be any capital for enterprises, either big or small. The question of Capital striking does not, therefore, arise. It is just a question of more people not saving and more people not coming forward with their savings. You will pardon me when I say that the parrot-like cry for more wages must stop and a real effort should be made to save. Otherwise, our national wealth cannot increase, and it will be preposterous to talk of dispossessing the few "Haves" in the country and sharing in the spoils —for the spoils do not amount to much. As Premier Sri Kumaraswami Raja observed the other day—'it will be just six annas per head'— a sum barely sufficient for a simple breakfast.

FRUITS OF LABOUR

To return to the question of how our young men should engage themselves: I agree that there are not enough industries in the country at present to go round. I think that the answer to this problem lies in a great co-operative experiment. A few young men might band themselves into an association, as they do in America, start on modest beginnings and then gradually consolidate themselves. Initially, only disappointments might have to be faced; but you must remember, that for every single spectacular success recorded there are at least a hundred cases of ignominious failures. Recognition is sure to come, but it often takes time. If a brilliant person is not recognised in the course of, say, ten years, I must say, that he is certainly not brilliant, and something is fundamentally wrong with him. I referred earlier to Indian youth suffering from a prestige complex. It also suffers from a frustration complex. To some extent, as Sri M. Viswesvarayya says, this may be 'because Government seem to rely on untrained non-technical men for important positions requiring technical skill'. This gnawing sense of frustration must go, if we are to achieve any measure of success. Rightly is it said in Baghavad Gita, and I fancy that the gilt has not been rubbed off this line by frequent repetition:

"कर्मण्येव अधिकारस्ते मा फलेषु कदाचन।"

And the poet Longfellow said the same thing when he wrote: 'Learn to labour and to wait'.

POWDER METALLURGY

by

GREGORY J. COMSTOCK

THE Incas had no furnace hot enough to melt platinum—so they discovered a simple way to mould the metal without melting it. Historians say the Egyptians probably used the same trick 5,000 years ago. In 1828 an Englishman named Wollaston copied this ancient process. By working platinum in the form of a fine powder, he began a new technique which to-day is revolutionizing many engineering and production methods. The technique was powder metallurgy—the art of mass-producing precision parts from metallic dust and powder without melting or machining.

The spectacular possibilities of this ancient process were not fully demonstrated until World War II, when metallurgists forced the attention of mass-production industries on the proved advantages of metal powder tool materials. In the United States, 50 years of progress were squeezed into 50 wartime months, and by the end of the war, metal powder technology had invaded many fields of American metal working. The dramatic wartime record of powder metallurgy promises intriguing possibilities for peacetime use of this process. It has already made obsolete many applications of standard metallurgical techniques.

Shaping articles from metallic powder is somewhat like moulding clay, with the addition of great compacting pressure to force the powder into the desired shape. Like clay, the powder is baked after shaping. The process is distinguished from conventional casting by the fact that temperatures are below the melting point.

PROCESS

For normal production, the metal powder is placed in a die at room temperature and subjected to a pressure of 10 to 50 tons per square inch. The "briquets" produced by these extreme pressures have the shape desired in the finished article. They look strong, but at this stage are actually so brittle that they crumble if dropped. The second step is sintering—baking at below-melting-point temperature. In some manner, not yet fully understood, sintering bonds the powder particles together without fusion and adds great strength to the briquet.

The shaped compacts are sintered in an oxygen-free atmosphere for one-half to one hour at a temperature well below their melting point. After cooling for a brief period the products are strong, durable, and ready for hard use. Iron powder briquets are sintered at about 2,000 degrees Fahrenheit. (Iron melts at 2,786 degrees.) Iron compacts so treated become stronger than cast iron, though not so strong as steel. For most purposes only two steps are necessary—pressing and sintering. Sometimes sintering is followed by another compression, either hot or cold, to improve finish, tolerance, or strength. Some complex shapes require a small amount of machine finishing before use.

VERSATILITY

Powder metallurgy is especially advantageous for working metals with melting points too high to be reached by ordinary melting and casting techniques. Production of tungsten filaments, one of the first practical applications of powder metallurgy in the United States, is an example. Metals which cannot be alloyed can be combined as powder mixtures. This method is used to make electrical contacts combining highly conductive soft metals like copper and silver with less conductive hard materials such as tungsten, molybdenum, or nickel for strength and non-fusing properties.

Inclusion of non-metals in metal articles to obtain unusual properties is another example of powder metallurgy's versatility. In making electrical brushes, for instance, copper powder is used in combination with graphite in order to add permanent self-lubricating properties to the brushes. Improved drill bits are prepared by embedding diamonds in a sintered powder metal structure. Alloy metal powders and plastics are combined to form a grinding wheel of high strength and heat conductively on the surface of which a diamond-impregnated rim can be attached. Tungsten carbide and cobalt powders mixed, pressed, and sintered, form a strong structure of hard tungsten carbide particles in a softer matrix of cobalt alloy binder.

Certain products that are impossible to fabricate by any other means can be prepared by powder metallurgy. Oil-impregnated bearings of controlled porosity are compacted from a mixture of copper, tin, and graphite, *plus* volatile materials, all in controlled percentages and of controlled particle size. The final sintered bearings, impregnated with oil, contain a reservoir of lubricant which normally lasts as long as the machine in which the bearing is used. Porous filters prepared from metal powders have higher corrosion resistance and mechanical strength than conventional filters.

Iron powder in the form of individually insulated particles is used in small high-frequency radio and telephone cores to cut down eddy current losses experienced with solid metal cores. This permits much smaller apparatus and makes feasible equipment which was formerly too bulky. The small size of the "Walkie Talkie" was possible principally as a result of powder metallurgy.

WIDE POPULARITY

In general, powder metallurgy has shown that in many cases it may:—

(1) Replace a present part by an equal or better part made at lower cost.

(2) Produce an irregular shape difficult or impossible to make by ordinary machining methods.

(3) Incorporate self-lubrication in a part and extend its life.

(4) Save costly or scarce materials by replacing them with others and

(5) Release machines and skilled labour for other tasks.

Practically every metal and many alloys are now available commercially in powdered form, some of them as fine as face powder. Metallic powders can be made by any of several processes. However, the properties and suitability of a metal for powder metallurgical uses vary according to the process used to make the powder.

To-day, this youngest branch of the metallurgical industry is mass-producing millions of parts that cannot be made as economically by the usual methods of melting, forging, and machining. Hundreds of American engineers are turning to powder metal parts for superior performance. Production engineers are adopting powder metal units to save time and materials. Gears, cams, ratchets, door locks, levers, splined parts, zipper die moulds, trigger components, commutator rings, brake drums, and oil impregnated bearings found in many industrial and household appliances are typical articles now being pressed into shape from powder. A modern automobile contains dozens of parts made by this method.

The process is used principally for small parts that need extensive machining when made from bar stock or castings. Continuous automatic machines can press out such parts at the rate of 20 to 500 per minute. Parts made of iron powder alone are consuming between 5 and 7 tons of metal each day in the United States. Although a recent survey indicated that 40 to 50 tons per day will be required soon, America's domestic iron powder production capacity is now only 18 to 20 tons per day.

LIMITATIONS

Powder metallurgy has definite limitations. Parts having undercut sections cannot be compacted with existing presses. Articles must be so shaped that they can be ejected from the dies. In many cases a small amount of machine finishing is unavoidable. However, many restrictions caused by materials and sintering equipment are being overcome by research. New presses, new powders, and new processes are becoming available.

Recognizing the need for continued and broadened study, the Industrial Research and Development Division of the Office of Techincal Services recently granted a research contract to the Stevens Institute of Technology in New Jersey, covering special studies to be undertaken in the Institute's powder metallurgy laboratory. The contract was made possible by an authorization for the United States Department of Commerce to provide technical assistance to industry. A group of industrialists have joined an advisory committee to help guide the Stevens investigations. Basing its work on wartime research, the Stevens programme seeks to extend the applications of powder metal technology. A primary object is to increase the quality and lower the cost of articles made from various powders.

An important recent development is the production of alloy powders by breaking down a molten alloy stream with a high-speed jet of liquid. The result is an alloy powder of controlled particle size, suitable for use in powder metallurgy. Pre-alloyed powders made by mechanical methods have generally been too expensive for large-scale use. Larger and more complex pressing equipment is being designed to make larger compacts with more irregular contours.

SUPPLEMENTARY AID

One of the most recent applications of powder metallurgy is the preparation of parts for jet turbines. The majority of metals heat-resistant enough to stand the terrific working temperatures of these machines cannot be forged or machined into the complex shapes needed for turbine buckets. But these alloys can be powdered and finish-formed into the requisite shapes.

Powder metallurgy will not solve all metallurgical problems. It does not supplant conventional methods; rather, it supplements them. It is an important new way to work metals and is specially suited for certain types of products. Many articles impossible to manufacture profitably by other methods may now become plentiful through powder metallurgy.

—FEDERAL SCIENCE PROGRESS

Electrolytic Caustic Soda-Chlorine production:

MERCURY *Vs.* DIAPHRAGM CELLS

by

A. R. NARASIMHAN

INDIA'S requirements of caustic soda at the present time are estimated at 75000 tons a year. Indian installed capacity for electrolytic caustic soda production is, however, only 15,600 tons with a corresponding output of 13 800 tons of chlorine. Actual production has not exceeded 4,400 tons per annum. Except for one installation of the mercury type of electrolyser cells, all the other installations are of the diaphragm type. Capacity also exists for the production of caustic soda by the causticisation of soda ash, but production by this method is rather limited on account of the high cost of soda ash.

Several Uses

The development of the electrolytic caustic soda-chlorine industry has been slow, principally because of the lack of an immediate outlet for chlorine. An increase in the demand for chlorine in the days to come can, however, be safely forecast, having regard to the potential uses to which this versatile chemical can be put—in addition to its increased use as bleaching powder for water purification, public health and sanitation. It has to be admitted that fundamental, preventive hygiene and public health measures have grossly been neglected in this country, in the past, but our present Government are committed to a policy of providing facilities calculated to prevent the occurrence and recurrence of all avoidable epidemics. The development of the organic chemical industry will, therefore, provide a large-scale outlet for the consumption of chlorine. India is, at present, solely dependent on imports for such indispensable requirements as insecticides, solvents, plastics, dye-stuffs and dye-stuff intermediates, in all of which chlorine is an important constituent.

Electrolytic caustic soda, as produced by the diaphragm cell method, may be satisfactory enough for most industrial applications, but it will not do—that

is, it must be of much higher purity, for purposes of rayon manufacture. For the sake of comparison, specifications of both rayon grade caustic and diaphragm cell caustic are given below :—

	Rayon grade Caustic.	Caustic Soda Commercial
NaOH	99·54 per cent	93-94 per cent
Na_2CO_3	0·31 ,,	2·25 ,,
NaCl	0·01 ,,	2·2 ,,
Na_2SO_4	0·013 ,,	—
SiO_2	0·006 ,,	—
Fe_2O_3	0·013 ,,	0·1 ,,
Al_2O_3	0·001 ,,	—

It will be clear from this table of comparison that most rigid standards have been set for caustic soda for its acceptance by rayon manufacturers, and that, for caustic soda obtained from diaphragm cells or by the causticisation method to be acceptable to such manufacturers, it has to undergo a further purification "ceremony."

