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Government of Madras.

Public Works DEPARTMENT.

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12

*Proceedings of the Madras Government, Public Works Department,
17th January 1873.*

No. 326. Read the following letter from the Officiating Deputy Secretary to the Government of India, Public Works Department (Irrigation), to the Joint Secretary to Government of Madras, Public Works Department (Irrigation Branch), dated Simla, 8th October 1872, No. 874-I.

IN continuation of this office letter, No. 402-I., of the 29th September 1870, I am directed to forward, for information, copies of remarks by Mr. Dejoux on Colonel Brownlow's report on cement manufacture and of that officer's reply thereto, including the drawing of the machine recommended by him for testing cement.

Remarks on Lieutenant-Colonel Brownlow's Report.

THE rates estimated by Lieutenant-Colonel Brownlow for cement delivered in Delhi are very correct; but it will not do to calculate on more than four cubic feet of cement in pretty good order in a cask, as the remainder will be found spoilt during the shipping or during transit from Calcutta to Delhi.

I have myself received in Calcutta nearly 10,000 casks of cement, and from experience I always found an average of four cubic feet of cement in good order per cask.

Accordingly the rate of Portland Cement at Delhi should be 5.66 instead of 5.2.

I do not quite agree with Lieutenant-Colonel Brownlow as regards the advantage in India of

using clay and pure slaked lime instead of clay and chalk. Without considering the increase in the cost on account of the double burning,

I think the burning is always more difficult in one case than in the other, and the tenacity of the cement is never so good.

If a prejudicial action takes place on account of the oxyde of iron, I would advise the use of clay either entirely free from, or containing a small portion of, it.

Many cement stones in France yielding cements nearly as good as Portland Cement contain little or no oxyde of iron.

In the case of Portland Cement sent from such a distance as England to Delhi, the cement will always lose a certain amount of its strength.

My experience authorizes me to say that it loses, in ordinary circumstances, one-fourth of its strength, and if left in godowns for six months it will lose at least one-third of its original strength.

It should be borne in mind that the cement casks are always placed at the bottom of the ships and exposed to the moisture and dampness therein; that the unloading in Calcutta is, and will always be, done in a more or less careless manner; and that the great heat of this country affects the quality of the cement to a certain extent.

Considering the question of the loss of strength in the cement imported from England, my opinion is that it is possible, if great care is taken in the manufacture, to make in India cements, artificial or natural, which will be about the same kind and the same quality as some of the French cements, which, excepting the Boulogne Cement, possess from one-fourth to one-fifth of less tenacity than the English Portland Cement of good quality. Such being the case, the cement which will be manufactured in India may be as good as that received from England; but, of course, at the same time one-fourth inferior (for the reason above adduced) to the cement of fresh quality used at Home.

The rough calculations I have made about the probable cost of cement manufactured in India show that it will vary from 1 Rupee to 1 Rupee and 4 Annas per cubic foot in the case of artificial cement, and from 9 Annas to 14 Annas in that of natural cement.

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Note to paragraph 13.
Silica Alumina.

In the Bengal ghooting or kunkur stones
I have analyzed I found a proportion of clay
varying from 26 to 34 per 100.

This result impressed me with the idea of trying the possibility of manufacturing either Roman or Portland Cement with such stones, in pulverizing those which were not too hard, and making bricks, etc., or in extra burning, in their natural state, those which are homogeneous.

I may now safely say that, as regards preliminary experiments, I have already succeeded in obtaining slow and quick-setting cements, although I am proceeding with further experiments on that score.

"Paragraph 13.—Supposing it be decided on to commence manufacturing in India, I think we should aim first at the utmost simplicity of machinery and plant employed."

I quite agree with Lieutenant-Colonel Brownlow as regards his proposal to aim first at the utmost simplicity of machinery and plant necessary for the manufacture.

I am of opinion that the best kind of fuel for burning Portland Cement is coke, and will place charcoal in second order.

"Paragraph 16.—Fuel to be employed."

But coal also may answer, as I have seen it used in France.

As I am, however, about to try to burn cement with coal, I will be able in a short time to afford a more decided opinion on the subject.

I do not quite agree with Lieutenant-Colonel Brownlow as regards his opinion of using for the mixture of materials the dry and German system instead of the wet English.

"Paragraph 18.—Sketch of process of manufacture."

It may be said that principally, when using pure slaked lime and clay, the German system is superior to a certain extent, but it is also more expensive.

Mr. Reid in his treatise about cement says that the two principal inconveniences arising from the English system are—

1st.—That a much larger area is necessary in the English system than in the German one, and consequently, in a country where the value of the land is always high, it increases to a great extent the amount of the capital invested in the manufacture of cement.

2ndly.—That it requires about two months for the materials in the vats to dry before being moulded into bricks.

As regards the first point, there is at present in India hardly any difficulty in the acquisition of land under the provisions of Act X. of 1870.

Referring to the second point, I should say that in a country so hot as India, the evaporation being much more rapid, it is to be expected that the time necessary for drying will be comparatively much less.

I think the proportion of materials used in the manufacture of artificial Portland Cement will vary as follows :—

"Paragraph 19.—Sketch and process of manufacture."

