CEMENT AND LIME MANUFACTURE

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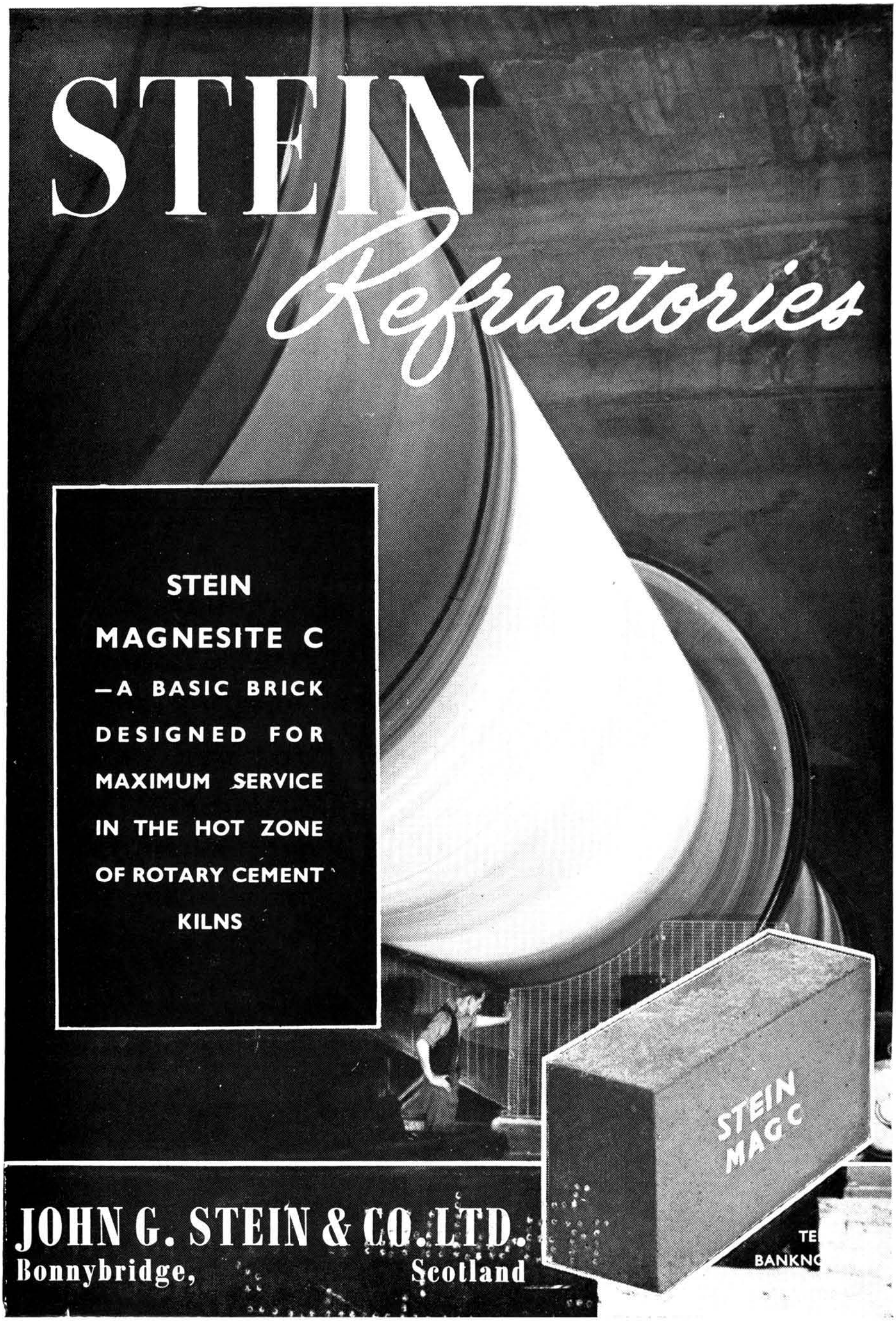
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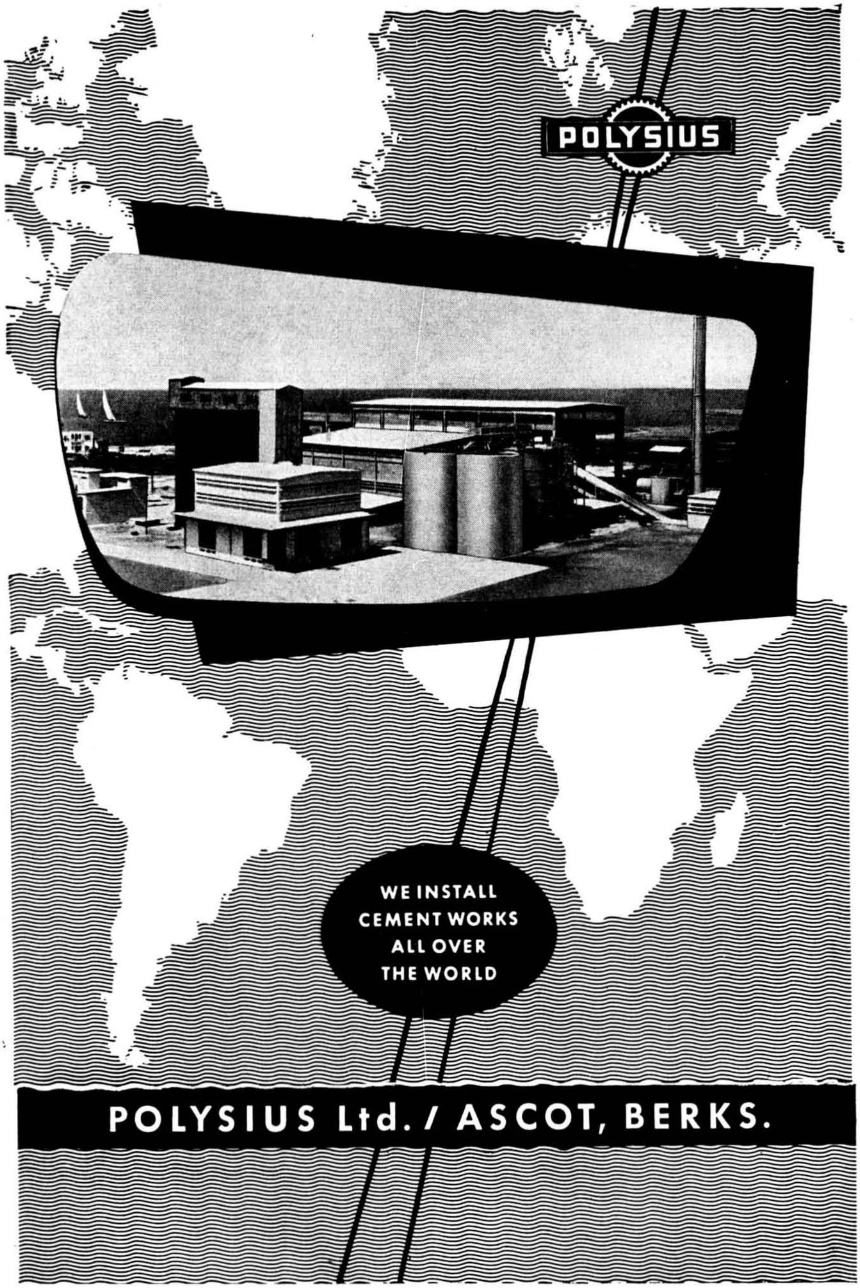
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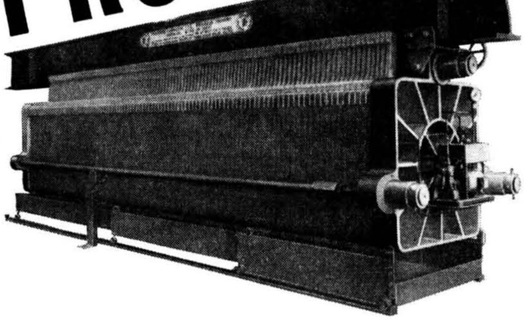