The following are the usual purification processes :—

1. Crystallisation as hydrate by refrigeration.
2. Dialysis.
3. Triple salt method.
4. Ammonia method.

It must be noted, here, that to produce caustic soda of the necessary purity at a price level, that would be considered economical enough for rayon manufacture, a diaphragm cell of at least 50 tons daily capacity is required. Actually, however, no diaphragm cell unit, at present, in operation, in India, has a daily capacity exceeding 10 tons.

India's annual requirements of caustic soda mentioned earlier do not include those of the Rayon Industry. Rayon factories are springing up all over the country, and the need for high grade caustic soda is bound to arise in the near future. Mercury cell installations, which straightway produce caustic soda of the rayon grade, present, therefore, the correct answer to the prayers of rayon manufacturers.

Mercury *Vs.* Diaphragm Cell

Let us now proceed to consider the two processes. The comparison established here is between processes, each having a daily capacity of 20 tons of caustic soda.

Flow sheets of both processes are given on page 21.

Both processes utilise solid salt. The diaphragm cell operation can utilise brine obtained, as such, from wells, but this is of little help to a country whose salt is obtained by solar evaporation. The mercury cell operation can, however, use only solid salt, as the unelectrolysed brine returned from the cell is at 280 g. p. l. whereas the brine feed is at 305 g. p. l., and the return brine has to be resaturated only with solid salt.

In the case of diaphragm cells, starting with saturated brine, the unelectrolysed salt, after passage through the cells is reclaimed as solid salt from the caustic evaporators, this quantity representing about 50 per cent of the sodium chloride fed into the cell. The reclaimed salt is used together with fresh supplies of raw salt for further batches of brine.

In the case of the mercury cells, however, only 15 per cent of the sodium chloride content of the salt is used up in electrolysis, the return brine retaining the balance of 85 per cent. This is resaturated with salt. As a lesser percentage of sodium chloride in the brine is converted into caustic soda in the mercury cell process than in the diaphragm cell process, larger volumes of brine have to be handled in mercury cells to achieve the same amount of caustic soda production. As the chlorine in the mercury cell rises through brine, the return brine is found to be saturated with chlorine. This brine has, therefore, to be dechlorinated—which means the use of equipment and necessary pipe-line with rubber or ebonite, to prevent corrosion. It will be appreciated that all this will add up to production costs.

The purity of brine for the two processes is somewhat different. In diapharagm cells, complete removal of calcium and magnesium is essential to prevent the plugging of the pores of the diaphragm. Sulphate can be tolerated up to 8 to 9 g. p. l. in diaphragm cells, although it is good to keep this, even lower, in order to keep down graphite consumption. Some means of purging the sulphate from the system is always available to keep down the sulphate content during a continuous operation cycle.

In the mercury cell process, Ca. as calcium chloride is not highly objectionable, and can be tolerated up to 0·2 to 0·3 g. p. l. Ca., although Ca. present as calcium sulphate is objectionable. Magnesium impurity is specially deleterious. The complete removal of iron oxide, alumina and magnesium is essential, because these metals plate out in the amalgam with mercury butter formation. This involves considerable loss of mercury in the process which puts up operating costs. Also, the allowable sulphate concentration is very low for good operation of mercury cells, and should not be more than 1 to 1·5 g. p. l. Purging or removal of sulphate by precipitation is an absolute necessity. Unlike in diaphragm cells operation, it is not possible to purge the sulphate, in mercury cells, by washing. The only method of removal of the sulphate, here, is by the use of barium carbonate or barium chloride — particularly costly chemicals. Sulphate removal of barium compounds is an absolute necessity, not only to keep down the electrode consumption, but also to prevent the dangerous concentrations of hydrogen and chlorine which might result from excessive disintegration of electrodes. Due to the higher standards of purity of brine demanded by mercury cells, the brine

handling and purification equipment of these is somewhat more complicated and naturally more expensive.

Electrolysis

The one important difference between the two types of cells is that mercury cells are bigger units, and require a larger floor space. It is usual to mount mercury cells on a second floor, which adds to the over-all height of the building. Further, it is necessary to line the mercury cell units with rubber or ebonite to resist the action of both chlorinated brine and moist chlorine. Also, additional equipment, such as a pump unit, for circulating the mercury in each cell, is required. All this, *plus* mercury, which is an expensive material, adds to the capital cost of the mercury cell plant.

Labour requirements for operating both mercury and diaphragm cells are more or less the same. It would, however, be necessary to bestow constant attention on mercury cells to ensure that the circulating mercury is pure, that all the surface impurities are skimmed out and that the anodes are adjusted or replaced properly.

Power consumption per ton of product in a mercury cell is greater than in a diaphragm cell. The voltage per cell will run approximately half-a-volt higher. Against this, the mercury cell has the advantags of producing caustic soda of 50 per cent concentration straight at the cell end.

In the case of diaphragm cells, the caustic soda liquor from the cells usually contains 12 to 13 per cent caustic and 14 to 15 per cent undecomposed salt. Consequently, this salt must be evaporated to 50 per cent strength. During the process of concentration, the undecomposed salt is recovered and re-used in the process. The recovered salt must also be purged of the sulphate and properly washed in order to minimise the carry-over of caustic. Such evaporation needs large quantities of steam. It is 9 to 10,000 lbs. steam per ton caustic as against less than 1,000 per ton for mercury cells. So, the diaphragm cell plant usually involves additional investment in caustic evaporators, steam plant, etc.

Chlorine from the mercury cells is generally contaminated with a certain percentage of hydrogen. This has to be carefully watched.

Roughly, 3,700 kWH. are required per ton of caustic soda in the case of mercury cells, as against 3,150 kWH. per ton in the case of diaphragm cells. If production is to be economical, cheap, hydro-electric power is necessary. Considering the fact that a fairly sufficient supply of hydro-electric power is available in our country, it should be possible for us to go in for mercury installations.

CAPITAL COSTS

The following table gives comparative costs for the two processes :—

Item	Mercury Cell	Diaphragm Cell
1. Brine handling including building	Rs. 14,00,000	Rs. 3,00,000
2. Cell plant inclusive of building	„ 15,00,000	„ 10,00,000
3. Mercury	„ 4,00,000	..
4. Caustic evaporators inclusive of storage ..		„ 12,00,000
5. Steam and Water ..		„ 4,00,000
6. Mercury arc rectifier	„ 4,00,000	„ 4,00,000
	Rs. 37,00,000	Rs. 33,00,000

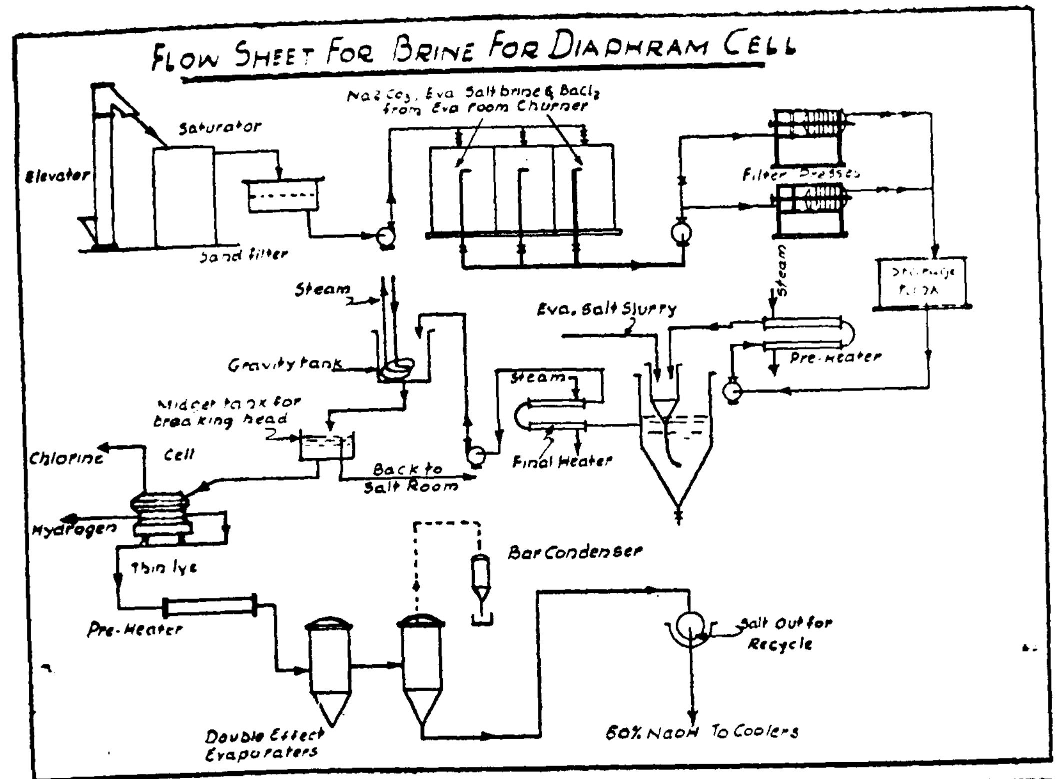
Although the addition of mercury in the mercury cell process makes a difference of Rs. 4,00,000 in capital investment, it is offset by the several advantages mercury cells have over diaphragm cells.

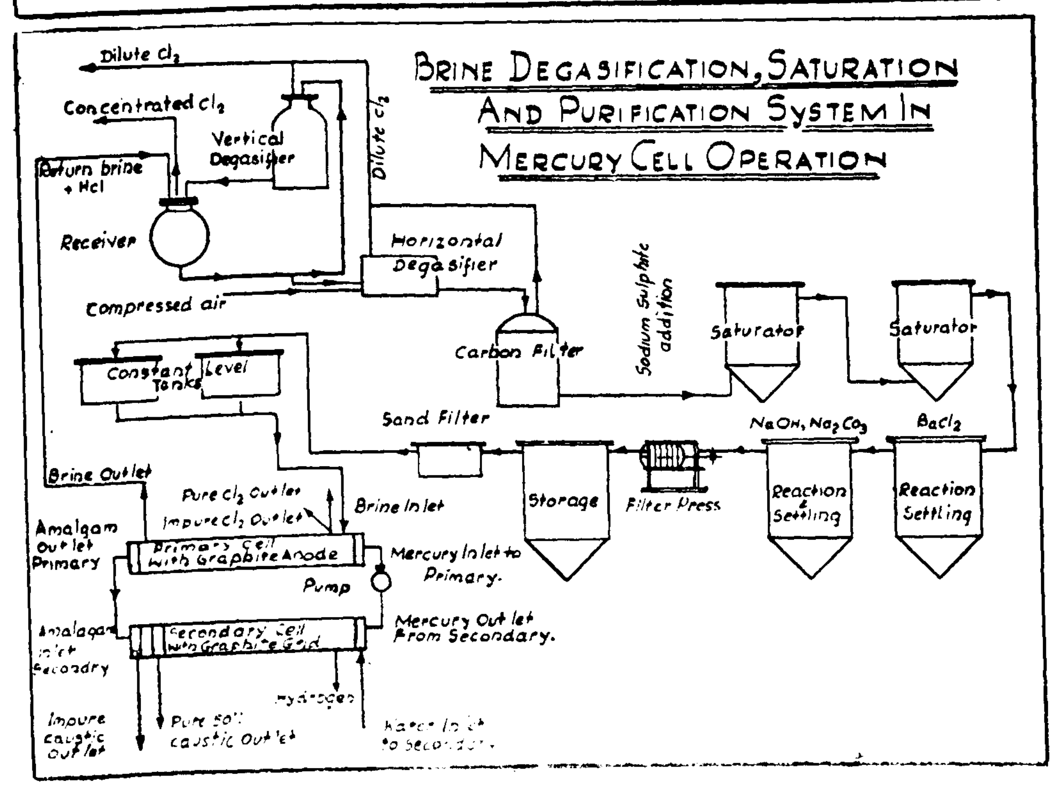
Briefly, these are :—

1. The caustic soda produced is of the highest quality.
2. Pure 50 per cent caustic potash can be produced approximately under the same conditions.
3. By the electrolysis of the sodium amalgam in another cell, metallic sodium can be produced instead of caustic soda.
4. Pure 60 per cent sodium sulphide can be produced in the secondary cell with a few alterations.
5. Sodium alcoholate is another product which can be made from the sodium amalgam by reaction with alcohol. (Sodium alcoholate is widely used in organic synthesis.)
6. Sodium hyposulphite can be manufactured from the sodium amalgam by the reaction of sulphur dioxide.
7. Hydrogen peroxide, azobenzene, hydroxylamine and a number of organic reductions are possible by the use of sodium amalgam.