1st.—For artificial cement made of a mixture of chalk and clay—

From 3 chalk and 1 of clay (in measure).

To 4 chalk and 1 of clay.

2nd.—In the case of artificial cement made of pure slaked lime and clay—

From 5 lime and 2 of clay (in measure),

To 5 lime and 3 of clay.

Suggestions about manufacture of Portland Cement.

Except the remarks I have already made I quite agree with Lieutenant-Colonel Brownlow on all other points. I would, however, advise, as regards the details of manufacture, to follow the treatise of Mr. Reid on cements.

2. *Kilns.*—As regards kilns for a small factory, I would advise their construction according to the sketch (Figure 2) of Mr. Reid's book, but making them one-third smaller and increasing the height of the tapering dome by three feet.

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3. *Experiments.*—I would advise the construction at once of a small kiln, as per sketch annexed, for the trial of samples of different kinds of lime and clay in various proportions; the balls for samples may be made of clay and chalk, or lime reduced in impalpable powder and mixed in water in a tub: the water is on the following day to be removed by decantation, and the substance is then to be exposed to the sun until the evaporation reduces it into a plastic paste; with this balls may be made about two inches in diameter and dried well; these balls may then be burnt, and, when reduced to powder, a stiff mortar made with the cement thus obtained, which can be tested under water by means of the Aiguille of Vicat. Some cakes or balls made with this mortar may be left exposed to the air.

4. *Natural Cement.*—In France the Engineers have been using for several years cements proceeding from the burning, in the same way as for Portland Cement of marly clays of different kinds.

I have already found from the hills of Margohi and Rohtas, near Dehree, in the Soane Circle, two kinds of clay, which (mixed together in certain portions, and at times with a feeble addition of pure clay) will yield Portland and Roman Cement. I send some samples of these for transmission to the Chief Engineer to the Government in the North-Western Provinces, and would like to know if clay of similar descriptions cannot be found in or near the lime quarries in the North-Western Provinces; and, if so, I would desire one cubic foot of each sort to be sent to me.

Every sort of clay giving a strong effervescence with hydrochloric acid may be considered as marly clay, and may be found useful in the manufacture of cements.

The analysis of the sorts of clay of which I send samples give the following results :—

Yellow Marly Clay.	Carbonate of Lime ...	60 65	White Marly Clay.	Carbonate of Lime ...	80 00
	Do. of Magnesia ...	14 35		Do. of Magnesia traces, but not appreciable.	
	Oxyde of Iron ...	0 67		Oxyde of Iron, do. do. do.	
	Clay { Silica. } ...	23 33		Clay { Silica. } ...	20 00
	Alumina. } ...			Alumina. } ...	
	Sand ...	1 00		Sand ...	0 00
	Total...	100 00		Total...	100 00

5. *Cement of Boulogne.*—The best marly clay used in France is that found in Boulogne, with which Messrs. Demarle and Co. manufacture a cement in high demand in France.

I have been using it in large quantities for three years in the manufacture of artificial stone (Coignet's system), and found it even sensibly better than the Portland Cement of Messrs. White Brothers, which is considered as one of the best sort in England.

The Boulogne marly clay contains from 19 to 25 per 100 of clay.

Every sort of clay containing more than one-fifth per 100 of sand is to be rejected.

To be certain of a good homogeneity, the clay is pulverized and mixed with water in vats, the water is then removed by decantation, and, the clay being thus, by evaporation, in a sufficiently stiff state to be moulded, balls are made of it and burnt in a kiln up to a white heat.

The white heat is necessary for the spreading of the bad parts, which are picked and rejected carefully after the burning.

The cement is afterwards ground in fine powder and sifted through a sieve of 60 meshes per inch.

6. *Cement in the neighbourhood of Paris.*—Sometimes clays may be found homogeneous enough to enable their being burnt without the process of either pulverization or washing. The clay found near Paris contains about the same proportion of silica and alumina as that of Boulogne (in descriptions of marly clay are found (in beds) close to the beds of gypsum (or sulphate of lime); great care must, however, be observed in selecting them to avoid the mixture of gypsum with them. These may be burnt in their natural state and treated after the same manner as the cement of Boulogne.

The best factories are those of Messrs Barbier and Co. at Paris, Chronne, and Argenteuil, Messrs. Slacker and Letellier at the Butts Chammont, the Moulineaux, and the Rainey.

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I used these cements, particularly the first sort, for the building of several miles of sewer in Paris, and found it not much inferior to the English Portland.

7. *Marly Clays*.—I feel almost sure that marly clays of about the same composition as those of Boulogne or Paris may be found in the proximity of many lime quarries now existing in India, and I opine, therefore, that a careful search will enable the discovery of materials well adapted for the manufacture of cement, and producing a cement less expensive than artificial cements.

8. *Bulk of each material required for experiments*.—As regards the quantity of materials which will be required for experiments, I think for the manufacture of artificial cement three cubic feet of lime-stone and two of clay of each sort may be sent, and if stones or marly clay, supposed to be natural cement stones, are found in the Sewalik Range, a cubic foot of each kind will do for the present.