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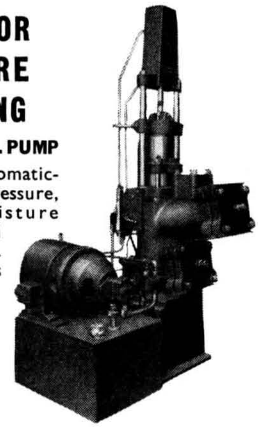

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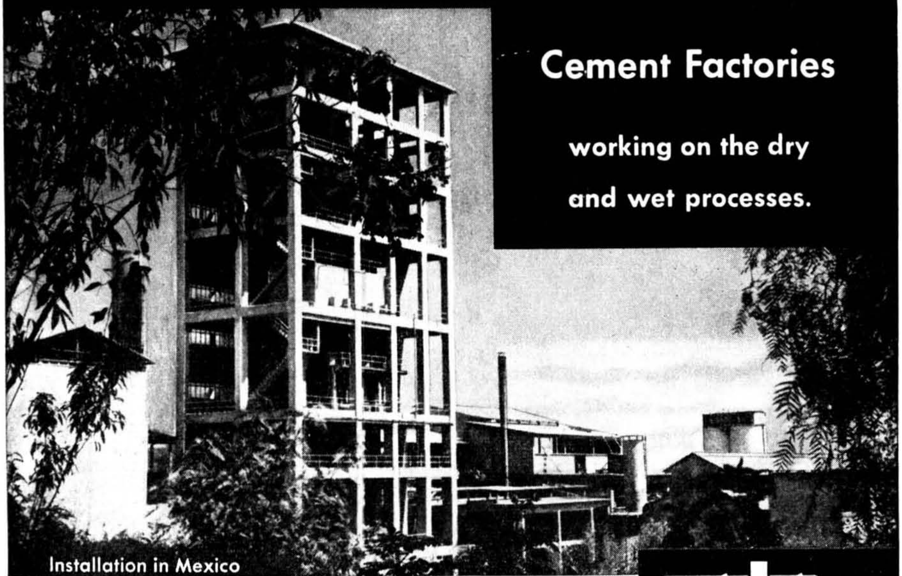

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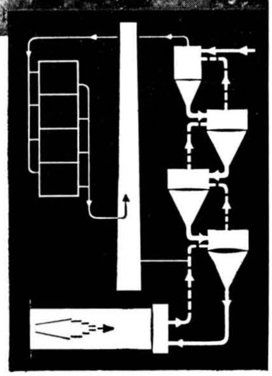

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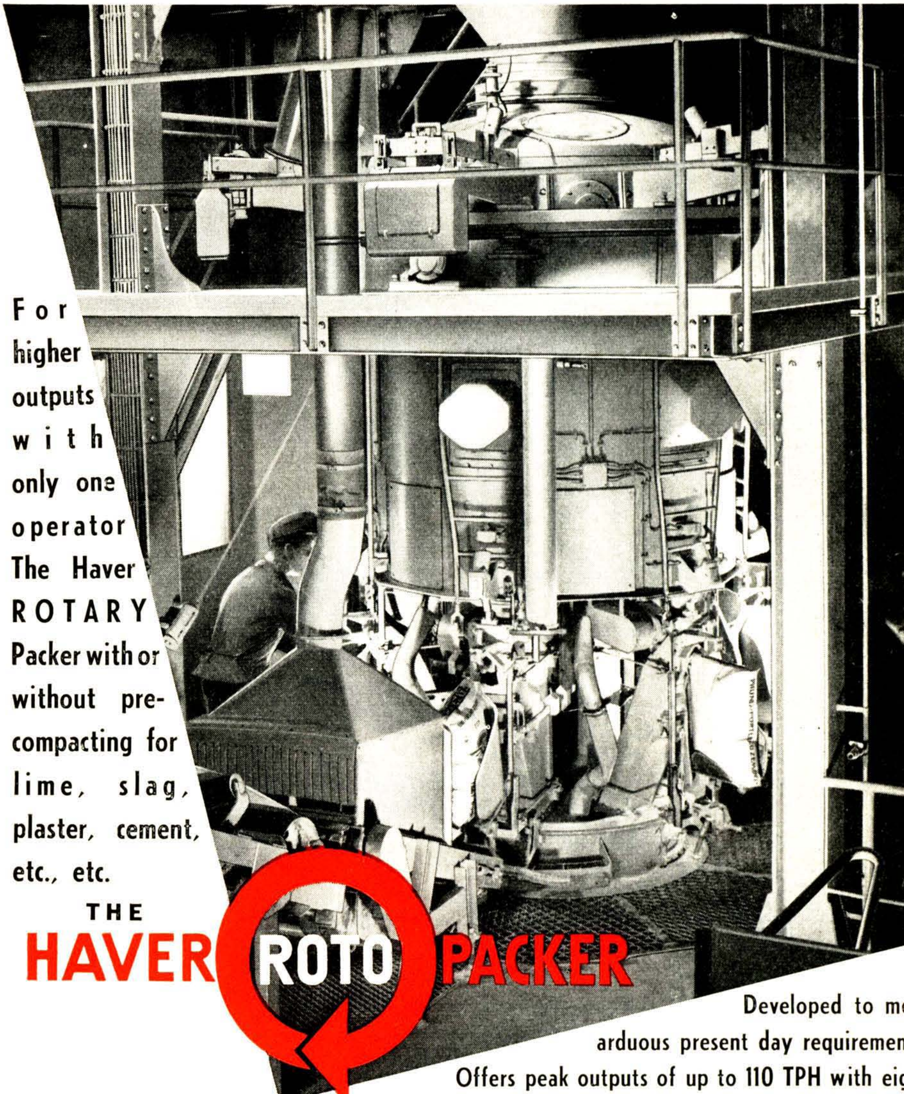

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A Dry-process Kiln with Preheaters.

A ROTARY kiln about 10 ft. in diameter and 197 ft. long commenced operating last year at the Sparsk Cement Works, U.S.S.R. It is a dry-process plant, and the kiln, which is shorter than would be required otherwise, is provided with cyclone preheaters for the raw-meal; the installation resembles in general design the Humboldt air-suspension preheater kilns developed in Germany. The output of the installation is about 12 tons of clinker per hour at a heat consumption of about 1000 K-cal. per kg. clinker. The particulars in the following are based on information provided by Diment, and others in "Tsement," No. 1, 1959.