It seems to this writer that in view of the fact (1) that this country will soon be having a number of rayon units, and (2) that even now there is an enormous gap between caustic soda production and demand we would do well to launch on the manufacture of mercury cell caustic soda. This would enable us to meet the growing demands of rayon manufacturers, who, otherwise, would have to be dependent on foreign imports.

Messrs. Seshasayee Brothers who have considerable experience behind them in the manufacture of electrolytic caustic soda have now on hand a major scheme for the production of 20 tons/day rayon grade caustic soda by the mercury cell process. A good deal of the equipment has already arrived in this country, and it is expected that in the not too distant future this plant will go into production, adding substantially to existing manufacturing capacity.





Magazine Digest

MR. R. L. Murray, executive Vice-President of the Hooker Electro-Chemical Company, Niagara Falls, New York, is the 1949 recipient of Jacob A. Schoellkopf Medal of the American Chemical Society's Western New York Station. (The new extensions to our caustic chlorine plant, now in progress—it may be stated here—will be with Hooker S Type cells for which the Hooker Electro-chemical Co. have licensed us.) In receiving the award Mr. Murray predicted the continuing growth of the S. 600-million-chlorine-alkali industry, which, some consider, to have expanded, out of all proportion, during the war.

Current estimates forecast that the chlorine output of the U. S A. will be more than 60 per cent of the world total for 1949, said Mr. Murray, and added that further expansion must result, should the tremendous amount of research now going on in this field, continue.

One outstanding disadvantage of the diaphragm electrolytic cells, from which most of the chlorine and caustic soda in the U. S. A. is obtained, is that the caustic, or alkali, is contaminated with salt and must be purified at relatively high expense, Mr. Murray pointed out. Only the purest alkali could be employed in making rayon, one of the major uses for caustic soda.

"Looking into the future," he continued, "it will not be surprising to see diaphragm cells so developed that will allow a higher percentage decomposition of the brine fed into the cells, permitting a much higher percentage alkali in the cathode liquor, and possibly even rayon-grade caustic soda directly from the cells."

"It is a certainty that cells will be developed having higher and higher amperage ratings. A vertical mercury cell very economical of floor space is a future possibility. Contact or mechanical rectifiers capable of high efficiency even at low voltages, which were in limited use in Germany during the war, are now being made in the U. S. A. and should have a widespread use. The economic recovery of cholorine from by-product hydrochloric acid by an improved and modernised Deacon process is a definite necessity and entirely within the realms of possibility."

* * *

New South African Plant for Salt : Mr. O. Vrany, the Czechoslovakian Chemist, (who served the Indian Government during the war years and worked in

the METTUR CHEMICAL AND INDUSTRIAL CORPORATION for sometime) has set up a factory four miles north of Saldanha Bay, designed to produce 100,000 tons of different grades of salt, 36,000 tons of magnesium, 700 tons of potassium and 200 tons of bromide. Part of the plant is laid out in terraced pans where the sea-water is evaporated. The water is pumped through pipes, laid under the breakers, 300 feet from the shore, and is then distributed through canals to the pans, where a controlled flow maintains a depth of 6 inches. Machinery is being imported from the U. S. A. to convert the magnesium hydroxide into pure magnesium. Altogether £ 100,000-worth of building is in progress, including an electricity power plant. The salt produced will be used as food, and in the manufacture of alkalis, glass, soap, plastics, paper, textiles, paint, chlorine, soda ash and other chemicals.

—THE CHEMICAL AGE.

* * *

Alkali Chlorine Market in the U.S.A.: The United States production capacity for chlorine is estimated at over 5,100 tons per day and is still expanding. More and more chlorine is demanded for ethylene glycol and ethylene oxide, bromine, titanium pigments and metal, solvents and tetraethyl. Chlorine demand now exceeds that for its co-product, caustic soda. About six per cent of to-day's production is already being achieved without concurrent production of caustic—by separation of metallic sodium by electrolysis of molten salt and the action of nitric acid on salt. Investigation of other methods of producing chlorine without caustic is making progress. Particularly in the South West which produces an estimated 1300 tons of chlorine per day, and where production is still expanding, it is anticipated efforts will be made to move caustic to other parts of the country or overseas.

—CHEMICAL INDUSTRIES.

* * *

Fertilized Ponds Increase Fish Supply: The world's supply of fresh-water fish can be greatly increased by putting fertilizer in ponds, declares a report in INDUSTRIAL AND ENGINEERING CHEMISTRY.

"By fertilization, the catch from a one-acre pond can be increased from 40 to 50 pounds a year to more than 209, and the rate of growth of the fish increases dramatically," the report says.

The fish do not consume the fertilizer directly, it is explained, but they derive the benefits of increased growth of plankton, the tiny aquatic plants which are their major source of food.

In tests conducted by Earl F. Kannamer of the Alabama Polytechnic Institute, Auburn, Alabama, a large number of bluegill bream spawned at the same time were divided into two groups and placed in combination with bass in fertilized and unfertilized ponds when about one month old. The rate of stocking was about 1,500 bluegills an acre.

A year later the fish from the fertilized pond weighed 4 to 6 ounces, "quite a respectable keeper size for this small pan fish," it was reported, whereas fish from the unfertilized pond weighed only about one ounce.

The fertilizer, a mixture of 2 parts of nitrogen, 2 of phosphorus, and 1 of potassium, is added 6 to 12 times a year, the report states, pointing out that fertilizer costs run from $ 12 to $ 25 a year for the usual breeding pond.

Mineral fertilizers have proved best as stable manure causes scum formation, which hampers fishing and makes the pond unsuitable for swimming or boating.

"Fertilizer treatment is started in the spring after the period of heavy rains," the report continues. "Applications are repeated at intervals of 2 to 4 weeks until the water becomes green or greenish-brown. After that, fertilizer is added only when the colour diminishes enough for objects to be seen in water one foot deep."

their livelihood, she does not; hers is just a labour of love.

BONNIE BABIES born at the Centre.

The centre was started in July 1947, and has handled so far a little over 200 indoor cases, in addition to 4000 outdoor cases. To start with, it had only one nurse and one *ayah*, but as its needs grew, its staff strength was doubled.

The members of the Mettur Cultural Association defray its running expenses by recurring monthly contributions of a voluntary kind.

The centre is housed at present—well, let us not mention it—and its greatest need is a permanent building. A sum of about Rs. 25,000 is required to accomplish this laudable object; we have been able to raise, so far, only a small fraction of this amount. Will all public-spirited citizens and institutions come forward to help a worthy cause? Donations however small may be sent to the Secretary, Cultural Association, Mettur Dam R. S., and will gratefully be acknowled by him.

THANK YOU, C. S. S -- While on the subject of babies, births and maternity centres, we should like to recall here

C. S. SRINIVASAN

what Alexander Pope, the Augustan poet, said of himself:

> *While still a child, nor yet a fool to fame,*
> *I lisped in numbers, for the numbers came.*

Similarly, is it with C. S. Srinivasan, the retiring editor of METKEM who lays down office, in this particular capacity, after a year and more of gruelling work. Srinivasan was born—apparently—with

printer's ink in his veins! Even as a freshman at St. Joseph's he wrote regularly for the College Mag. Again, at Loyola, he was on the editorial staff of *Loho News*, a monthly bulletin issued by the College Hostel, purporting to hold the mirror up to (under-graduate-) Nature! So when METKEM was born, MCIC had its job cut out for it; it did not have to send its talent scouts, scouring the ends of the earth. Srinivasan was available right on the spot, and a few discerning friends promptly slipped the editorial mantle on his able shoulders.

On his splendid record of achievement Srinivasan can certainly look back with pride, but as he is one of those shrinking modest violets, we shall have to do it for him!

Short, shy and smiling, Srinivasan has two hobbies which he relentlessly pursues—photography and reading.

Happily, he continues to be a Member of the Editorial Board, and by his inclusion, this journal is going to profit immeasurably.

Here's to him wishing him the best of it!

GOOD LUCK, RADHU—Yet, another recipient of our good wishes, this quarter, is young Radhakrishnan, the eldest son of Mr. K. K. Raman. Radhu, as he is affectionately known to his intimates, emplaned from Bombay for Montreal, on Sept. 17 for further studies in Chemical

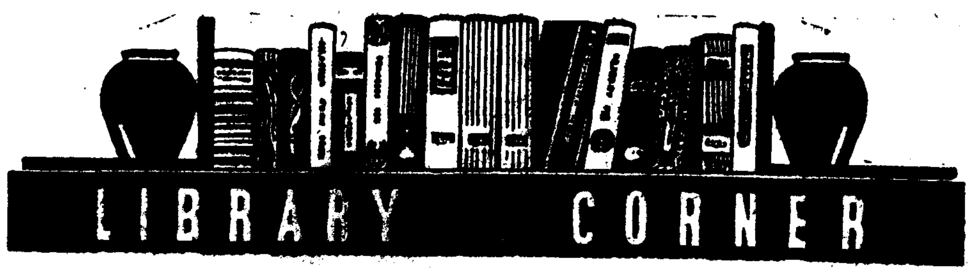
R. RADHAKRISHNAN

Engineering at the McGill University. A brilliant graduate of the University of Madras, R. Radhakrishnan was doing his Chemical Engineering at the A. C. College of Technology, Madras, when this Canadian call came.

At the farewell party got up on the eve of his departure by the staff of MCIC, Tiruchi, on Sept. 10, several speakers, including Mr. Fred Alberts, Mr. G. Ganesan and Mr. M. S. Subramaniam wished Radhu *bon voyage* and good luck.

And on this happy note we shall now close.

—R. P.



INDIA'S BASIC INDUSTRIES: By P. J. Thomas, Economic Adviser, Government of India, Finance Ministry. (Oriental Longmans Ltd., Price Rs. 16/-).

AS Economic Adviser to the Finance Ministry of the Government of India and a former Professor of Economics of the University of Madras, Dr. P. J. Thomas is an acknowledged authority on the subject of Industrial Statistics. And his present book is chiefly a compilation of statistics, relating to the various basic industries of India.

Divided into seven parts, the book covers several industries including those relating to our power and raw material resources. Brief descriptions of industrial processes, labour required, production costs, market facilities, and future demands of each industry are given.

The book rightly ends with a chapter on the need for scientific and industrial research. Existing institutions like the Indian Institute of Science, the Institute of Food Technology, Electro-chemical Institute, etc., are all briefly touched. Stressing the importance of research in the industrial development of the country and the need for the establishment of first-class technological institutions like the M. I. T., the author puts forward a forceful plea for increased effort in these directions, both by Government and by Industry.

