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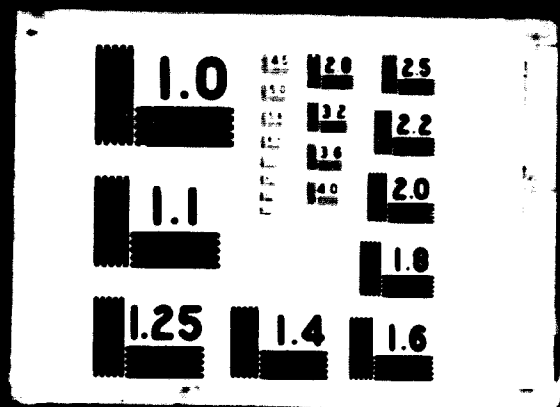
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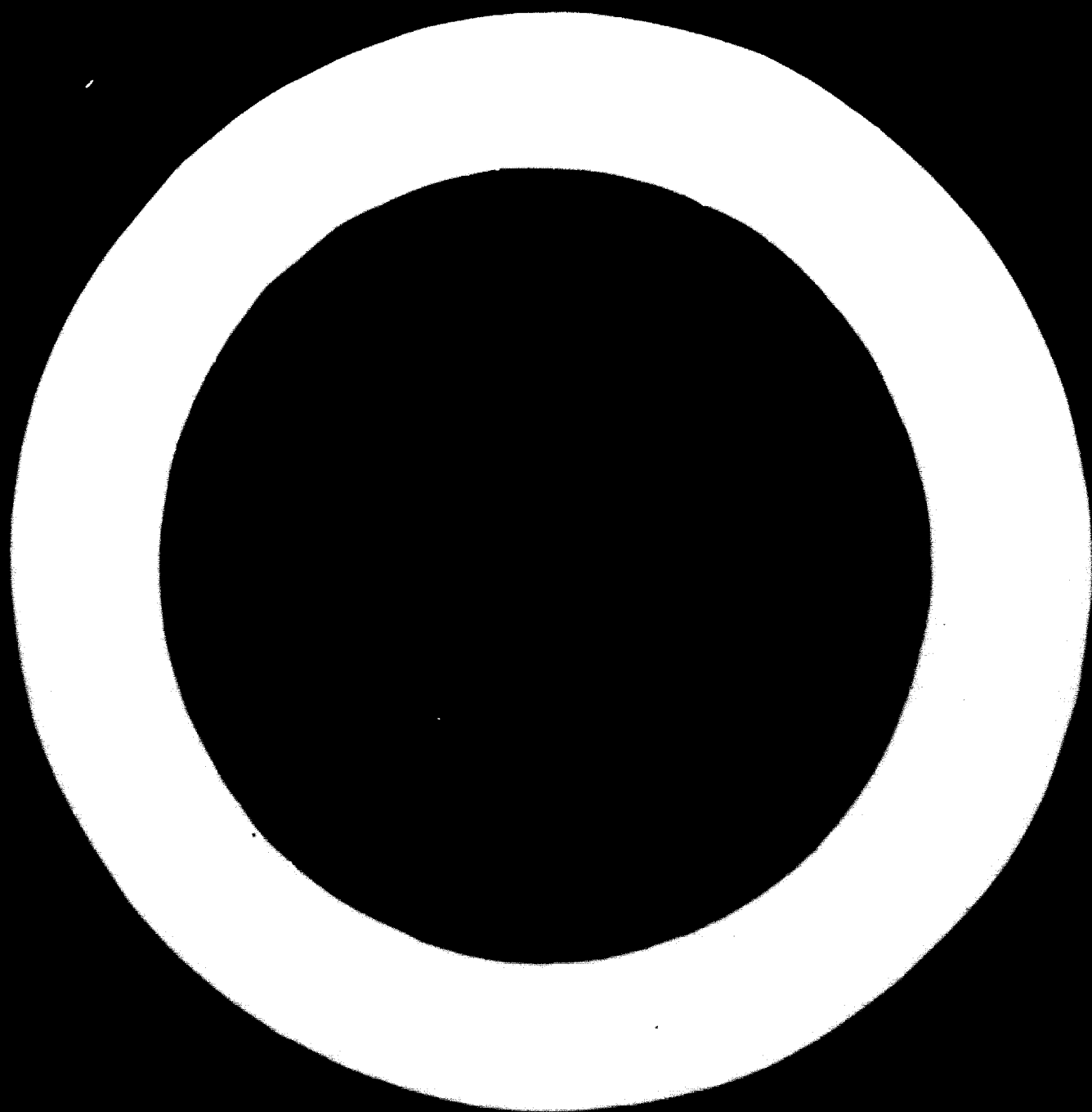
MANUFACTURE AND UTILIZATION
OF PORTLAND CEMENT IN THE SUMAR^{1/}