Powdered raw materials are preheated by the kiln-exit gases in a counter-current system in a battery of cyclone heat-exchangers (*Fig.* 1). This type of plant is particularly suitable for burning raw materials which are not plastic enough for pelletisation. Because the plant can operate with non-plastic raw-meals and there is no lower limit on the moisture content of the raw-meal, the heat requirements of the kiln are lower than in other dry processes.

The kiln is fed through two branches of the preheaters each of which consist of two stages. The diameters of cyclones I, II and III (*Fig.* 1) are 12 ft., 12 ft. and 10 ft. 8 in. respectively. The preheater stage IV consists of three cyclones each 3 ft. in diameter. The preheater exit-gases are drawn off at the temperature of 250 deg. C., passed through a de-dusting cyclone, and then forced up a flue 197 ft. in height. The fan used for drawing the preheater exit-gases has a capacity of 45,000 cu. ft. per minute. To reduce the heat lost by radiation and to improve the thermal efficiency of the plant, the cyclones and air ducts are lined with an insulating layer consisting of diatomite-porous light-weight brick compound having a total thickness of 4 in. In addition, the external surfaces of the cyclones are painted with aluminium. The overall height of the battery of preheaters is 167 ft. The clinker is cooled in a rotary cooler about 10 ft. by 50 ft.

The number of cyclones in each branch of the preheater was determined on

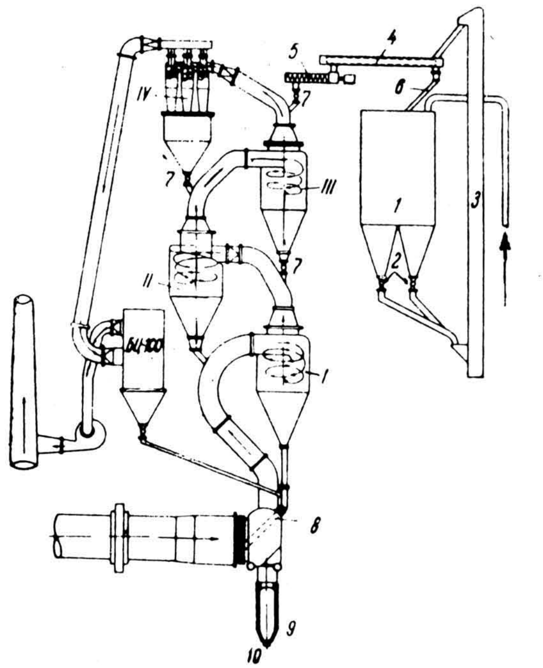


Fig. 1.

the basis of the mean fall in the temperature of the gases as they pass through the cyclones, which in preliminary tests was found to be from 150 to 200 deg. C. The diameters of the cylones (in metres) were calculated from the formula

$$D = 0{\cdot}536 \sqrt[4]{\frac{V^2LE}{p}}$$

in which V is the volume of gases passing through a single cyclone (cu. m. per second), L is the mean specific weight of gas (kg. per cu. m.), E is the hydraulic-resistance coefficient of a cyclone, and p is the hydraulic resistance of a cyclone (water gauge in m.m.).

The plant was designed for use with two cyclone branches in order to increase the thermal efficiency. If only one branch of the cyclones is used, the capacity of the installation is limited by the value of the suction developed by the extraction fan (about 800 m.m. w.g. at kiln-gas temperature of 250 deg. C.). An increase in the diameter of the cyclone when only one branch of the cyclone system is used would result in an increase in the output of clinker but this was thought to be undesirable because the overall height of the preheaters would also be increased and this was not practicable.

The essential features of the installation are as follows. Referring to *Fig.* 1, powdered raw-meal is fed by a pneumatic conveyor into a silo (1) having a capacity of about 45 cu. yd. and from which the raw-meal is transported by means of two separate feeders (2) to an elevator (3). A reserve elevator is also provided. The raw-meal now passes through a screw-conveyor (4) and from there to two similar conveyors (5). The excess of the raw-meal is returned to the silo through pipe (6). Each of the screw-conveyors feeds the raw-meal into the gas pipe connecting the cyclone stages III and IV of its branch. The gases leaving stage III cyclone, lift the raw-meal to stage IV. The raw-meal deposited in the discharge end of cyclone IV passes to the pipe joining cyclone stages II and III and then reaches the kiln feed-pipe (8). Dust extracted in the de-dusting cyclone is also fed to the kiln through the same feed pipe, which is cooled with air supplied by one of two high-pressure fans, one of which is working while the other is in reserve. The dust deposited in the trap (9) is picked up with a scraper-conveyor (10) and by a feed system it is returned to the kiln.

The pulverized fuel used for burning the clinker is drawn pneumatically from the storage silo and fed through an auxiliary system to the burner pipe in which it is carried to the kiln by the primary air stream produced by a fan having a capacity of 6000 cu. ft. per minute under a pressure of 600 m.m. w.g.

The finished clinker is passed through the cooler, fed to an elevator, and hence to the clinker store.

Operational Difficulties.

Experience showed that the scraper-conveyors did not work satisfactorily and they had to be replaced by screw-conveyors. Considerable difficulties were also experienced in the operation of the cyclone discharge-valves which often failed to open especially in stages I and II. The vibrating type of valves had to be replaced by a simple shut-off valve working on the counter-weight principle. Loss of pressure in the cyclone preheater system was found to reduce the clinker output to about 6 tons per hour and, in addition, the cyclones have a tendency to choke, which makes it necessary often to shut down the plant for cleaning purposes.

Another difficulty was experienced at the feed-end of the kiln even after a modified design was introduced; up to 7 per cent. of the preheated raw-meal failed to reach the kiln and had to be returned to the kiln for re-burning by means of a special conveyor system.

At the beginning of the operation of the plant, the volume of air leaking into the system was excessive, but by means of improved sealing and the introduction of a better type of cyclone discharge-valve, the percentage of excess air was reduced from 250 per cent. to 120 to 150 per cent. It was also noted in the initial stages of operation that the clinker cooler became overheated and this made it rather difficult to increase the output of the kiln to more than 13 tons per hour. This difficulty was overcome by insulating the cooler shell with a refractory lining, by the provision of additional cooling air, and by drawing off a part of the cooler air and using it as the primary combustion air in the kiln.

Practice shows that normal operating conditions can be reached very quickly even after a prolonged period of shut-down but that the rates of feeding in the raw-meal and fuel require stricter control than is the case with an ordinary rotary kiln. Irregularities in the raw-meal feed lead to an immediate rise (up to 900 deg. C.) of the temperature of the exit gas. Coarsely-ground coal or under-burnt clinker produce choking of the cyclone in stage I which defect is very difficult to overcome and may necessitate the stopping of the entire plant while the cyclone is being cleaned. Stage I can also be choked by running the kiln too slowly.

Performance.

The performance of the installation during August 1958 was as follows.

The utilisation of the plant was about 90 per cent. with a mean output of clinker of 12 to 13 tons per hour. The heat consumption was 1000 K-cal. per kilogramme of clinker. The loss of dust to the atmosphere was ½ ton per hour. The rate of feeding preheated raw-meal to the kiln was 1·2 tons per hour. The electrical energy required for the fan drive was 20 k.W.h. per ton of clinker.