As the book is liberally interspersed with authentic statistics of the various industries, it should prove to be particularly useful to industrialists and economists, who are interested or engaged in the task of planning industrial production.

Notwithstanding the fact that it is a 1948-publication, its statistics end up generally with 1944. To that little extent, the statistics are out of date. This criticism applies in particular to the three chapters on "Power Resources" dealt with, in Part C. The production of power has vastly increased since the year 1944, and new projects, to meet India's growing demands, are making rapid headway in different parts of the country.

The chapters on "Mineral Industries" (Part B) distressingly disclose two salient facts: (1) vast territories in India remain *undiscovered* yet, and (2) the few minerals that have been located are not being exploited to the best advantage of the country.

Vast resources of bauxite, mica and lignite have been known to exist in this country. Aluminium is vital to India's economy; lignite will not only help us eke out our power resources in coal, but will also provide the basic materials for a vast chemical industry, in the production of aromatics and dye-stuffs.

Mica, of which India probably holds a world monopoly, is at present exported raw to countries like England and America, where they are processed and used in the manufacture of electrical machinery. We could, certainly, increase our dollar earnings by manufacturing the mica to the stage required by the Industry.

There is vast scope for much 'development work' to be done by the Geological Survey of India, and it is gratifying to note that the Department is already on the job.

The Wyanads in the Nilgiris have been known to have deposits of auriferous pyrites, various types of clays, useful for paints and potteries. It should indeed prove to be a great boon to South India if all this wealth could be wooed and won, at no great expense. The difficulties of working in the Wynads at present appear to be the rather heavy monsoon, difficult road communications and inadequate work on development. But these are certainly not insurmountable difficulties, as examples of countries in the West would go to show—where minerals are won under even more difficult conditions.

Got up neatly and edited well, this is an extremely useful publication, and must be in the hands of any industrialist or economist who has industrialisation plans up his sleeve.

—H. K. RAMASWAMI.

RAW MATERIALS FROM THE SEA: By Edward Frankland Armstrong, F. R. S. and L Mackenzie Miall, B. A., (Constructive Publications, Limited, 152, Upper Walk, Licester, England: Price 15 sh. or Rs. 12/8/-).

A useful method for assessing the industrial advancement of a country will be to examine the extent to which it is using up its mineral wealth. The sea provides one of the richest sources of some of our materials. Occupying roughly three quarters of the earth's surface, its resources are vast, limitless, inexhaustible.

There are 300 million cubic miles of sea, and each cubic mile of it contains on the average, 166 tons of dissolved salts—of which industrially important sodium chloride, magnesium chloride, magnesium sulphate, calcium sulphate and potassium sulphate are of the order of 128, 18, 8, 6 and 4 million tons.

The authors describe, here, in detail, the recovery of all these chemicals. Besides, they furnish brief but adequate notes on such scarcer constituents as aluminium, arsenic, boron, copper, gold silver, iron, manganese, phosphorus, vanadium and zinc.

They also give details of the various manufacturing methods of salt as are, at present, followed, in the United States, West Indies, India and South Africa.

How in countries like Great Britain and Poland salt is mined from large deposits resulting from the drying-up process of inland seas, during past geological ages, and how in countries having an extremely cold climate like Sweden and the U. S. S. R. it is obtained from frozen sea-water are all interestingly told in the book.

We learn further that from the brine wells in the plains of Cutch at Kharagoda, bromine can be recovered from the bitterns. The Dow Chemical Co., in the United States, treat the bromine, with chlorine to liberate the bromine, blow it out of solution with air, and absorb it in alkali. It is also obtained direct from sea-water by the precipitation of bromine on the insoluble tribromoanilne, reagents required being sulphuric acid, chlorine, and aniline sulphate.

The authors, also, devote some space to the recovery of magnesium as magnesium hydroxide from sea-water by the addition of lime to the bitterns. This magnesium hydroxide is consumed in America as " Milk of Magnesia " at the astounding rate of 15,000 gallons a day. It could also be converted into magnesium metal, which, with other metals as alloys, finds great use in the aircraft industry—because of its inherent lightness and strength.

A description of the general nature of sea-weeds and the process of recovering iodine from them constitute one of the fascinating chapters of this book.

Potassium salts are very good fertilizers and the precipitation method of recovering these by the addition of organic reagents such as dipicrylamine and hexanitrodiphenylamine deserves careful study, especially as the recovery of the reagent for each operation is said to be high and the cost of precipitation of the reagent, on a commercial scale, must, necessarily, be low.

The chapter on " Potable water from sea-water " makes particular reference to the method of using in turn both base and acid exchanging reagents such as zeolites and resins, for converting ordinary hard water, into something like distilled water.

In the concluding chapter, the authors ably marshall the details of analytical methods for the various ingredients of sea-water.

This book, on the whole, provides interesting reading, and is a welcome addition to the literature already on the subject.

M. PADMANABAN.

CHEMICAL BRIEFS

Caustic Chlorine Industry in India :— A deputation consisting of representatives of I. C. M. A. recently met the Commerce Minister of the Govt. of India to urge on him the necessity for opening a Central pool of all imported and Indian manufactured caustic soda and soda ash. The need for regulating imports by placing a ceiling on quantities in such a manner as, at no time, will the country carry excessive stocks was emphasised at the meeting. The O. G. L. policy previously pursued, it was pointed out to the Hon'ble Minister, had resulted in a drain of the country's scarce hard currency resources.

As the principle of protection to the Caustic Soda-Bleaching Powder Industry had been conceded only after the most careful enquiry and as detailed investigations on application for protection must necessarily take time, it was urged by the deputationists that early steps be taken to prevent the recurrence of conditions that recently unsettled the indigenous industry.

The Minister promised careful consideration of the representation made to him.

Cheaper Synthetic Gasoline :— A significant reduction in the cost of the synthetic gasoline and oil now being produced experimentally from coal is promised by new refinements in processing techniques, revealed Dr. Henry H. Storch, Chief of the Research and Development Branch of the office of Liquid Synthetic Fuels, United States Bureau of Mines, Bruceton, Pennsylvania, at a meeting at which he received the 1948 Pittsburgh Award of the American Chemical Society's Pittsburg Section.

Although no commercial quantities of gasoline or light oil have been made from coal, Dr. Storch said that the Bureau of Mines had made definite progress in a comprehensive study of coal and its chemistry, aimed at finding the most efficient process for combining hydrogen with carbon in coal, to form liquid fuels A combination of several procedures currently being developed "may result in a much cheaper process."

"In the Bruceton Laboratories, a basically new approach to the problem of synthetic liquid fuel production by direct hydrogenation of coal is under investigation" Dr. Storch reported.

The new method is a departure from the conventional Bergius process utilized by the Germans. In the Bergius process, coal dust is mixed with oil to form a paste, which is then treated with hot hydrogen under a pressure of more than 2,000 pounds per square inch.

D. D. T's. German Cousin:-A German born cousin of D. D. T. has proved a more potent weapon than its famous relative against house flies and other flying insects, it was stated, at the Fourth Annual Southwest Regional Meeting of the American Chemical Society.

The compound, called DFDT, is reported to be less poisonous than DDT to warm-blooded animals and fish. A low-melting, white solid with a faint odour resembling that of ripe apples, DFDT is known to chemists as Di-Fluoro-Diphenyl-Trichloro-ethane. It was widely used as an insecticide by the Germans during World War II, but up to now has received little attention elsewhere.

It is gathered that DFDT does not possess the broad killing power of DDT towards all insects, but it has a greater knock-down power against flying insects, especially house flies.

Microbes drafted to fight starvation: Carl S. Miner, Founder and Director of the Miner Laboratories, Chicago, recently revealed that microbes can make a major contribution to the world's food supply, by converting wood waste and other inedible materials into animal feed, and thus freeing vast quantities of grain —for human consumption.

Better insecticides and weed killers, more bountiful strains of food plants, and more effective protection of stored food are among the other scientific achievements which Mr. Miner predicted, will prove potent weapons in mankind's battle for survival in a world of expanding populations and diminishing natural resources.

Scientists in the United States and abroad have shown that ammonia salts or urea can be fed to cows and other ruminants in amounts equivalent to about one third of their normal protein rations, and that bacteria in the animals' digestive systems can transform such nitrogen compounds into protein which the animals can use to build body tissue, Mr. Miner reported.

The use of ammonia and its derivatives as protein substitutes for farm animals is no longer a laboratory experiment, Mr. Miner emphasized. More than 2,000,000 tons of urea-containing feeds have already been fed to livestock in place of some of their ordinary plant protein feeds, such as cotton-seed meal, soyabeans, and—alfalfa.

" When we realize that one of the serious world shortages is of protein and that here is a potential substitute for one third of the protein now fed to ruminants and that, in the last analysis,

it can be made from the constituents of air and water, the tremendous potentialities become apparent," he said.

Germs improve taste of drinking water:—The medical taste of city drinking water can be removed by unleashing microbes to devour the chemical impurity responsible for the offensive flavour, says a report from the United States.

Usually in towns and cities we add chlorine to water supplies to kill germs, but often minute traces of carbolic acid from industrial wastes get into the water and bring out the chlorine taste.

It is stated that a quantity of carbolic acid—the size of an aspirin tablet would be enough to impart a bad flavour to all the chlorinated water which one man would drink in fifty years.

A recently investigated method which promises to be highly successful in ridding water of carbolic acid consists of adding certain microbes to the water, says the report. Although carbolic acid, also known as phenol, is a powerful disinfectant, it is consumed as food by some micro-organisms when it is greatly diluted.

Salt Advisory Committee:— The Government of India have constituted a Committee consisting of the following members to advise Government on measures to be adopted for promoting and developing the Salt Industry in the country on rational lines, and on all other matters incidental thereto :—

1. Shri R. K. Sidhwa,
   Member, Constituent Assembly,
   Room No. 138, New Delhi.
2. Pt. Lakshmi Kanta Moitra,
   15, Ferozeshah Rd., New Delhi.
3. Sirdar A. Vedaratnam Pillai, President,
   Madras Provincial Salt Industrialists Association, 118, Armenian Street, Madras.
4. Mr. A. H. Bhiwandiwalla, President,
   Salt Merchants Association,
   583, Chira Bazar, Bombay.
5. Mr. P. A. Narielwala,
   Tata Chemicals, U. S. Headquarters Building, Connaught Circus,
   New Delhi.
6. Shri S. Ramaswamy,
   The Mettur Chemical & Industrial Corporation Ltd., Mettur Dam R. S., S. India.
7. Shri R. K. Dutta,
   Care: Calcutta Salt Merchants Assn.,
   New Custom House, Calcutta.
8. Dr. J. N. Ray,
   Dy. Director General,
   Industry & Supply, New Delhi.

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1. SACK RACE : Natesan (W) and Ratnam
2. HIGH JUMP : R. K. Murthi
3. VOLLEY BALL: T. Devakannu in action.
4. SLOW CYCLE RACE : R. K. Murthi (W) and Chockalingam.
5. THREE LEGGED RACE : Natesan and Venkataraman (Ws)
6. SHOT PUT : T. Devakannu (W)
7. POLE VAULT : Exhibition by Chockalingam.