by

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MANUFACTURE & UTILIZATION OF PORTLAND CEMENT IN THE SUDAN

The Cement Industry in Sudan has begun at about 1945 when the first plant of Maspio Cement Corporation was erected at Atbara (Some 300 km. north of Khartoum). The second factory of the Nile Cement Co. at Babak (Some 300 Km. south of Khartoum) was started at 1964 and production started 1968. The raw materials and locality of each being slightly different, we shall discuss each separately.

MASPIO CEMENT CORPORATION, ATBARA

SITE.

The factory was sited on the eastern side of the river near the railway line, while the quarry was some 24 miles west of the river and stone is transported to the works by a narrow gauge railway system to the leading station of an aerial ropeway where the material is transported to buckets carried across the Nile and discharged into storage hoppers or upon a stockpile.

RAW MATERIALS

Limestone is obtained from an outcrop of high quality stone on the western bank. The quarrying is done by explosive where average height of the quarry is about 14m. The supply and reserve are quite adequate for the plant and for its possible future.

The other basic material namely, Clay is excavated close to the factory from borrow-pits and is fed to the hoppers immediately.

Gypsum is not quarried in this area and has to be brought from Port Sudan area where there is a very big reserve of very high quality.

PRODUCTION

The process established for production is the Dry System Process which suited the climatic conditions of Sudan perfectly. The pre-heater which will be installed in this plant shortly will increase the output by about 25%. The present production of the two Kilns is about 180,000 T/year and is expected to increase to 220,000 after pre-heater is being introduced.

The main product is the ordinary Portland Cement, other types like lowheat cement, sulphate resisting and Rapid hardening are produced as and when required.

There are two Kilns working now, an old one producing 150 T/day and a new one giving 450 T/day making a total of 600 T/day.

RABAK CEMENT FACTORY

RAW MATERIALS

a. Limestone

The location of the quarry is about 60 Kilometres south of the factory. The size of the deposit is enough to feed the factory for the next 40 years. The indicated amounts are even greater.

The chemical analysis of the limestone is as follows :-

SiO ₂	6.9 %
Fe ₂ O ₃	NIL -
Al ₂ O ₃	0.4 - 0.8 %
CaO	50 - 50.3 %
MgO	0.8 - 1.3 %

b. Clay

The location of the quarry is about 5 miles north of the factory at Rabak. The size of the deposit is unlimited all around the area.

The chemical analysis of the clay is :-

SiO ₂	54 - 56 %
Fe ₂ O ₃	9.0 - 9.6 %
Al ₂ O ₃	12 - 13 %
CaO	0.4 - 1.2 %
MgO	NIL %

c. Gypsum

The location of the deposit is in Port Sudan on the Red Sea hills.

The size of the deposit is unlimited and is enough to supply the factory for hundreds of years.

The chemical analysis of the gypsum is as follows :-

SiO ₂	0.50 %
Fe ₂ O ₃ + AL ₂ O ₃	1.10 %
CaO	32.8 %
MgO	0.50 %
SO ₃	14.2 %
CaCO ₃	75.14 %
Total Carbonate	95.05 %
Ignition Loss	20.97 %

PRODUCTION

There is one Kiln in Rabak producing 300 T/day and a maximum production of 390 T/day. As the quarry is far from the factory and there is not an all-weather road connecting the two, the production usually stops in the rainy season and major maintenance work is done during that time. The total production is about 80,000 T/year.

The main product is ordinary Portland Cement, and while other types can be produced yet there are rarely orders for production.