The inoperative time of the plant (expressed as a percentage of the calendar time) and the cause of stoppages were as follows:—Cyclone choking, 5 per cent.; repair of electrical equipment, 2 per cent.; mechanical repairs, 1 per cent.; tests and other reasons, 2 per cent.

Consideration of the performance data indicates means of improving the efficiency of the plant. For instance, the clinker output of 13 tons per hour could be increased by (i) returning to the kiln for re-burning the preheated raw material (at about 700 deg. C.) deposited in the chimney; (ii) reducing the air leaking into the system, which is particularly bad in the de-dusting cyclone system, for which calculation shows that elimination of this cause of loss could improve the output of the kiln by a ton per hour; and (iii) providing a separate feed for the new installation because during the tests the same kiln-feed was used for two old kilns (with a heat consumption of about 1600 to 1700 K.-cal. per kilogramme of clinker) as for the new installation (with heat consumption of 1000 K.-cal. per kg.) and the chemical composition of the raw-meal could not be adjusted to suit all the kilns simultaneously.

The output of the installation working with one branch of the preheater cyclones was greater by 5 to 10 per cent. than with other rotary kilns provided with waste-heat boilers and operated at the highest output. If both of the cyclone preheater branches are in operation, the output of the installation is increased by about 20 per cent. in comparison with ordinary dry-process rotary kilns. After the initial difficulties connected have been overcome, the output expressed in comparison with the two types of kilns mentioned in the foregoing were increased by 20 to 25 per cent. and 35 to 40 per cent. respectively.

The heat consumption for the clinker burning represents 65 to 70 per cent. of the heat consumption of the ordinary type of dry-process rotary kilns. It is expected that the heat consumption of the new kiln can be reduced to about 880 K.-cal. per kg. by reducing further the heat losses in exit-gases by providing better sealing of the system. It is also intended to provide a light-weight refractory lining in the kiln and to increase the amount of the dust returned for re-burning.

The quality of the cement produced in this installation is better than usual and had a compressive strength of 5700 lb. per square inch in normal production. The burning process is very stable provided that the kiln-feed is uniform and that its chemical composition shows no excessive variations.

Research in the Lime Industry.

THE activities of the Chalk Lime and Allied Industries Research Association during its first five years are described in "Research for Industry 1959" (H.M.S.O. Price 8s.). Research has been made in the production and uses of lime, and the manufacture of sand-lime bricks.

The new uses of lime which have been sought, include the stabilization of soil, and combining with Portland cement in making precast concrete products. The Association in consultation with the Building Research Station has endeavoured to produce standard methods of testing the properties of lime mortars and the effects of various constituents of the mortar and to obtain data for comparison with other mortars. The properties of mortars containing additives, and the advantages and disadvantages of air entrainment are the subjects of experiments. A new method of testing to detect the presence of quicklime in building limes, is being sought to replace the current methods which are slow. Efforts are being made to determine the factors in manufacture which result in the occurrence of quicklime. Samples of hydrated lime supplied from manufacturers have been tested to determine their fineness, freedom from quicklime, and other properties. If the product was unsatisfactory the manufacturer was informed and measures recommended to rectify the faults. An examination is also being made of the factors affecting fuel economy in making lime and prolonged tests are being made on members' kilns. The help of the Association has been sought by the British Standards Institution in revising the British Standard for building limes.

Information gained by the Building Research Station on the shrinking of sand-lime bricks, due to drying is the basis of other investigations by the Association and, although research is proceeding, it has been possible to inform members of means of reducing the shrinking. The Association is also studying the effects of the silicone-treatment of sand-lime brickwork, the resistance of sand-lime bricks to weathering and frost, the use of aggregates other than sand in the brick process, the relative values of pigments and the efficiency of members' mixing plants. A periodical magazine entitled " C.L.A.I.R.A. News " and an abstracts service have been commenced.

Cement from Peat.

RECENTLY, in many rural areas in Russia, peat-ash cement produced by a method suggested by Professor V. V. Mikhailov has been used in the building industry. Peat-ash cement is the product obtained by grinding a special clinker. To make the clinker, up to 5 per cent. by weight of crushed limestone is first added to the peat. The limestone can be in any form, such as fines from limestone quarries, from old buildings or from dumps and which is of no value for making quicklime and is unfit for use as crushed stone. This addition does not interfere with the combustion of the peat. The lime, which is produced from the limestone when the mixture is burnt, reacts with the peat-ash to form calcium silicates and aluminates, although some of it still remains in the free state as quicklime. The peat-ash clinker contains 5 to 15 per cent. of peat by weight depending on the ash content and the method of calcining.

The peat-ash clinker is broken up and ground in a vibrating mill. During this process 5 per cent. of gypsum or plaster is added and the resultant product is the peat-ash cement. It is used as a binder for local building materials and for making rendering and plaster. Works for producing peat-ash cement have been installed in several towns. The annual production of each of them is over 8000 tons. In 1960, works will be erected in Gopkob and Bryan.

The information in the foregoing is abstracted from an article by K. Kablov in the Russian journal " Science and Life," No. 1, 1960.

PEAT-CEMENT CONCRETE.—It was stated in the Report of the Building Research Board for the year 1948 that an investigation had been made for the Department of Agriculture for Scotland of concrete made from granulated peat and cement. The object was to develop a material likely to be of use in the Western Islands where conventional building materials have to be transported long distances, and where peat has to be cleared from the site. A laboratory investigation showed that the partially dried peat, ground to pass a ¼-in. sieve, could be used in proportions of 3 : 1 by volume with cement. Lime to the extent of 10 per cent. and calcium chloride to the extent of 5 per cent. by weight of the cement were added to overcome the effect of the peat acids in delaying setting. Subsequently a cottage was erected at Uig, Skye, using cast-insitu peat-concrete for the walls and roof. Observations during two winters showed that no defects had developed, in spite of the high dimensional changes found in laboratory specimens. On the other hand, the material had a tendency to sweat persistently, due to the high calcium chloride content. Further laboratory tests indicated that the amount of calcium chloride could be reduced to 1 per cent. and with this proportion no dampness from this cause occurs.

[Enquiries made at the Building Research Station recently have resulted in the information that the investigation commenced in 1948 was not continued. The house was inspected a few years ago, when it was being used as a store by the Department of Agriculture for Scotland. It is reported that, except for a few cracks, the building is quite sound.—ED.]

A Method for the Determination of the Amount of Cement in Mortar and Concrete.

THE method of determining the amount of cement in mortar and concrete used at the Bihar Institute of Hydraulic Research, Patna, India, is described by J. N. MITRA and K. S. MUKHERJEE in "Cement and Concrete," July, 1960, from which the following description is abstracted.