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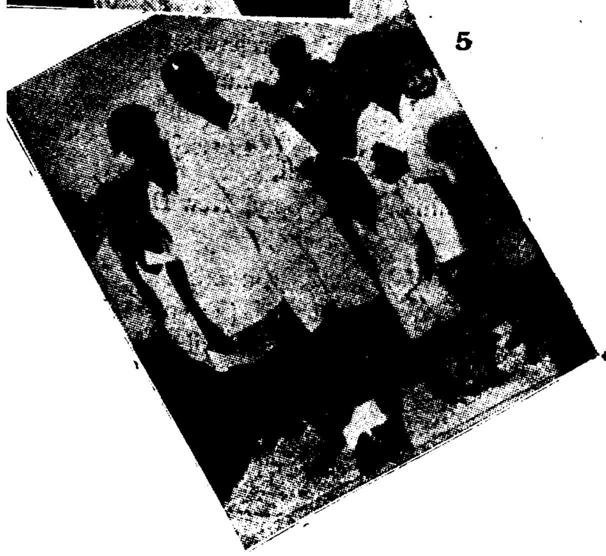

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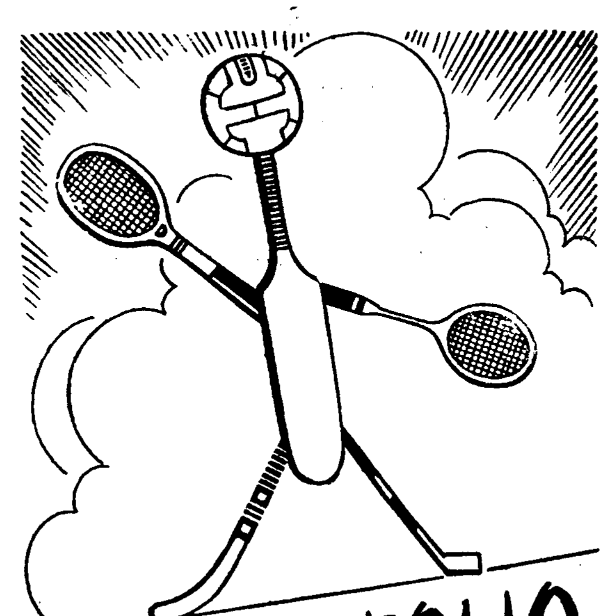

SPORTFOLIO

CRICKET :

Captain : N. Kalyanam,
Vice-Captain : K. Sampath.

We commenced the Season with a resounding victory over the powerful Salem Cricket Club which was captained by the Provincial player, R. T. Parthasarathy.

The visitors won the toss, and had first lease of the wicket. Padmanabhan contributed an invaluable 55 and scored all round the wicket, with neatly placed strokes.

The visitors were all out for 145 runs.

Ganesh and Jayaram shared the bowling honours with 4 for 34 and 3 for 39 respectively. Ganesh in particular pegged an impeccable length and often made the ball rise disconcertingly.

In our innings two wickets fell early. However, Raman and Sampath became associated in a brilliant third-wicket century partnership, and carried our total past that of our opponents, without further loss. Raman played scintillating cricket for his 67. His innings was characterised by vigorous drives and lofty pulls, and was unblemished until he got out. Sampath gave his partner wonderful support and continued to keep his end up with stylish play, until he was out for 44.

This victory, over a strong all-round combination like the Salem Cricket Club, in our initial match, has put our players in great mettle. We are looking forward to the future with interest and confidence.

TENNIS:

Captain: P. B. Srirangan,

Vice-Captain: N. Sundaresan.

In the Singles Finals of the Staff Association Annual Day Celebration Tournaments, R. S. Raman beat P. B. Srirangan. (6—1; 2—6; 6—4.)

SRIRANGAN and RAMAN

In the Doubles Finals, P. B. Srirangan and T. R. Sundararajan beat N. Sundaresan and S. Ramaswamy in straight sets. (6—4; 6—2.)

BADMINTON:

Captain: R. Krishnamurthy,

Vice-Captain: A. R. Narayanan.

The League (Fives) Tournament which started nearly a year ago, came to an end, at last! Rathnam's team (K. S. S. Mani, S. G. Ramanujam, K. Rathnam, R. Natarajan and K. Ganesh.) were the winners and Sambandham's team (T. M. Krishna Rao, N. Kalyanam, S. Sambandham, S.K. Chakrapani and P.R. Subramanian.) were the runners-up.

In the Doubles Finals, S Sambandamurthi partnered by Arokiaswamy beat K. Ganesh and S. Panchapekesa Iyer.

VOLLEY BALL:

Captain: N. Venkatraman,

Vice-Captain: S. Sanjeevi.

In the Staff Association Sixes Finals, R. G. Raghavan's team (T. K. Sitaraman, T. A. Javanthinathan, A. Krishnamurthi, B. V. Natarajan, T. S. Subba Rao, and R. G. Baghavan.) beat Sanjeevi's team. (P. R. Śubramaniyam, M. Padmanabhan, P. K. Yegnasamy, K. Rathnam, P. B. Srirangan and S. Sanjeevi.)

In the Triples Finals, T. Devakannu's team, (K. Sampath, K. Rathnam and T. Devakannu.) beat Raghavan's team. (N. Venkatachalam, S. Rajagopal and R. G. Raghavan.)

Besides these, track events and sports were also held in connection with the Staff Association Annual Day Celebrations.

SUNDARARAJAN and SRIRANGAN Vs. RAMASWAMY and SUNDARESAN

R. K. MURTHI & DEVAKANNU

The following is the list of winners and runners-up :—

Item.		Name.	Record.
Shot-put ..	I.	T. Devakannu	.. 32′ 2″
	II.	T. G. Rengan	.. 30′ 10½″
High-Jump ..	I.	R. Krishnamurthi	.. 5′ 2″
	II.	T. Devakannu	.. 5′ 1″
Long-Jump ..	I.	R. Krishnamurthi	.. 15′ 7½″
	II.	K. Venkatachalam	.. 15′ 4″
Hop, Step & Jump ..	I.	N. Venkatachalam	.. 33′ 10½″
	II.	S. Sanjeevi	.. 33′ 10″
Throwing the Cricket Ball.	I.	R. S. Raman	.. 227′ 4″
	II.	V. Subramanian	.. 222′ 7″
Half-Mile Race ..	I.	S. Srinivasan.	
	II.	G. Ramiah.	
	III.	Iyappan.	
Slow-Cycle ..	I.	R. Krishnamurthi.	
	II.	Chockkalingam.	
Sack-Race ..	I.	K. A. Natesan.	
	II.	K. Rathnam.	
Three-legged Race ..	I.	K. A. Natesan and S. Venkataraman.	
	II.	T. James and S. Rajagopal.	
Boys' Sack Race ..	I.	Siddhan.	
	II.	Venkatachalam.	

What's COOKING?

IN the present context of the country's food shortage, recipes using subsidiary foods should be particularly welcome. Here are two such, for housewives to try out.

Dahibadas

Ingredients:—Urad dal (black gram) without the husk, 9 ozs. Sweet potato flour, ½ oz. Groundnut cake flour ½ oz. Soda bicarb ½ tea spoon. Salt to taste. KAMADHENU. Curd 1½ srs. Green chillies 6—8. Haldi (turmeric) ¼ teaspoon. Salt to taste, 1½ teaspoons.

Method: Pick and soak black-gram overnight. Wash well and grind to fine dough. Add sweet potato flour, groundnut cake flour, soda bicarb and salt. Mix well.

Beat the curd, add chopped green chillies, turmeric and salt. Mix well.

Fry badas in KAMADHENU to very light brown colour and put them in the prepared curd. Cover and leave aside for 3 to 4 hours to soak and serve.

Omelettes (*Without Eggs!*)

Ingredients: Basen (gram flour) 1 chatak, tapioca flour ½ chatak. green chillies 2—3, onion 1 medium size, red chilli powder and salt to taste. Green dhania (coriander leaves). KAMADHENU (1 tola) to mix in the batter and to fry. Soda bicarb, a pinch.

Method: Chop finely onion, green chillies and the coriander leaves. Make a smooth batter of both the sieved flours, add the masala and soda bicarb and mix well. Heat a little KAMADHENU, put some of the batter, flatten and fry both sides. When it is fried to light brown, remove from fire and proceed similarly with the remaining batter. Nearly 3 medium omelettes can be made with the above.

மெட்கெம் பத்திரிகை

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குறிப்பு:

சுதந்திர தின விழா

இந்திய சுதந்திர தின விழாவின் 3-வது ஆண்டுப் பிறப்பானது ஆகஸ்டு பதினைந்தன்று, மேட்டூர் கெமிகல் இன்டஸ்டிரியல் கார்பொரேஷனைச் சார்ந்த பாடசாலையில் அதி விமரிசையுடன் கொண்டாடப்பட்டது.

காலை 8 மணிக்கு, பாடசாலை கமிட்டியின் காரியதரிசி ஸ்ரீ. N. ராஜகோபால் அவர்களால் தேசியக் கொடி ஏற்றுவிக்கப்பட்டது. பள்ளிச் சிறுவர், சிறுமியர்களும், விழாவிற் கலந்துகொண்ட பெரியோர்களும் தாயின் மணிக்கொடிக்கு அஞ்சலி செய்தனர். பிறகு, மாணவிகள் இன்னிசை கீதம் இசைக்க, பாடசாலைத் தோட்டத்தில், காரியதரிசி அவர்களால் பழ மரங்கள் பயிரிடப்பட்டன.

பின்னர், ஒரு பொதுக் கூட்டம் நடைபெற்றது. ஸ்ரீமான் G. வெங்கட்ராமையா அவர்கள் (Staff Officer, M. C. I. C. Ltd.) தலைமை வகித்தார்.

ஸ்ரீமான்கள்: O.S. நடராஜ ஐயர், B.A., பள்ளியின் தலைமை ஆசிரியர், M. V. சுப்பிரமணியம், உதவி ஆசிரியர், D. வில்லியம் ஜேம்ஸ் முதலியோர்களால் சொற்பொழிவுகள் ஆற்றப்பட்டன. சுதந்திரத்தின் மகிமை, மகாத்மா காந்தி அடிகள் போதித்த சத்தியம், அஹிம்சை இவற்றை பின்பற்ற வேண்டுவதின் அவசியம், பழக்கங்களைப் பயில சிறு வயதின் மேன்மை, ஒற்றுமை, தனக்கென வாழாமல் பிறர்க்கென வாழ்தல், நம் நாட்டில் பயிரிடப்படும் சகல தானியங்களையும் சாப்பிட்டு பழகவேண்டியதின் அவசியம், பழங்களின் சிறப்பு, முதலான சீரிய விஷயங்கள் மாணவ, மாணவிகளுக்குத் தெளிவாக விளக்கிக் கூறப்பட்டன.

மாணவிகள் நாட்டியம், கோலாட்டம் புரிந்து சபையோரை மகிழ்வித்தனர்.

தலைவர் தமது பின்னுரையில் நற்பழக்கங்களை இள வயதில் பழக வேண்டியதின் அவசியத்தை அழகாக எடுத்துரைத்தார்.

வந்தனோபசாரத்திற்குப் பின்னர், தேசீய கீதம் பாடப்பெற்று, கூட்டம் இனிதே காலை 10 மணிக்கு முடிவுற்றது.

சிறுவர், சிறுமியர்களுக்கு தின்பண்டங்கள் வழங்கப்பட்டன. பின்னர், பள்ளிக் குழந்தைகள் கெமிகல் காலனியின் வீதிகளின் வழியே, வழிநடைப் பாடல்கள் இசைத்துக்கொண்டும், 'ஜே' கோஷத்துடனும் ஊர்வலமாகச் சென்றனர்.

நாமே செய்வோம் : ரசாயனப் பொருள்கள்*

எம். பத்மநாபன் (M. C. I. C.)