IMPORTS

Before Rabak factory started production, there were some imports for cement for odd jobs, but since 1968 importation of cement was prohibited and the product of the two Kilns was enough for the time being. The ex. factory price for the two Companies is the same at Ls.10.50 while the imported was some Ls.8.500 before the latest Customs duties increase and may well be Ls.10.00 after these increases.

BUILDING PLANS & ACTIVITIES

The Government has already approved a housing scheme whereby it is expected that 2,500 houses will be built yearly in Sudan.

A scheme for building two bridges in the Blue & White Niles is already underway. El Rahad Agricultural Project is also being approved. Development in the South will start after a handicap of some time. We expect that all these will boom the Cement Industry and already plans for vertical and horizontal expansions are ready namely :

- a. To construct a new Kiln parallel to existing one and thus doubling production to 200,000 tons.
- b. To build a new factory at Port Sudan to serve the eastern area and may be to cater for export to some neighbouring Countries.
- c. To build a new factory in Western Sudan to serve that area and adjacent places that have shortage in supply.

As can be seen the idea is to spread our factories as much as possible and where there are the raw materials to minimise haulage, as this constitutes a main problem in our industry. The sites of the two factories have been decided mainly because of the railway line and even then, availability of wagons is very rare and even this prospected production is sometimes not obtained for shortage of transport.

River transport was not introduced due to Cataracts in the River Nile, but this we shall have to overcome as it is becoming most inevitable to introduce river transport (the two factories luckily enough lie on the river).

Our plans also include an Asbestos Cement Factory which will be associated with one of our factories, preference being given at time being to Rabak as Asbestos ore is expected to be near the vicinity. The preliminary feasibility study and program are now almost approved and tenders will be invited for quotation very soon.

Although pre-cast concrete products have been used on a small scale, but plans are now studied for a big plant for fully automatic machine to produce concrete pipes, concrete tiles and other pre-cast concrete products.

All above we hope will help in the development of the cement industry and will further suffice the requirements for the development of the Sudan.

MASPIO CEMENT CORPORATION

SPECIFICATION FOR LOW HEAT PORTLAND CEMENT

	The Requirements of BS 1370:1958	CEMENT FROM MASPIO
A. Fineness	Min 3200 sq. cm/g	Min 3300 sq. cm/g
B. Chemical Composition		
a. Lime - C_2S (SO_3)	Max. Percentage: $2.4(SiO_2) + 1.2(Al_2O_3) + 0.65(Fe_2O_3)$	Max. Percentage: $2.3(SiO_2) + 1.2(Al_2O_3) + 0.65(Fe_2O_3)$
b.	Min. percentages: $1.5(SiO_2) + 1.2(Al_2O_3) + 0.65(Fe_2O_3)$	Min. percentages: $2.1(SiO_2) + 1.2(Al_2O_3) + 0.65(Fe_2O_3)$
b. Insoluble Residue	Max. 1.5 %	Max. 0.5 %
c. Magnesia	Max. 4.0 %	Max. 2.0 %
d. Alumina-Iron Ratio	Min. 0.66	Min 1.0
e. Sulphuric Anhydride (C_3A is less than 7%)	Max. 2.5 %	Max. 2.3 %
f. Loss on Ignition	Max 4.0 %	Max. 1.0 %
C. Compressive Strength:		
a. Mortar		
3 days	Min 77 kg/sq.cm	Min. 150 kg/sq.cm
7 days	Min 141 kg/sq.cm	Min. 250 kg/sq.cm
28 days	Min 281kg/sq.cm	Min 350 kg/sq.cm
b. Concrete		
3 days	Min 35 kg/sq.cm	Min 70 kg/sq.cm
7 days	Min 70 kg/sq.cm	Min 110 kg/sq.cm
28 days	Min 141kg/sq.cm	Min 200 kg/sq.cm
Setting Times		
a. Initial	Min 60 Minutes	Min 120 Minutes
b. Final	Max 10 hours	Max 4 Hours
Soundness (Expansion)	Max 10 mm	Max 1 mm
Heat of Hydration		
a. 7 days	Max 60 cal/g	Max 55 cal/g
b. 28 days	Max 70 cal/g	Max 65 cal/g

Low heat cement from Maspio is manufactured as low heat and low alkali cement which means that the percentage of alkalis (i.e. $(Na_2O) + 0.658(K_2O)$) is less than 0.60 %
See ASTM Standard Part 9, C 150)