The method depends upon the determination of the percentage of calcium in cement-sand mixtures. Calcium is precipitated in the hydrochloric-acid extract of a sample as calcium oxalate in the presence of glacial acetic acid without the elimination of the soluble silica and the sesquioxides. The proportion of cement used is determined from the amount of calcium present in the sample. The procedure is as follows. The sample is crushed to fine dust. If coarse sand had been used in the mortar or concrete, it is removed by passing the sample through a 40-mesh sieve. One gm. of powder is weighed accurately and digested in a pyrex beaker with 10 to 15 c.c. of 1 : 1 Hcl solution for about 5 minutes on an electric heater. The solution is then filtered and washed with hot distilled water, and made up to 100 c.c. Fifty c.c. of the aliquot is just neutralized with ammonium hydroxide (NH_4OH). Sufficient glacial acetic acid is then added just to dissolve the precipitates of Al_2O_3, Fe_2O_3, PO_4, TiO_2 etc. thus formed. Saturated solution of ammonium oxalate is then added in excess to the solution, and a copious white granular precipitate of calcium oxalate is obtained. This precipitate is then filtered and washed with distilled water and dissolved in hot 1 : 4 H_2SO_4

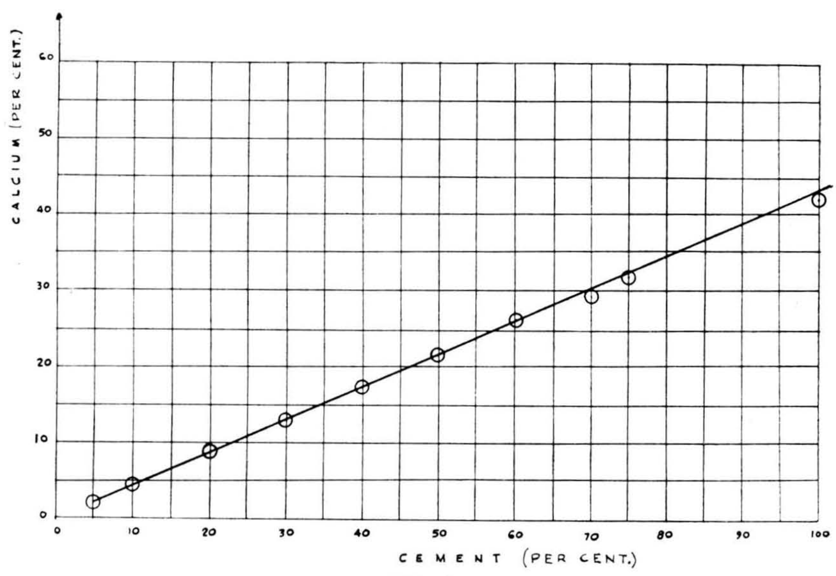


Fig. 1.

solution. The whole is then titrated with standard $KMnO_4$ solution to determine the percentage of calcium.

1 c.c. of a 0·1N solution of $KMnO_4$ = 0·002 gms. Ca.

= Vol. in c.c. of 0·1N solution of $KMnO_4$ required $\times 200 \times 0{\cdot}002$

= Vol. in c.c. of 0·1N solution of $KMnO_4$ $\times$ 0·4

After a series of determinations with different proportions of cement used in cement mixtures, mortars or concrete, have been made, a graph with the percentage of calcium as ordinate or abscissa and percentage of cement as other axis, should, in all cases be a straight line. From the graph it is easy to determine the percentage of cement used in any unknown cement-sand mixture, or concrete, when the calcium content of the sample has been determined by the foregoing method. Typical results of such an experiment are given in *Table I* and *Fig.* 1.

TABLE I.—PERCENTAGE OF CALCIUM IN CEMENT-SAND MIXTURES.

Sample No.	Cement in mixture (per cent.)	Calcium in freshly prepared sample. (per cent.)	Calcium in briquettes cured for 7 days (per cent.)	Calcium in briquettes cured for 28 days. (per cent.)
1	100	42·18	39·72	39·55
2	75	31·80		
3	70	29·50	29·10	29·03
4	60	26·45	26·20	25·20
5	50	21·52	22·70	20·55
6	40	17·31	16·80	17·15
7	30	13·01	13·04	12·96
8	20	8·86	8·84	8·65
9	10	4·46	4·44	4·21
10	5	2·26	2·22	2·02

NOTE.—CaO is slightly soluble in water. So it appears that a small portion of free CaO is washed away or dissolved in water while curing the briquettes. This may be the reason for the percentage of calcium used in cement-sand briquettes being slightly lower than in the freshly prepared mixture.

The results produced by this method are inaccurate if the cement is mixed with extremely calcareous sand or with free lime.

A New Cement Works in Australia.

A cement works is to be built near Geelong, Victoria, Australia, by the Associated Portland Cement Manufacturers Ltd. An Australian company, The Victoria Portland Cement Co., Ltd., has been formed to operate the works, which will incorporate modern methods of production. The works will have an initial productive capacity of 200,000 tons annually.

Problems on Cement Investigated by the Building Research Board.

SEVERAL matters relating to cement are being investigated by the Building Research Board, and are described by the Director of Building Research, DR. F. M. LEA, C.B.E., D.Sc., in his report* for 1959. Some of the problems dealt with are described in the following.

Constitution of Portland Cement.

The classical method of estimating the constitution of cement to assist in evaluating the contribution of the various minerals to the properties of the cement is to recast the chemical analysis in terms of the four main constituents: $3CaO.SiO_2$ (C_3S), $2CaO.SiO_2$ (C_2S), $3CaO.Al_2O_3$ (C_3A) and $4CaO.Al_2O_3.Fe_2O_3$ (C_4AF), but it is known to be subject to errors which for the aluminate and ferrite can be substantial. More direct methods are now available and good results have been obtained using the X-ray diffractometer, which was installed recently at the Research Station. It is possible to determine the main constituents quickly and with the following accuracy: C_3S, $\pm$ 2 per cent.; C_2S, $\pm$ 5 per cent.; C_3A, $\pm$ 0·5 per cent.; iron compounds, $\pm$ 0·5 per cent. The method is of particular use in evaluating the sulphate resistance of cements, since it is known that deterioration in sulphate ground-waters becomes more likely as the C_3A content increases.

Phosphate-bearing Raw Materials.

Work for Uganda Cement Industries, Ltd. was continued with both applied and fundamental studies of conditions affecting the quality of cement made from phosphate-bearing raw materials. The inclusion of fluorspar as a means of overcoming the difficulties associated with the presence of phosphates results in the formation of an increased proportion of tricalcium silicate with a corresponding decrease in the amount of dicalcium silicate. This would normally be associated with an increase in the strength of the cement, but with the addition of fluorspar the strength is not directly related to the content of tricalcium silicate. A similar effect can be demonstrated by making tests of the comparative strengths, using dicalcium silicate stabilized with phosphate. Studies of the system $2CaO.SiO_2$–$3CaO.P_2O_5$ have shown that there are four polymorphic forms of dicalcium silicate which, in the pure state, are stable only at successively higher temperatures, but which can all be stabilized at ordinary temperatures by the incorporation of increasing amounts of phosphate. The rates of development of strength of the four stabilized forms are contrasting, as shown in *Table I*, in which it is seen that small amounts of P_2O_5 are beneficial in encouraging the formation of the most hydraulic (β) form of dicalcium silicate, but that an excess of phosphate becomes increasingly harmful.

Slags for Cement.

Current practice, which favours the use of more dolomitic burdens in blast-furnaces, has led to the production of slags having a much higher magnesia content

* "Building Research, 1959" Published by Her Majesty's Stationery Office. 1960. Price 7s.

TABLE I.—DEVELOPMENT OF STRENGTH OF STABILIZED DICALCIUM SILICATE.