தேசத்தின் முன்னேற்றத்திற்கும் மக்களது சுபிட்சத்திற்கும் ரசாயனத் தொழிற்சாலைகள் அத்தியாவசியம். பார்க்கப் போனால் இந்த நூற்றாண்டையே ஒரு ரசாயன சகாப்தம் என்று கூறலாம்.

முக்கியமாக ஒவ்வொரு நாடும் தற்பாது காப்புக்காக தானே வெடி மருந்துகள் செய்ய போதிய வசதிகள் பெற்றிருக்கவேண்டும். யுத்த சம்பந்தமான ரசாயனத் தொழிற்சாலைகளை எப்பொழுதும் நல்ல நிலைமையில் வைத்திருப்பது அவசியம். இரண்டாவதாக மக்களுக்குப் போதிய உணவை நாமே உற்பத்தி செய்ய நில வளத்தை அதிகரிக்க ரசாயன உரங்கள் ஏராளமாக தேவை. இவைகளை நாமே உற்பத்தி செய்யவேண்டும். மூன்றாவதாக துணி, சணல், காகிதம், சோப், இரும்பு முதலிய தொழிற்சாலைகளுக்கு அவசியமான மூல ரசாயனப் பொருள்களை மிகவும் சொற்பச் செலவில் பெருவாரியாகச் செய்தல் நலம். நான்காவதாக மக்களையும் கால் நடைகளையும் நோய் அண்டாதவாறு தடுப்பதற்கும் நோய் பீடித்தவர்களை குணப்படுத்துவதற்கும் வேண்டிய பல்வேறு மருந்துகளை நாமே உற்பத்தி செய்யவேண்டும்.

நாம் இரும்பு, எஃகு, துணி, சர்க்கரை, சிமெண்டு, சணல் முதலிய பொருள்கள் உற்பத்தியில் சிறிது முன்னேற்றமடைந்திருந்தாலும் இத்தொழிற்சாலைகளுக்கு வேண்டிய மூல ரசாயனப் பொருள்கள் உற்பத்தி செய்வதில் மிகவும் பிற்போக்கான நிலைமையில் இருக்கிறோம். முதல் உலக யுத்த சமயத்தில் இந்தியாவில் எந்தவித பெரிய ரசாயனத் தொழிற்சாலையும் இருந்ததாகத் தெரியவில்லை. யுத்தகாலத்தில் வெளிநாடுகளிலிருந்து வரும் மூல ரசாயனப் பொருள்களின் இறக்குமதி மிகவும் தடைபட்டது. இதனால் நம் தேசத்தில் பல தொழில்கள் மிகவும் பாதிக்கப்பட்டன. முதல் உலக யுத்தம் முடிந்த உடனேயே பிற நாட்டை எதிர் பாக்கவேண்டிய நிர்ப்பந்தம் இல்லாமல் இருக்கும் பொருட்டு ஒரு சில ரசாயனத் தொழற்சாலைகளை நாம் நிறுவ ஆரம்பித்தோம். இவைகள் கடந்த இரண்டாவது யுத்த காலத்தில் நமக்குப் பெரிதும் பயன் பட்டன. அவைகளும் வெகுவாக முன்னேற்ற மடைந்தன. சென்ற சில வருஷங்களில் சில புதிய ரசாயனத் தொழிற்சாலைகளும் ஆரம்பிக்கப்பட்டிருக்கின்றன.

நம் நாட்டில் இரும்பு, கரி, அலுமினியம், உப்பு, சுண்ணும்பு, ஜிப்ஸம், பாஸ்பேட், மாக்னஸைட், பாக்ஸைட், வெடியுப்பு முதலிய பல மூலப் பொருள்கள் ஏராளமாகக் கிடைக்கின்றன. போதிய லிங்க், (துத்தநாகம்) ஈயம், கந்தகம், வெள்ளீயம், முதலியவை நம் நாட்டில் கிடைப்பதாக இதுவரை தெரியவில்லை.

* Courtesy : All India Radio.

நம் தேசத்தில் கிடைக்கும் மாங்கனீசம், குரோமியம், மக்னீசியம், முதலிய உலோக தாதுப்பொருள்கள் பிறநாடுகளுக்கு இன்று வரை வெகுவாக ஏற்றுமதி செய்யப்பட்டு வந்தன. இனி அவைகளை நாமே நமது தொழிற்சாலைகளுக்குப் பயன்படுத்தக்கூடும்.

1. சல்ப்யூரிக் அமிலம் :— ரசாயனப் பொருள்களில் முக்யத்துவம் வாய்ந்தவைகளில் ஒன்று சல்ப்யூரிக் அமிலம். இந்த அமிலத்திலிருந்து நாம் ஹைட்ரோக்ளோரிக் அமிலம். நைட்ரிக் அமிலம், அமோனியம் ஸல்பேட், ஸுபர் பாஸ்பேட் உரம், செயற்கைப் பட்டு, சாயங்கள், மற்றும் பல சல்பேட்டு உப்புக்கள் செய்யப்படுகின்றன. நம் தேசத்தில் இப்பொழுது வருடத்திற்கு 75 ஆயிரம் டன் உற்பத்தி செய்கிறோம். இதன் உற்பத்திக்கு மூலப்பொருள் கந்தகம். போதிய அளவு கந்தகம் நம் நாட்டில் கிடைப்பதாக இதுவரையிலும் கண்டுபிடிக்கப்படவில்லை. ஆகவே, அமெரிக்கா, இத்தாலி, ஜப்பான், முதலிய நாடுகளிலிருந்து கந்தகம் இறக்குமதி செய்து கொண்டு இருக்கிறோம். நமக்கு வேண்டிய சல்ப்யூரிக் அமில உற்பத்திக்கு வெளிநாட்டிலிருந்து இறக்குமதியாகும் கந்தகத்தையே நம்பியிருத்தல் நல்லதல்ல. நம் தேசத்திலேயே கிடைக்கும் பேரைடீஸ், அயர்ன்-பைரைட்ஸ், ஜிப்ஸம், முதலிய பொருள்களில் உள்ள கந்தகத்தை உபயோகித்து சல்ப்யூரிக் அமிலம் செய்யலாம். இதற்குப் போதிய ஆராய்ச்சிகள் நடத்தப்படவேண்டும். வட இந்தியாவில் பஞ்சாப், ராஜபுதன பிரதேசங்களிலும் தென்னிந்தியாவில் திருச்சி ஜில்லாவிலும் ஜிப்ஸம் ஏராளமாகக் கிடைக்கிறது. திருச்சி ஜில்லாவில் மட்டும் இருபத்தி இரண்டரை சதுர மைல் விஸ்தீரணத்தில் ஐம்பது அடி ஆழம் வரையில் ஜிப்ஸம் கிடைப்பதாகத் தெரிகிறது. ஆகவே ஜிப்ஸத்தை உபயோகித்த சல்ப்யூரிக் அமிலம் செய்யும் முறையை நாம் பின்பற்றக்கூடும்.

சோடா உப்பு :—கண்ணாடி, சோப், காகிதம், நெசவு, வெடிமருந்து, முதலிய தொழிற்சாலைகளில் சோடா உப்பு அபரிமிதமாக உபயோகிக்கப்படுகிறது. நம் நாட்டில் வருடத்திற்கு லட்சத்து எழாயிரம் டன் சோடா உப்பு செலவாகிறது. ஆனால் தற்போது நம் தேசத்தில் உற்பத்தி முப்பதாயிரம் டன்தான். இந்தியாவில் காகிதம் கண்ணாடித் தொழில்கள் அபிவிருத்தியாகிறதற்கு நல்ல வசதிகள் இருப்பதால் சோடா உப்பும் அதிகம் உற்பத்தியாக்கப்படவேண்டும். இதற்கு வேண்டிய மூலப்பொருள்கள் உப்பு, சுண்ணும்புக்கற்கள், நிலக்கரி. இவை தேசத்தில் பல பாகங்களில் சிதறி இருப்பதால் இவற்றை எல்லாம் பரிசீலனைசெய்து தொழிற்சாலைகள் அமைக்க வேண்டும்.

3. காஸ்டிக் சோடா :—சோப், காகிதம், துணி, வனஸ்பதி, தோல் பதனிடுதல், சாயங்கள் முதலிய தொழில்களில் காஸ்டிக் சோடா மிகவும் உபயோகப்படுகிறது. நம் தேசத்தில் இதன் உற்பத்தி மிகவும் குறைவாக இருக்கிறது. சுமார் 70 ஆயிரம் டன் தேவைக்கு தற்சமயம் உற்பத்தி 5 ஆயிரம் டன்தான். கூடிய சீக்கிரம் நமக்கு புதிய தொழிற்சாலைகள் வேலை செய்ய ஆரம்பித்ததும் வருட உற்பத்தி 15 ஆயிரம் டன் ஆகக்கூடும். எனினும் மீதி 50 ஆயிரம் டன்னுக்கு வெளிநாடுகளை எதிர்பார்க்காமல், நம் தேவையை நாமே பூர்த்தி செய்யவேண்டும். சுத்தம் செய்யப்பட்ட உப்பு நீரில், மின்சார சக்தியை பிரயோகித்து காஸ்

டிக் சோடா செய்யும் முறை அமெரிக்கா முதலிய நாடுகளில் அதிகமாக கையாளப்பட்டு வருகிறது.

இதற்கு வேண்டிய உப்பு, கடல் நீரிலும், சில ஏரிகள் நீரிலும், சில பாறைகளிலும் இயற்கையாகக் கிடைக்கிறது. தினசரி வாழ்க்கைக்கு மிகவும் அவசியமான இந்த உப்பு காஸ்டிக் சோடா உற்பத்திக்கு மூலப்பொருள். உப்பின் விலை அதிகமாக இருந்தால் அதிலிருந்து செய்யப்படும் காஸ்டிக் சோடாவின் விலையும் அதிகமாகும். மேலும் உப்பு சுத்தமானதாகவும் இருக்கவேண்டும். இரண்டாவது தேவை மின்சாரம். இது அதிக அளவில் மலிவாகவும் கிடைத்தல் வேண்டும்.

4. **குளோரின்:**—மின்சார பிரிவு பாகத்தினால் காஸ்டிக் சோடா செய்யப்படும் தொழிற்சாலைகளில் குளோரின் உண்டாகிறது. ஆனால் இதை உபயோகிக்கக்கூடிய தொழிற்சாலைகள் நம் நாட்டில் இன்னும் விருத்தி செய்யப்படவில்லை. காகித உற்பத்தியில் மரக்கூழை வெளுப்பதற்கு குளோரின் உபயோகிக்கப்படுகிறது. தற்பொழுது காகித உற்பத்தி மிகவும் குறைவு. கட்டாயக் கல்வித் திட்டமும் முதியோர் கல்வித் திட்டமும் அமுலுக்கு வரும்பொழுது நம் நாட்டில் காகித உற்பத்தி பன்மடங்கு பெருகும். அப்பொழுது குறைந்த பட்சம் ஒரு லட்சம் டன் குளோரின் தேவை இருக்கும் என்று எதிர்பார்க்கப்படுகிறது. தற்போது உற்பத்தி மூவ்வாயிரம் டன்தான். வருட தேவையோ 34 ஆயிரம் டன். ஆனால் காஸ்டிக் சோடா உற்பத்தி பெருகும்பொழுது குளோரின் உற்பத்தியும் பெருகும். அப்பொழுது உற்பத்தியாகும் எல்லாக் குளோரினையும் சரியாக உபயோகப்படுத்துவதற்கு குளோரின் சம்பந்தப்பட்ட மற்ற பொருள்கள் பல செய்யவேண்டும். இல்லாவிட்டால் காஸ்டிக் சோடாவின் விலை அதிகமாவதுடன் குளோரினை எப்படி பயன்படுத்துவது என்பதும் பெரிய பிரச்னை ஆகிவிடும்.