MASSPIO PORTLAND CEMENT
TECHNICAL SPECIFICATIONS

	The Requirements of IS 18: 1953	Cement from Maspio
1. Fineness	Min. 8000 sq. cm/g	Min. 8700 sq. cm/g
2. Chemical Composition:		
a) Lime Saturation Factor	Between 0.88 & 1.08	Between 0.87 and 0.92
b) Insoluble Residue	Max. 1.5 %	Max. 0.4 %
c) Magnesia	Max. 4.0 %	Max. 2.5 %
d) Alumine Iron Ratio	Min. 0.68	Min. 1.5
e) Sulphuric Anhydride (C ₃ A is greater than 7%)	Max. 3 %	Max. 2.4 %
f) Loss on Ignition	Max. 4 %	Max. 1.5 %
3. Compressive Strength:		
a) Mortar		
3 days	Min 154 kg/sq.cm	Min. 240 kg/sq.cm
7 days	Min 239 kg/sq.cm	Min. 330 kg/sq.cm
b) Concrete		
3 days	Min 84 kg/sq. cm	Min. 100 kg/sq.cm
7 days	Min 140kg/sq. cm	Min. 150 kg/sq.cm
4. Setting time:		
a. Initial	Min 45 Minutes	Min. 30 Minutes
b. Final	Max. 10 hours	Max. 4 hours
5. Soundness (Expansion)	Max. 10 mm	Max. 1 mm