P_2O_5 added to $2CaO.SiO_2$ as $3CaO.P_2O_5$ (Percentage weight)	Form in which $2CaO.SiO_2$ is stabilized	Compressive strength of 1 : 3 mortar cubes (lb. per sq. in.)			
		3 days	7 days	28 days	6 months
0	γ	51	43	67	468
2·4	β	—	485	1837	4380
9·2	α^1	34	89	411	1683
23·6	α	nil	nil	nil	nil

than hitherto. Changes in operating practice may affect the suitability of the slags for making cements and aggregates, and for that reason a renewed study of portions of the quaternary system CaO–Al_2O_3–SiO_2–MgO is being made to determine the extent to which such slags may safely be used without incurring a risk of instability occasioned by the presence of free magnesia or unstable forms of dicalcium silicate.

High-alumina Cements.

In previous work at the Research Station on the constitution of high-alumina cement, some progress was made towards the identification of a fibrous mineral which had long been recognized as a common constituent. In recent work it has been established that the "quaternary compound" is a solid solution of variable composition of two ternary compounds, $2CaO.Al_2O_3.SiO_2$ (gehlenite) and $7CaO.5Al_2O_3.MgO$. No ternary compounds were previously known to exist in the system CaO–Al_2O_3–MgO. A partial re-examination of this system has shown that $7CaO.5Al_2O_3.MgO$ is formed only by solid-state reaction, but that another ternary compound, $3CaO.2Al_2O_3.MgO$, having very similar optical properties, also exists and can crystallize from the liquid within a very restricted range of composition. These results have a further significance in that a series of analogous compounds may possibly be formed in high-alumina cement by substitution of Fe_2O_3 for Al_2O_3, and FeO for MgO.

Supersulphate Cements.

The methods of differential thermal analysis and X-ray diffraction have been applied to the study of the cementing action of supersulphate cements. The slag used in the United Kingdom is rather lower in lime content than those normally used on the Continent. The proportions of Portland cement and anhydrite, which are added to catalyse the setting of the slag, have to be specially selected to suit the lower lime content. The criterion used was that all the calcium sulphate should be used up in the reaction to form calcium sulphoaluminate, leaving no excess which would form gypsum. It was found that the proportions selected on the basis of the mineralogical studies also gave the best performance in strength tests. The setting of supersulphate cement at high temperatures is now being studied. It is known to give satisfactory performance at tropical temperatures but does not always respond well to steam curing. The effect is probably associated with the ease with which calcium sulphoaluminate loses its water of crystallization.

Low-heat Slag Cement.

A British Standard for low-heat slag cement is being prepared. Tests to investigate the suitability of a concrete-cube compressive-strength test and a soundness test for slag cements have been undertaken. Doubts had been raised as to whether the concrete-cube test and the Le Chatelier test specified for other types of cement would be equally suitable for slag cement. When slag cements are tested by the test specified in B.S. 12: 1958 for ordinary and rapid-hardening Portland cements, over-sanded mixtures are necessary in order to fulfil the slump and " filled-cube " conditions required for the test. Two solutions are suggested. (1) Using the same water-cement ratio of 0·60 as for Portland cement but specifying a fine sand. (2) Using a water-cement ratio of 0·55. It had also been reported that the Le Chatelier test on specimens stored in boiling water was of little value for slag cements, and that a cold-water expansion test might be more suitable. A sample of supersulphate cement and a sample of high-slag cement of the Portland-blastfurnace type were supplied to each of four suitable laboratories. Each laboratory selected its own aggregate and carried out tests on the concrete using fine and coarse sand in conjunction with gravel or crushed rock as coarse aggregate. The results so far indicate greater variability between the different laboratories than had been experienced previously with Portland cement. Further tests are therefore being undertaken to find a reason for these discrepancies before the concrete test can be accepted for slag cements.

Japanese Cement Association.

Synopses of eighty papers presented to the Twelfth General Meeting of the Japan Cement Engineering Association, which was held in Tokyo in May 1958, have been published recently. The subjects of some of the papers dealing with Portland cement are as follows:—

X-ray analysis of pure synthetized C_3S and C_2S mixture.

The solubility of Mg in the ferrite phase by X-ray investigation.

The behaviour of particles of raw mixture in the burning process.

Effect of MgO on burning velocity.

The effects of MgO on the properties of Portland cement.

The texture and products shown on the surface and interior of cement paste in regard to $C_3A.3CS.H_{31}$.

Study of calcium-sulphoaluminate hydrate by radio-active isotopes.

Systematic dissolution of calcium silicate by organic-acid solution.

The system CaO-SiO_2-H_2O and its reacted solid phase at 20 deg. C.

The thermal decomposition of calcium-silicate hydrate.

The effects of calcium chloride on the rate of formation of calcium sulphoaluminate in the hydration of Portland cement.

Census of Production of Cement for 1958.

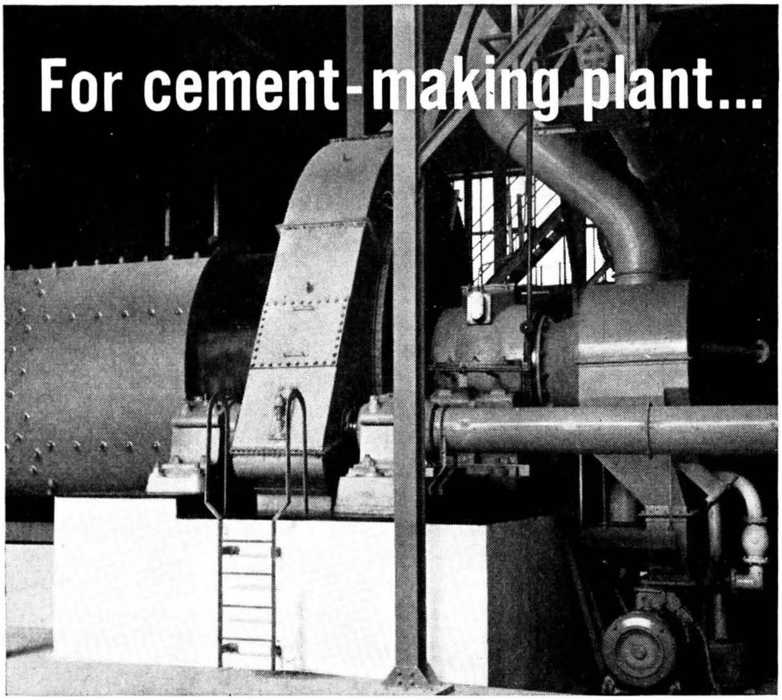
THE last census of this kind taken by the Board of Trade was in 1954, but for the purpose of the 1958 census a number of changes were made which affect a comparison of the two reports. One change is the requirement of full details only from firms employing twenty-five or more persons, whereas in the 1954 census the number was eleven or more. In addition firms were asked in 1958, but not in 1954, to give details of any ancillary activities, for example, whether they manufactured their own containers, or operated their own canteen, and whether or not these activities were carried on at the same address.

The cement industry is defined in terms of the principal products, that is Portland and high-alumina cements, clinker and other cements, but excluding refractory, gypseous and "plaster" cements which are covered in the report on Miscellaneous Building Materials (Part 109). In order that the closest possible comparison between the two reports can be made the statistics for 1954 have been re-tabulated, and on this basis the number of returns for 1954 and 1958 is sixty, which are divided into enterprises and establishments; an enterprise is where one or more firms are under the same ownership or control; an establishment comprises the entire premises under the same ownership or management at a particular address, but includes offices and ancillary places even though they may be at another address.