குடி தண்ணீர் சுத்தம் செய்வதற்கு பெரிய நகரங்களில் தற்பொழுது குளோரின் உபயோகிக்கப்படுகிறது. அதே வசதி நமது எண்ணற்ற கிராமங்களுக்கும் ஏற்படுத்தும்போது குளோரின் உபயோகம் மிகவும் பெருகும். மற்றும் நெசவாலைகளில் நூல், துணி இவைகளை வெளுப்பதற்கு வேண்டிய பிளீச்சிங் பவுடர் செய்வதற்கும் இது அவசியம். முக்கியமாக நம் தேசத்தில் மலேரியா முதலிய நோய்களை ஒழிப்பதற்கும் பூச்சிகளால் பயிர்கள் சேதம் அடைவதை தடுப்பதற்கும் மிகவும் அவசியமாக D. D. T. போன்ற கிருமி நாசினிகளைச் செய்வதற்கு குளோரினை உபயோகிக்கலாம்.

5. **ஹைட்ரோ-க்ளோரிக் அமிலம் :**—பிறநாடுகளில் இந்த அமிலம் பலவித தொழிற்சாலைகளில் பயன்படுத்தப்பட்டாலும் நம் நாட்டில் முக்கியமாக நெசவாலைகளிலும், ஈயம் பூசுதலிலும், உலோகங்களை தகடாக அடிப்பதற்கு முன் சுத்தம் செய்வதிலும் மற்றும் (Zinc Chloride) அம்மோனியம் குளோரைட் முதலிய பொருள்கள் செய்வதிலும் வெகுவாக உபயோகப்படுகிறது. சென்ற யுத்தத்திற்கு முன்னிருந்தே தேவைக்கு வேண்டிய இந்த அமிலத்தை நாம் உற்பத்தி செய்துகொண்டுவந்திருக்கிறோம். தற்போதைய உற்பத்தி இரண்டாயிரத்து ஐந்நூறு டன். உப்பையும் சல்ப்யூரிக் அமிலத்தையும் கலந்து உண்டாகும் சேர்க்கையிலிருந்து வெளிவரும் வாயுவை தண்ணீரில் கரையவைத்து இந்த அமிலம் செய்யப்படுகிறது. ஆனால் இம்

முறையில் விலை அதிகமுள்ள சல்ப்யூரிக் அமிலம் உபயோகப்படுகிறது. மேலும் இம்முறையில் கிடைக்கும் ஹைட்ரோகுளோரிக் அமிலமும் சுத்தமாக இருப்பதில்லை. ஆகையால் உப்பு நீரில் மின்சாரம் செலுத்தி பிரிவு பாகம் செய்யும்பொழுது வெளிவரும் ஜல வாயுவையும் குளோரினையும் சம அளவில் சேர்த்து எரியவிட்டு, இந்த அமிலம் தயாரிக்கும் முறை மிகவும் சிலாக்கியமானது. ஆயிரம் டன் குளோரினை உபயோகித்து இம்முறையில் செய்யப்படும் மூவ்வாயிரத்து ஐந்நூறு டன் அமிலம் நம் தேவைக்குப்போதுமானது. மேலும் D. D. T. முதலிய கிருமி நாசினிகள் செய்வதிலும் இந்த அமிலம் ஒரு உப பொருளாக கிடைக்கிறது.

6. **நைட்ரிக் அமிலம் :**— இது வெடிமருந்து, உரங்கள், சாயம், தங்கம், இரும்பு முதலிய உலோகங்களை சுத்தம் செய்தல் ஆகிய தொழிற் சாலைகளில் உபயோகப்படுகிறது. சோடியம் நைட்ரேட்டையும் சல்ப்யூரிக் அமிலத்தையும் கலந்து நாம் இந்த அமிலம் செய்கிறோம். இந்த சோடியம் நைட்ரேட் நம் நாட்டில் கிடைப்பதில்லை. வெளிநாடுகளிலிருந்து இறக்குமதி செய்யப்படுகிறது. மேலும் இதற்கு வேண்டிய சல்ப்யூரிக் அமிலம் செய்வதற்கும் வெளிநாட்டு கந்தகத்தை எதிர்பார்த்து நிற்கிறோம். ஆகவே இம்முறையை இனிமேல் ஏற்படுத்தும் தொழிற்சாலைகளிலும் அனுசரிக்காமல் நவீன முறையைக் கையாளுதல் அவசியம், தண்ணீரிலிருந்து ஜல வாயுவையும் காற்றிலிருந்து உப்பு வாயுவையும் சேர்த்து அமோனியா செய்து அதிலிருந்து நைட்ரிக் அமிலம் செய்தல் வேண்டும். இந்த அமிலம் யுத்த காலத்திலும் மக்களுக்குப் பெரிதும் பயன்படுவதால் வருட உற்பத்தி சுமார் நாலாயிரம் டன்னுக்கு கொண்டுவர வேண்டும்,

7. **Slaked Lime**— நீத்தப்பட்ட சுண்ணாம்பு :—இது மிகவும் மலிவான ஒரு காரம். காரை செய்வதற்கும் சர்க்கரை ஆலைகளிலும், பிளீச்சிங் பவுடர் போன்ற பல ரசாயனப் பொருள்கள் செய்வதற்கும் இது உபயோகப்படுகிறது. நம் நாட்டில் வருடத்திற்கு சுமார் ஐந்து லட்சம் டன் சுண்ணாம்பு செலவாகிறது. நம் தேசத்தில் பல இடங்களிலும் தேவைக்கு அதிகமாகவே சுண்ணாம்புக் கற்களும், கிளிஞ்சல்களும் கிடைக்கின்றன என்றாலும் இவற்றைப்பற்றி பூர்வ பரிசீலனைகள் செய்யப்பட்டு அவற்றின் முழு விவரங்கள் கிடைக்கும் அளவு, ரகம் முதலியன நமக்குச் சரியாக கிடைக்கவில்லை. காரை சேர்ப்பதற்கு சுட்ட சுண்ணாம்பின் தரம் சிறிது குறைந்தது போதுமென்றாலும், சர்க்கரை சுத்தம் செய்வதற்கும், பிளீச்சிங் பவுடர் செய்வதற்கும் சுண்ணாம்பு உயர்ந்த ரகமாக இருத்தல் அவசியம். இதற்கு ஆங்காங்கே நவீன சுண்ணாம்புக் காளவாய்கள் ஏற்படுத்தவேண்டும்.

8. **அமோனியா :**—ஜல வாயுவையும் உப்பு வாயுவையும் சேர்ப்பதால் அமோனியா உண்டாகிறது. இதற்கு வேண்டிய ஜல வாயுவை நீரில் மின்சாரம் செலுத்தி பிரிவு பாகம் செய்தும் உப்பு வாயுவை காற்றிலிருக்கும் மற்ற வாயுக்களை பிரித்துவிட்டும் அடைகிறார்கள். முக்கியமாக நிலவளத்தை அதிகரிக்க உதவும் செயற்கை உரங்களான அமோனியம் ஸல்பேட், அமோனியம் பாஸ்பேட், யூரியா அமோனியம் குளோரைட் முதலிய செய்வதற்கும் அமோனியம் உபயோகப்படுகிறது. நம் தேசத்தில் இப்பொழுது வருடத்திற்கு சுமார் பதினான்காயிரம் டன் உண்டாக்கப்படுகிறது. நம் தேவை அறுபதாயிரம் டன்களுக்குமேல் என்று தெரிகிறது. தற்போது மைசூரிலும்

ஆல்வாயிலும் உள்ள தொழிற்சாலைகளைத் தவிர பீகாரிலும், ஹைதராபாத்திலும் நிர்மாணிக்கப் போகும் அமோனியா தொழிற்சாலைகள் மலிவான உரங்களைச் செய்து நம் தேவையை பூர்த்தி செய்யும் என்று எதிர்பார்க்கலாம்.

9. பாஸ்பேட் உரங்கள் :— பாஸ்பேட் உருண்டை கற்களும், எலும்புகளும் பாஸ்பேட் உரங்கள் செய்வதற்கு மூலப்பொருள்கள். சல்ப்யூரிக் அமிலத்தை இவைகளுடன்சேர்த்து ஒரு வாரம் வரை வைத்திருந்தால் ஸுபர் பாஸ்பேட் எனப்படும் மிகச் சிறந்த உரம் உண்டாகிறது. ஆனால் எலும்பிலிருந்து ஸுபர் பாஸ்பேட் செய்யும்பொழுது அதிலுள்ள கொழுப்பு, பசை முதலிய பிரயோசனமுள்ள வஸ்துக்களை நாம் தள்ளிவிடுகிறோம். இது முறை அல்ல. இதனால் நாம் செய்யும் பாஸ்பேட் உரங்களில் விலை அதிகமாகிறது. வெளிநாட்டிலிருந்து இறக்குமதி ஆகும் இவ்வித எருக்களோடு போட்டியிட முடியாமல் போய் விடுகிறது. ஆகையால் எல்லாவித பொருள்களையும் உபயோகிக்கத் திட்டம் போட்டு நடத்தவேண்டும். மேலும் எலும்புத்தூளையே உரமாக உபயோகிக்கும் முறையே நாம் இன்னும் அதிகமாக பின்பற்றலாம். அப்பொழுது சூபர் பாஸ்பேட் செய்வதற்கு உபயோகிக்கப்படும் சல்ப்யூரிக் அமிலத்தை மிச்சப்படுத்தி மற்ற தொழில்களுக்கு பயன்படுத்தலாம். மேலும் அமெரிக்காவில் சல்ப்யூரிக் அமிலம் உபயோகிக்காமலேயே பாஸ்பேட் உரங்கள் செய்யும் ஒரு நவீன முறையைக் கண்டுபிடித்திருக்கிறார்கள். நாமும் இந்த முறையை பரிசீலனை செய்து முக்கியமாகத் திருச்சி ஜில்லாவில் அபரிமிதமாகக் கிடைக்கும் பாஸ்பேட் கற்களைக்கொண்டு இம்முறையில் பாஸ்பேட் உரங்கள் தயார் செய்யலாம்.