MASSPIO CEMENT CORPORATION

MASPIO CEMENT CORPORATION

SPECIFICATION FOR SULPHATE RESISTING PORTLAND CEMENT

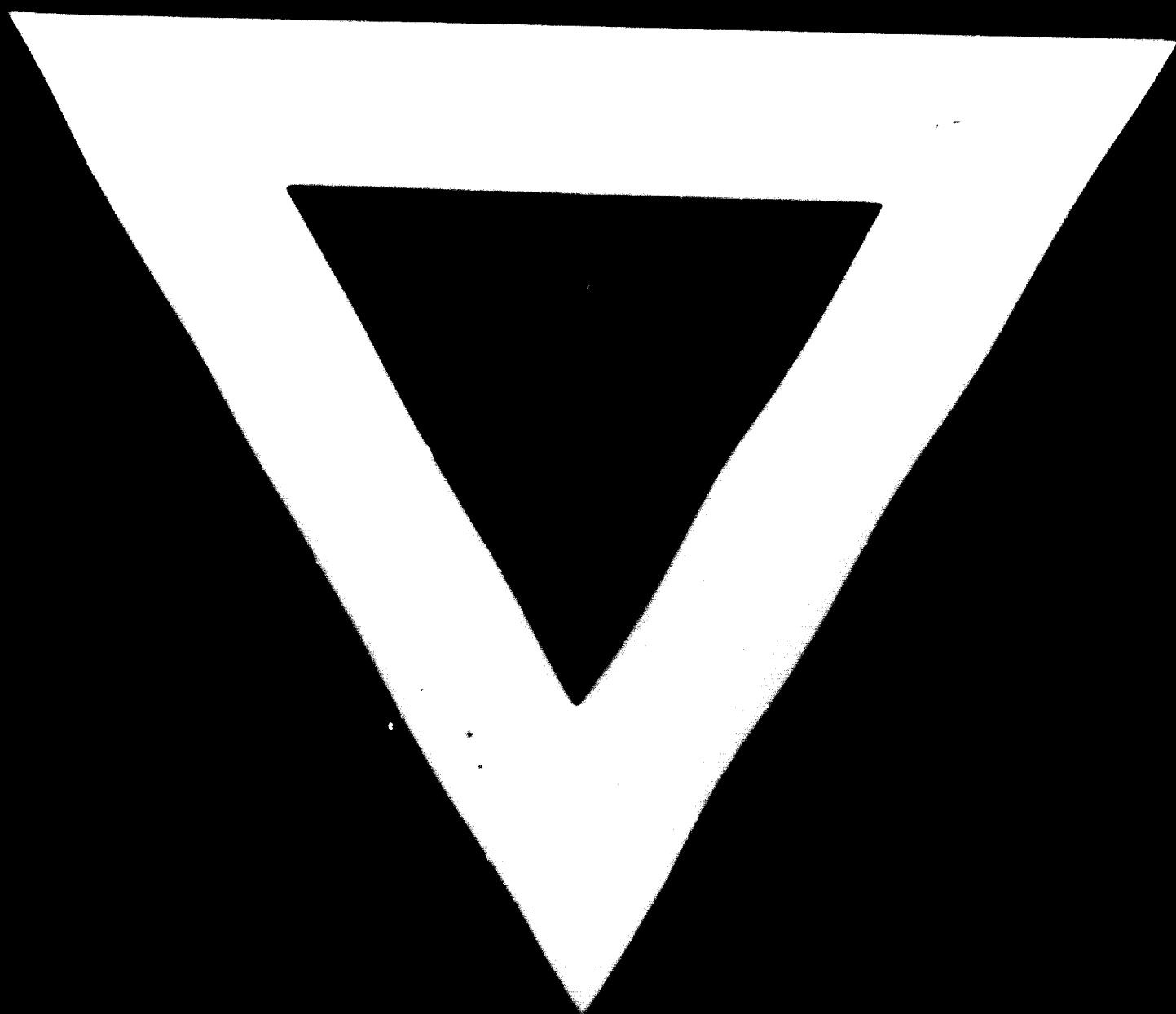
	The requirements of S3 4027: 1966	CEMENT FROM MASPIO
1. Fineness	Min 2500 sq. cm/g	Min 3000 sq. cm/g
2. Chemical Composition		
a. Lime Saturation Factor	Between 0.66 and 1.02	Between 0.81 & 0.86
b. Tricalcium Aluminate	Max 3.5%	Max. 2.5 %
c. Insoluble residue	Max. 1.5%	Max. 0.4 %
d. Magnesia	Max 4.0%	Max. 2.5 %
e. Sulphuric Anhydride	Max 2.5%	Max. 2.5 %
f. Loss on Ignition	Max 4.0%	Max 1.5 %
3. Compressive Strengths		
a. Mortar 3 days	Min 154 kg/sq.cm	Min 240 kg/sq.cm
7 days	Min 239 kg/sq.cm	Min 330 kg/sq.cm
b. Concrete 3 days	Min 34 kg/sq.cm	Min 100 kg/sq.cm
7 days	Min 140kg/sq.cm	Min 150 kg/sq.cm
4. Setting Times:		
a. Initial	Min 45 Minutes	Min 30 minutes
b. Final	Max 10 hours	max 4 Hours
5. Soundness (expansion)	Max 10 mm	Max 1 mm

ASPIO CEMENT CORPORATION

SPECIFICATION FOR PORTLAND CEMENT (SUPERGRATE)

	The Requirement OF BS 12 : 1958	CEMENT FROM ASPIO
1. Fineness	Min. 3250 sq.cm/g	Min 3500 sq. cm/g
2. <u>Chemical Composition:</u>		
a. Lime Saturation Factor	Between 0.85 and 1.02	Between 0.87 and 0.92
b. Insoluble Residue	Max. 1.5 %	Max. 0.4 %
c. Magnesia	Max. 4.0 %	Max. 2.5 %
d. Alumina-Iron Ratio	Min. 0.26	Min. 1.5
e. Sulphuric Anhydride (CSA is greater than 7%)	Max. 3 %	Max. 2.6 %
f. Loss on Ignition	Max 4 %	Max. 1.5 %
3. <u>Compressive Strength:</u>		
a. Mortar		
3 days	Min 210 kg/sq.cm	Min. 300 kg/sq.cm
7 days	Min 251 kg/sq.cm	Min. 370 kg/sq.cm
b. Concrete		
3 days	Min 119 kg/sq.cm	Min. 130 kg/sq.cm
7 days	Min 175 kg/sq.cm	Min. 190 kg/sq.cm
4. Tensile Strength (1 day)	Min 21 kg/sq.cm	Min. 25 kg/sq.cm
5. <u>Setting Times</u>		
a. Initial	Min 45 minutes	Min. 90 minutes
b. Final	Max 10 Hours	Max. 3 Hours
6. Soundness (Expansion)	Max 10 mm	Max. 1 mm





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