Among firms employing twenty-five or more persons, the value of sales for 1958 was £63,678,000 plus £1,362,000 for merchanted goods and canteen takings. Omitting the two latter items the sales for 1954 were £56,125,000. The total quantities of the various materials sold during 1958 are given as 11,411,000 tons of ordinary and rapid-hardening Portland cement, 786,000 tons of other calcareous and high-alumina cements, and for other cements, including clinker but excluding refractory, gypseous and "plaster" type cements, as 326,000 tons For 1954 the corresponding quantities were 11,506,000 tons, 555,000 tons, and 116,000 tons respectively. Sales of these products by establishments classified with other industries, such as the chemical and constructional industries, amounted to 307,000 tons in 1958 but were not given for 1954. Other than the principal products mentioned, the value of the sales of chalk, clay and limestone in 1958 was £78,000 and for plaster goods and other building materials £1,936,000. For 1954 the combined value of these products is given as £2,621,000. The total number of persons employed in the cement industry by firms having twenty-five or more employees, for the week ending October 25, 1958, is given as 12,512.

The report also includes statistics on the net salary and output per employee, classifying employees as operatives or administrative staff. Statistics are also given of the plant and vehicles acquired or disposed of in 1954 and 1958.

"The Report on the Census of Production for 1958 (Part 107—Cement)" is published on behalf of the Board of Trade by H.M. Stationery Office, price 1s. 9*d*. Details of the changes in the 1958 census are given in a separate booklet entitled "Introductory Notes" which forms Part 1 of the Report.



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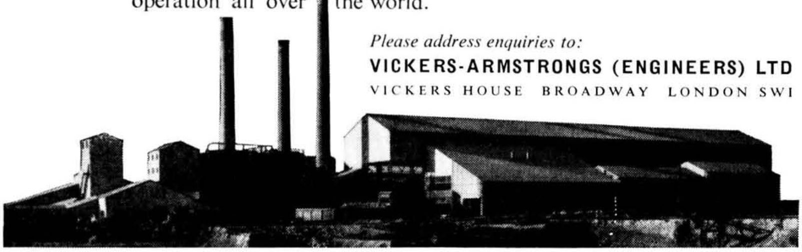


TGA BTE 319

Concrete in Sea Water.

The Effect of the Type of Cement.

IN "The Durability of Reinforced Concrete in Sea Water" (H.M.S.O.; price 4s.) is given the twentieth report of the Sea Action Committee of the Institution of Civil Engineers. The general conclusion emerging from the investigation, which commenced in 1929 is that the primary cause of the deterioration of reinforced concrete piles is the corrosion of the reinforcement and not disintegration of the concrete from the chemical or physical effects of the salts in sea water. In general it was found that with ordinary concrete those containing Portland cement only were less resistant than those containing Portland-blastfurnace cement but high-alumina and trass-Portland cements produced concrete more resistant than Portland-blastfurnace cement. The conclusions in detail are as follows.

The primary cause of deterioration of reinforced concrete piles is corrosion of the reinforcement and not disintegration of the concrete from the chemical or physical effects of the salts in sea water. The salts nevertheless influence corrosion, since this becomes progressively greater as the resistance of the cement to direct attack decreases. The cement content and the thickness of the cover of concrete over the reinforcement were of major importance in determining the durability of piles. With a 1 : $2\frac{3}{5}$ mixture and a cover of 2-in., no cracking occurred with any cement either in the first ten years of controlled exposure or in the subsequent thirteen years of uncontrolled exposure. This result applied also to the 1 : $\frac{2}{3}$: $4\frac{1}{3}$ pozzolana-concrete which in actual Portland cement content corresponds to 1 : 5. No corrosion of the steel was found on breaking the piles. With the more usual mixture of 1 : 5 by weight and with 2-in. cover, cracking occurred to a greater or lesser extent with Portland cement in the first ten years and became more accentuated in the subsequent thirteen years. Similar piles made with high-alumina, Portland-blastfurnace, and trass-Portland cements (corresponding to a 1 : 9 mixture in Portland cement content alone) were entirely free from cracking after ten years. After the subsequent thirteen years, piles containing high-alumina cement and trass-ordinary Portland cement mixture only remained uncracked, and on breaking these piles some corrosion of the steel was found in about half of both the trass-Portland cement and the high-alumina cement piles.

With 1-in. cover and 1 : $2\frac{3}{5}$ concrete, only the piles made with high-alumina and Portland-blastfurnace cements remained free of cracks after ten years and only with high-alumina cement after the subsequent thirteen years. Some corrosion of the steel over lengths of a few inches was, however, observed in the latter piles. With 1 : 5 concrete, only high-alumina cement concrete remained uncracked after ten years, but cracked later.

The results show that a 1 : 5 by weight Portland cement (ordinary or rapid-hardening) concrete and 2-in. cover is insufficient to guarantee protection against corrosion of the steel above low-tide level and that a richer mixture or thicker cover is required. Over a period of ten years, a 2-in. cover of 1 : 5 concrete sufficed to protect the reinforcement from corrosion with Portland-blastfurnace and trass-Portland cements, but after twenty-three years some of the piles with the former cement had cracked and also some of those with trass cement. High-alumina cement gave the best performance up to the twenty-three years, but the behaviour of this cement can be affected if a high temperature is reached within the concrete.

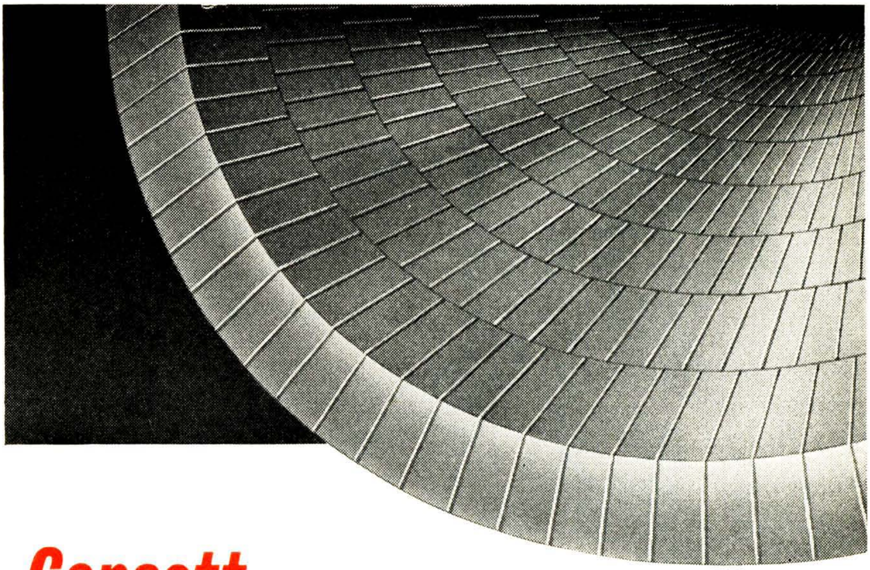
The Cement Industry in Europe in 1959.