ரசாயனத் தொழிற்சாலைகளின் வளர்ச்சிக்கு முதல் தேவை மலிவான மின்சாரம். மின்சார உற்பத்தி நார்வே, அமெரிக்கா, கானடா, ஜப்பான் முதலிய தேசங்களில் பெருகி இருப்பதுபோல நம் தேசத்தில் இன்னும் விருத்தியாகவில்லை. ஆனால் பெரிய அணைகள் கட்டுதல் நீர்வீழ்ச்சிகளை பயன்படுத்தல் போன்ற பல திட்டங்களை வகுத்து நடத்தப்போகும் வருங்காலத்தில் இந்தக் குறை நீங்கிவிடும் என்று எதிர்பார்க்கலாம். (2) மூல ரசாயனப் பொருள்கள் பல அன்றாட வாழ்க்கை சாதனப்பொருள்களின் உற்பத்திக்கு அடிப்படையானவை. ஆகவே இவை மிகவும் மலிவாகக் கிடைக்க வேண்டும். நம் நாட்டில் உற்பத்தியாகும் பொருள்களுக்கு சலுகைகள் காண்பிப்பதோடு வெளி நாடுகளில் இருந்து இறக்குமதியாகும் பொருள்களுக்கு தடைகளும் ஏற்படுத்தவேண்டும். இந்த மாதிரி மூலப் பொருள்கள் சிலவற்றிற்கு இருக்கும் வரிகளையும் இவற்றில் ரயில் கட்டணங்களையும் சிறிது குறைக்கலாம். நம் நாட்டிலிருந்து மூல தாதுப்பொருள்கள் ஏற்றுமதி செய்வதையும் தடைப்படுத்த வேண்டும். (3) இந்த தொழில்களுக்கு வேண்டிய முக்கிய இயந்திரங்கள் இந்தியாவிலேயே கூடுமானவரை செய்யப்படவேண்டும். (4) ரசாயனத்தொழிற்சாலைகளில் வேலைசெய்துகொண்டிருக்கும் ரசாயன இன்ஜினியரிங் அறிஞர்களைப் பொறுக்கி அமெரிக்கா, இங்கிலாந்து முதலிய நாடுகளுக்கு இதே வித தொழில்களில் பயிற்சியும் தேர்ச்சியும் பெற அனுப்புதல் அவசியம், (5) இந்த திட்டத்தை வகுப்பதற்குப் ஆதார பூர்வமான புள்ளி விவரங்கள் தேவை. நம் நாட்டிலோ இவை மிகவும் குறைவு. நம் ரசாயனத் தொழில்களைப்பற்றி போதிய விவரங்கள் சேகரிக்கப்படவேண்டும்.

ரசாயனத் தொழிற்சாலைகள் அதிகமாக நிர்மாணிப்பதற்கு நமக்கு ஒரு அரிய சந்தர்ப்பமும் அவசியமும் சேர்ந்திருக்கின்றன. ஊக்கமும், உழைப்பும் இருந்தால் ரசாயனத் துறையில் நாம் வெகுவாக முன்னேறக்கூடும்.

கந்தகி காமிலம்
(Sulphuric Acid)

பி. பி. ஸ்ரீரங்கன்

கந்தகி காமிலம் என்கிற திராவகம் மிகவும் முக்கியமானதாகவும் ரசாயன தொழிற்சாலைகளுக்கு இன்றியமையாததாகவுமிருக்கிறது. ஒரு நாட்டின் முன்னேற்றத்தையும் நாகரீகத்தையும் இந்த அமிலம் பயன்படுத்தும் அளவிலிருந்து சாதாரணமாக நிர்ணயிக்கலாம் என்பார்கள்.

கந்தகி காமிலத்தின் சரித்திரம் மிகவும் புராதனமானது. பத்தாம் நூற்றாண்டிலேயே இதை உண்டாக்கி ரஸவாதிகளும் வைத்தியர்களும் உபயோகித்து வந்திருக்கின்றனர். ஆனால் பெருவாரியாகச் செய்யப்பட்டது பதினெட்டு, பத்தொன்பதாவது நூற்றாண்டுகளில் தான். முதலில் காரீய அறை முறையிலும் பிறகு ஸ்பரிச முறையிலும் தயாரிக்கப்பட்டது.

தயாரிப்பு :-காரீய அறை முறையில் கந்தக துவி பிராணை (Sulphur dioxide) யையும் காற்றையும், பாக்கிய ஜனக பிராணைகளையும் (Oxides of Nitrogen) கலந்து காரீய அறையில் விட்டு, பிறகு அங்கு நீராவியையாவது நீர்த்துளிகளையாவது விடுவார்கள். அறையினடியில் அமிலம் தேங்கும். பிற்காலங்களில் இம்முறையையே சிறிது மாற்றி விஸ்தாரமான அறைகளுக்குப் பதிலாக உயரமான கோபுரங்களை வைத்தார்கள்.

ஸ்பிர்ச முறையில், கந்தக துவி பிராணையையும், காற்றையும் பிளாடினித்த கல்நாரின் (Platinised asbestos) உதவியால் கலக்கச் செய்து கந்தகத்திரி பிராணையை யுண்டாக்குகிறார்கள். பிறகு இதை அமிலத்திலேயே கரைக்கிறார்கள் இம்முறையில் கிடைக்கும் அமிலம் அதிகத்திண்மை பெற்றது. ஆனால் வாயுக்களை சேர்க்குமுன் மிகவும் ஜாக்கிரதையாகச் சுத்தப்படுத்தாவிட்டால் பிளாடினம் கெட்டுவிடும்.

குண விசேஷங்கள் :—கந்தகி காமிலம் நிறமற்றது ; அதிக வீரிய முள்ளது ; எண்ணெய் போன்று கனமுள்ள திரவம். சுத்தமானதாயில்லாவிட்டால் பழுப்பு நிறமாயிருக்கும். இது எல்லா உலோகங்களையும் பாதிக்கும். அதிக வீரியமில்லாத அமிலம் இரும்மை சீக்கிரமே பாதிக்கிறது. ஆனால் வீரியமுள்ள அமிலம் அவ்வளவு சீக்கிரம் பாதிப்பதில்லை. ஆகையால் வீரியம் குறைந்த அமிலத்தை காரீயமுள்ள பாத்திரங்களில் தான் வைக்கவேண்டும். காரீயக் குழாய்களில் தான் செலுத்தவேண்டும். வீரியமுள்ள அமிலத்தை இரும்புப் பாத்திரங்களில் வைக்கலாம். ஆனால் காற்று புகாதபடி பார்த்துக்கொள்ளவேண்டும். இந்த அமிலத்திற்கு நீரின்மேல் அதிக நாட்டமுண்டு. மற்ற பொருள்களிலுள்ள நீரையும் இது பிரித்து எடுத்துக்கொள்கிறது. பஞ்சின் மேலாவது மரத்தின் மேலாவது சில துளிகள் விட்டவுடன் அவை கருகிவிடுவதைப் பார்க்கலாம். இது தண்ணீருடன் கலக்கும்போது அதிக சூடு வெளிப்படுகிறது. ஆகையால் அமிலத்தை நீர்விட்டுப் பெருக்கும்போது நீரில் சிறுகச் சிறுக அமிலத்தைவிட்டு கலக்கவேண்டும். அமிலத்தில் நீரைவிட்டால், முதல் சில நீர்த் துளிகள் நீராவியாக மாறி வெளிப்படும். அப்போது அமிலமும் வாறி யிறைக்கப்படும். ஆகையால் அமிலத்தில் நீரை சேர்க்கவே கூடாது.

கையாள்வதில் ஜாக்கிரதை :—இந்த அமிலம் இரும்பு முதலிய கெட்டியான உலோகங்களையே கரைக்கும்போது, நம்முடைய மிருதுவான தோல் என்னவாகுமென்பதை சொல்

லவாவேண்டும்? இது பட்டவிடம் உடனே கவனிக்கப்படாவிட்டால் அபாயகரமான புண்ணாகிவிடும். இது எலும்பையே கரைக்கவல்லது. வந்தபின் காப்பதைவிட, வராமல் பார்த்துக்கொள்வதே சாலச் சிறந்ததல்லவா? ஆகையால், இதைக் கையாளும்பொழுது எவ்வளவு ஜாக்கிரதையாக இருக்கிறோமோ அவ்வளவுக்கவ்வளவு நல்லது. 'என்ன ஆகிவிடும்,' என்ற அலட்சிய மனப் பான்மையை அறவே அகற்றவேண்டும். காலில் செருப்பும், கண்களுக்குக் கண்ணாடியும், மேலங்கியும், கையுறைகளுமில்லாமல் இவ்வமிலத்தைக் கையாளவே கூடாது. இவ்வளவிற்கும் பிறகு அமிலம் மேலே விழுந்துவிட்டால் உடனே செய்யவேண்டியது செருப்பு, துணி முதலியவைகளை யகற்றிவிட்டு அமிலம் விழுந்த இடங்களில் ஸ்பிரிட்டை ஊற்றவேண்டும். பஞ்சில் ஸ்பிரிட்டை ஊற்றிக்கொண்டு அமிலம் பட்ட இடங்களை ஒத்தித் துடைக்கவேண்டும். பிறகு எண்ணெயோ வேறு மருந்தோ போடவேண்டும். இங்கு முக்கியமாக கவனிக்கவேண்டியது அமிலம் பட்டதாலுண்டாகும் எரிச்சலைப் போக்க தண்ணீரை ஊற்றக்கூடாது. தண்ணீரோடு சேரும்போது உண்டாகும் உஷ்ணத்தினால் சதை வெந்துவிடும். அமிலம் கண்களில் விழுந்துவிட்டால் மாத்திரம் நிறைய தண்ணீர் ஊற்றி கண்களைக் கழுவவேண்டும். இவ்விஷயங்களை மனதில் வைத்துக்கொண்டு, கலவரப்படாமல் அனுசரித்தால் அதிக அபாயமான காயங்களில்லாமல் தப்பலாம்.

உபயோகங்கள் :-கந்தகிகாமிலத்தின் உபயோகங்கள் கணக்கிலடங்கா. அது உபயோகப் படுத்தப்படாத ரசாயன தொழிற்சாலைகளே இல்லையென்று கூறிவிடலாம். அதற்கு நீரின் மேலிருக்கும் சாட்டத்தை மற்ற பொருள்களிலிருந்து நீரை யகற்ற பயன்படுத்திக்கொள்கிறார்கள். நம் தொழிற்சாலையிலும் ஹரிதகத்திலிருந்து (chlorine) நீரை யகற்ற இதை உபயோகப்படுத்துகிறோம். செயற்கை உரங்கள் செய்வதற்கு இது மிகவும் முக்கியம். மேலும், பெட்ரோல் செய்வதிலும் தோல் பதனிடுவதிலும், எண்ணெய் சோப் தொழிற்சாலைகளிலும் எலக்டிரிக் பாட்டரி செய்வதிலும், வர்ணங்கள் தயாரிப்பதிலும், மற்றும் வேறு ரசாயனப்பொருள்கள் தயாரிப்பதிலும் உபயோகப்படுத்தப்படுகிறது. இவ்வாறு இதன் உபயோகங்களை அடுக்கிக்கொண்டே போகலாம். இவையெல்லாம் பார்க்கும்போது இந்த அமிலத்தை உபயோகிக்கும் அளவு ஒரு நாட்டின் நாகரிகத்தையும் வளப்பத்தையும் குறிக்கிறது என்று சொல்வது மிகையாகுமா?

"தற்காலத்தில் மிகவும் முக்கியமானதும் சிக்கலானதுமான பிரச்னை உணவுப் பிரச்னையே. நமக்கு வேண்டிய உணவை பிறநாடுகளை எதிர்நோக்காமல் நாமே தயாரித்துக் கொள்ளவேண்டுமென்பதையே நம் தலைவர்கள் அடிக்கடி வற்புறுத்துகிறார்கள். உணவு உற்பத்தியைப்பெருக்க அவசியமான உரங்களை தயாரிப்பதில் கந்தகி காமிலம் மிகவும் அவசியம். ஆகையால் நாம் இதை அதிகமான அளவில் செய்யவேண்டும். இவ்வகையில் திருவிதாங்கூரிலிருக்கும் F. A. C. T. என்னும் தொழிற்சாலை நல்ல தொண்டு செய்கிறது. மைசூரில் பெல்கோல் என்னும் ஊரிலுள்ள தொழிற்சாலையிலும் இது தயாரிக்கப்படுகிறது இன்னும் பலரும் இவ்வகையில் தம் தேச முன்னேற்றத்துக்கு உதவுவார்கள் என்று எதிர்பார்க்கப்படுகிறது.

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