SEALDAH, No. 138, BALIAGHATTA ROAD,
5th June 1872.

(Signed) P. DEJOUX,
Ex. Engr., Cement Experiments Division.

No's by Lieutenant-Colonel H. A. Brownlow, R. E., Officiating Chief Engineer of Irrigation Works, North-Western Provinces, on Mr. Dejoux's remarks on Lieutenant-Colonel Brownlow's report on manufacture of Cement in India, dated 15th July 1872, No. 1,516-1.—C.

Use of pure slaked lime instead of chalk.—I recommended this because we have no chalk in this part of India, and I think burning the lime-stone will be found cheaper than grinding it to an impalpable powder. It is only a question of economy, and the cheapest process should be adopted.

Use of clay, free from oxide of iron.—The supposed prejudicial action of oxide of iron is, as will be seen from conclusion of paragraph 15 of my report, more than doubtful, and the action which takes place in the burning of Portland Cement between the oxide of iron in clay and the chalk (see paragraph 9 of my report), is understood to be most beneficial. I alluded to it in explanation of my remark that a cement of the same tenacity as Portland could not most probably be produced in India, where I proposed to use slaked lime instead of chalk, so that I do not think clay should be rejected because it contains oxide of iron so long as the proportion does not exceed fifteen per cent.

Loss of strength in imported Portland Cement.—Mr. Dejoux's experience seems to decide the question in favour of manufacture in India.

Process of manufacture.—While maintaining my opinions with some diffidence against those of Mr. Dejoux, who has a practical knowledge of his subject, I would suggest, as a further objection to the adoption of the "wet" or English system of mixing the raw ingredients of cement, that in these Provinces, for about four months in the year, the mixture in the settling reservoirs would be largely adulterated by sand and organic impurities driven on to it by the wind, and that during the rainy season the evaporation would be even slower than in England. Although more expensive, there can, I think, be no doubt of the superiority of the German over the English system of manufacture.

Testing the burnt cement.—Regarding the use of the Aiguille de Vicat for this purpose, I would remark—first, that it is only a test of rapidity of setting, and gives no idea of cohesive strength of the mortar; second, although remarkable quickness of setting is not necessarily accompanied by inferior hardness and strength, yet it is somewhat curious that within the range of experiments quoted by General Gillmore in his treatise on limes and hydraulic cements, the quickest setting cements gave ultimately the worst, and the slowest setting the best, results; third, that General Gillmore gives it as his decided opinion that the needle test is far less reliable than any simple device for trying the cohesive strength of the mortar when ten or twelve days old. The test proposed by me in paragraph 12 of my report is that universally adopted in England, and largely on the Continent as well, and I, therefore, strongly maintain its superiority over Monsieur Vicat's needle. The accompanying sketch shows an excellent form of testing machine and a better

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pattern of mould for making up the bricks to be tested than that shown in paragraph 12 of my report. They are both taken from Mr. Grant's admirable paper on Portland Cement (see Proceedings of Inst. C. E., Vol. XXV., Session 1865-66).

No. 327.

ORDER THEREON, 17th January 1873, No. 163.

IRRIGATION, No. 27.

COMMUNICATED to District Engineers
in continuation of G. O., No. 2,622, of
2nd November 1870.

(True Extract.)

(Signed) J. MULLINS, Lieut.-Colonel, R. E.,
Joint Secretary to Government.

To District Engineers.
To the Chief Engineer for Irrigation.

Ed. A. S. Rodgers?

If communications
should be addressed to
Secretary.

No. 874 I.

GOVERNMENT OF INDIA.

PUBLIC WORKS DEPARTMENT.

IRRIGATION.

To
The Joint Secretary to the Govt. of Madras,
Public Works Department,
Irrigation Branch.

Simla, 8th October 1872.

Sir,

In continuation of this Office letter
No. 402 of the 29th September 1870, I am directed to
forward for information copies of Remarks by Mr
Dejeux on Colonel Brownlow's report on cement
manufacture and of that Officer's reply thereto,
including the drawing of the Machine recommended
by him for testing cement.

I have the honor to be,

Sir,

Your Most Obedt. Servant

J. W. Parnall

Col. R. E.

Offg. Secy. to the Govt. of India

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Communicated to State
Engineer in continuation of G. O. No. 2629
of and November 1870

P. W. Biggs & Co. Portland Me.
No. 84 P. S. 10
Dec 24 O.
From Mr. D. Long to the
the Atts. of Genl. of Dist.
To the first dep't to him
Genl. of Dist.
P.M. D.
Migration -
Baldwin B. C. Oct. 72.
Dec 4 9th Dec. 72.
Recd 96th Dec. 72.
Enclos. 4.

Dadum 8 1/2 let. 72.
 Age 4 9 1/2 let. 72.
 Mary 9 1/2 0
 under 4.

I made for in from above
 Copies of remarks by Mrs.
 Bryant on Col. Brown's
 report on General Hancock's
 view of that officer's reply -
 He wrote together with drawing
 of the machine seen in sketch
 of the factory in sketch.

William Dock
Feb 15 - 17th Aug 1873

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London 7 June 1847