THE statistics for the cement industry in Europe in 1959*, prepared by the Organisation for European Economic Co-operation, show an increase in production and consumption among member countries of 12 per cent. compared with the previous year. There are eighteen member countries, including Spain, which country joined the organisation recently and the statistics of which are therefore published for the first time. The member countries now account for 32 per cent. of the total world production of cement. The recovery from the recession of 1958 is due substantially to the increase in the construction of housing and public works. This recovery in relation to the cement industry is particularly significant as European exports as a whole fell slightly whereas exports of cement increased by 12 per cent. and in most countries the price of cement was reduced slightly.

The total production of cement by member countries in 1959 was 91,500,000 metric tons which is an increase of 12 per cent. over the 1958 production. All member countries increased their production. Germany remains the leading producer of cement in Europe with 23,882,000 tons followed by Italy 14,270,000 metric tons, France 14,145,000 metric tons, and the United Kingdom 12,800,000 metric tons. Of these countries, Germany achieved the greatest increase, the production for 1958 being 19,876,000 tons.

Production capacity of the member countries at the end of 1959 was 101,000,000 metric tons, an increase on that for 1958 of 6,000,000 metric tons. The increase resulted from the construction of eight new cement works, the installation in existing works of twenty-five new kilns, and improvements of plant. Of the new cement works, four are in Italy where the largest increase in capacity (1,150,000 metric tons) occurred, three in Spain, and one in Turkey. Six new kilns were installed in Germany during the year with a total capacity of 1,080,000 metric tons. No new cement works were established in the United Kingdom, but a wet-process rotary kiln having an annual capacity of 200,000 metric tons was installed. With one kiln at each of the new works, the total number of kilns installed by member countries in 1959 was thirty-three, of which fifteen are dry-process rotary kilns, eleven wet-process kilns, and seven are vertical kilns. Other than that due to new works and kilns, the balance of the increased capacity for 1959 is attributed to improvements to existing plant, and is about 790,000 metric tons.

*"The Cement Industry in Europe. 1959 Statistics". Published by the Organisation for European Economic Co-operation. Obtainable from H.M.S.O., London. Price 6*s*.



The statistics for increases in production and capacity allow for the closing down of some kilns.

The personnel employed in the cement industry within the organisation increased slightly during the year. The United Kingdom was second to Spain in this respect, the increase being 1135 persons in Spain and 700 in the United Kingdom. Six countries decreased their labour force while increasing their production; of these Italy, the second largest producer of cement in the organisation, was the most outstanding since production increased by 1,613,000 metric tons but the labour force decreased by 150.

With the exception of the United Kingdom, Spain, Portugal, and the Netherlands, all member countries exported more, and the decline in exports over the 1957-58 period was checked. The increase was greatest in trade between European countries (26 per cent.).

There was an increase of 14 per cent. in imports compared with 1958 and most imports represented trade between member countries. Germany was responsible for the greater proportion and imports in that country increased from 56,000 tons in 1958 to 147,000 tons in 1959.

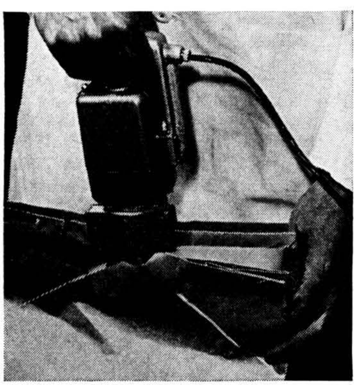
Clinker to the extent of 570,000 metric tons was traded among member countries during 1959; 122,000 tons were exported overseas.

The consumption of cement increased by 9,300,000 metric tons, compared with 1958, to 88,000,000 metric tons. Most countries increased their consumption, but the countries with the greatest increases were Germany, 4,100,000 tons, Italy 1,600,000 tons and the United Kingdom 1,000,000 tons.

The production capacity of the European cement industry is expected to be 109,000,000 metric tons by the end of 1961, when twelve new cement works are expected to be completed and forty-four new kilns are expected to be installed.

[All weights in the foregoing are in metric tons.]

A Portable Bag-opener.



The illustration shows a portable electric-power tool for opening multiple-wall paper bags, polythene and similar bags, and jute sacks. The cut can be made up to a distance of 4½in. from the top of the bag. The tool which weighs 5½lb., is made by the Thames Packaging Equipment Co., Ltd. (the successors to the Thames Sack and Bag Co., Ltd.) and is called the "Kleen-Kut."

Patent Applications.

Making Cement.

In the production of Portland Cement clinker, raw materials comprising precipitated chalk and argillaceous material are mixed with water to form a uniform plastic mud before being introduced into a kiln. The preferred raw materials, viz. the precipitated chalk produced by double decomposition of ammonium carbonate and calcium sulphate, and clay, may themselves provide the desired amount of water for the mud, i.e. 18 to 25% by weight.—No. 824,219. Imperial Chemical Industries Ltd., July 25, 1958.

Magnesia Cement.

A mixture suitable for preparing hydraulic cement comprises a magnesium oxide prepared by calcining a mineral containing magnesium carbonate at least twice with intermediate hydration, serpentine (magnesium bisilicate) and if desired also singly calcined magnesium oxide and/or powdered asbestos. A soap such as sodium or potassium oleate may also be present.—No. 820,081. E.C. Artemis, November 21, 1955.

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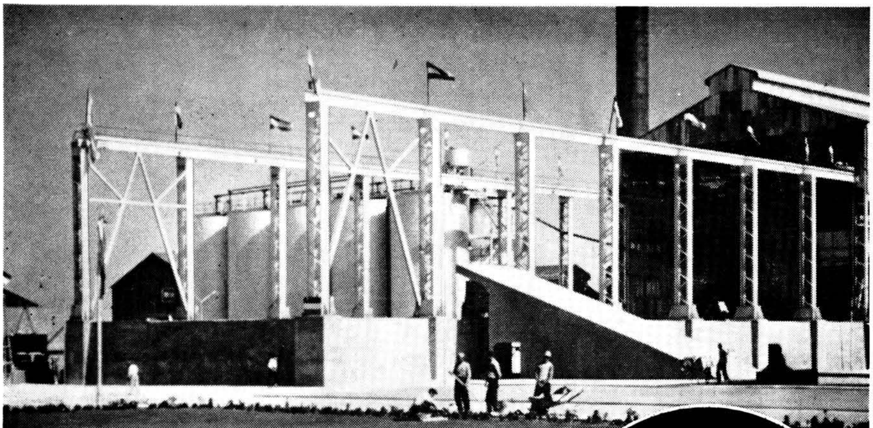

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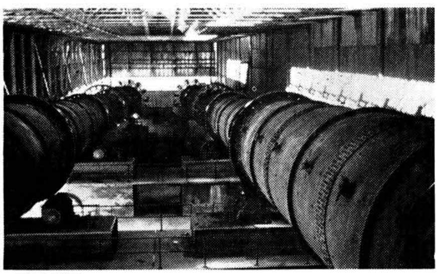

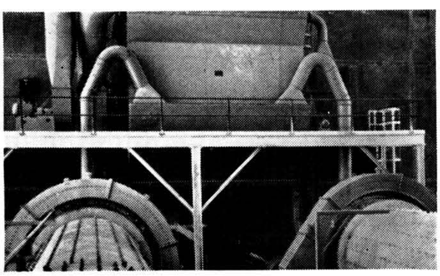

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