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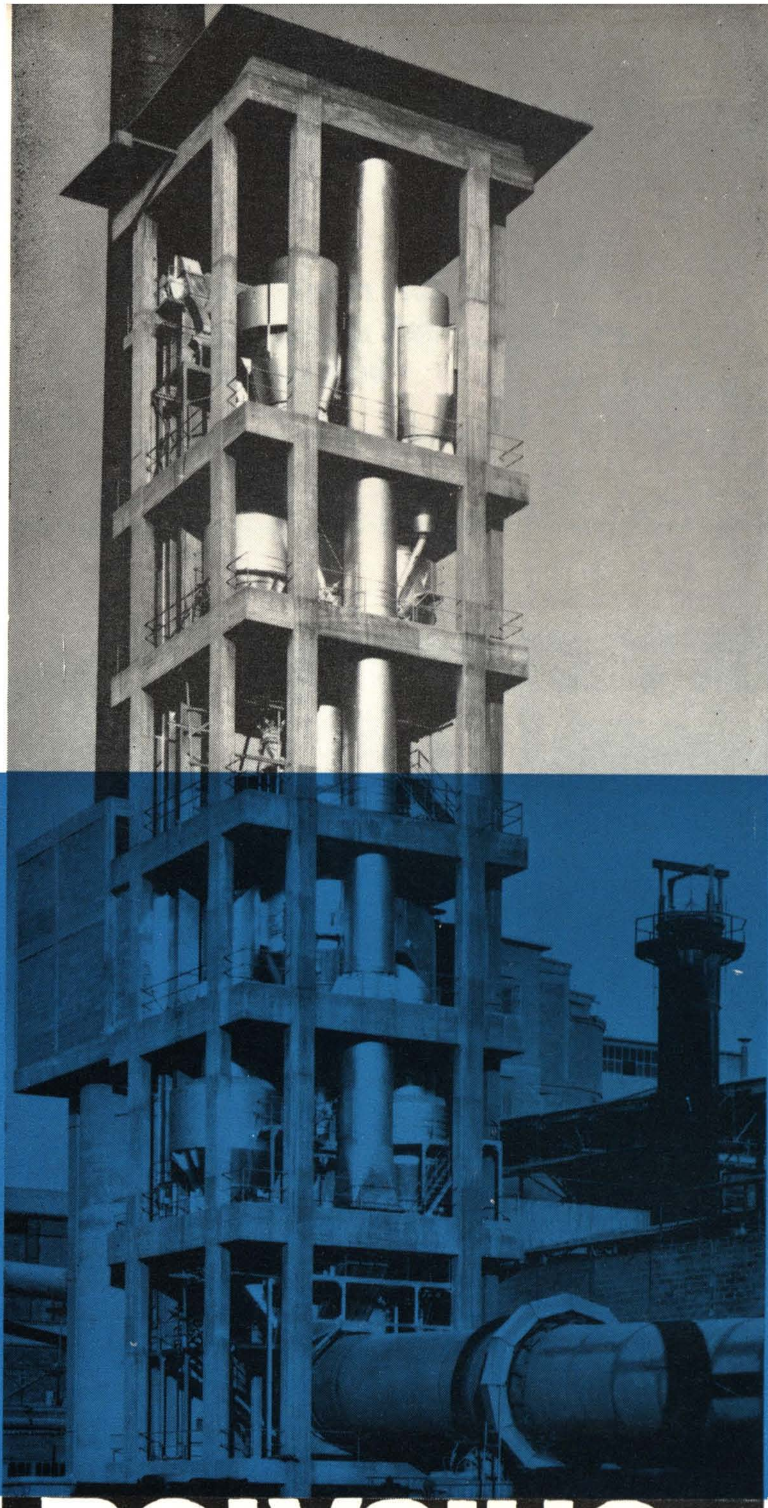

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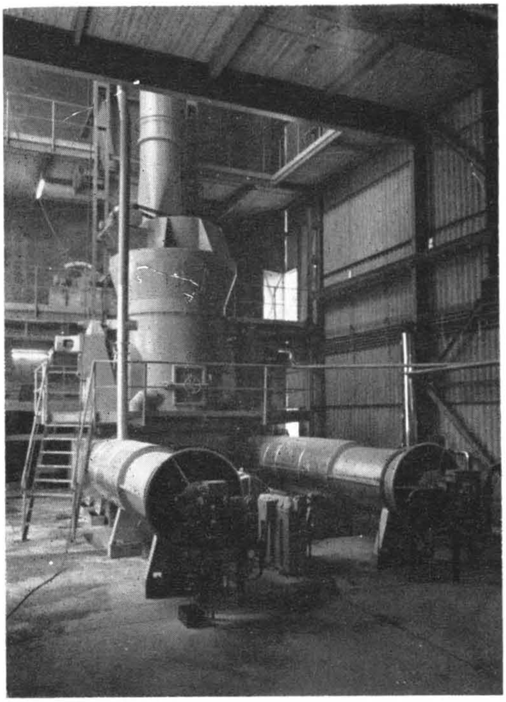

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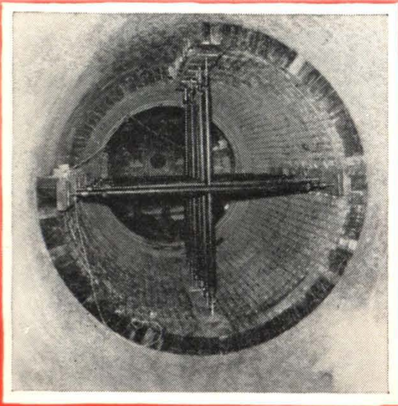

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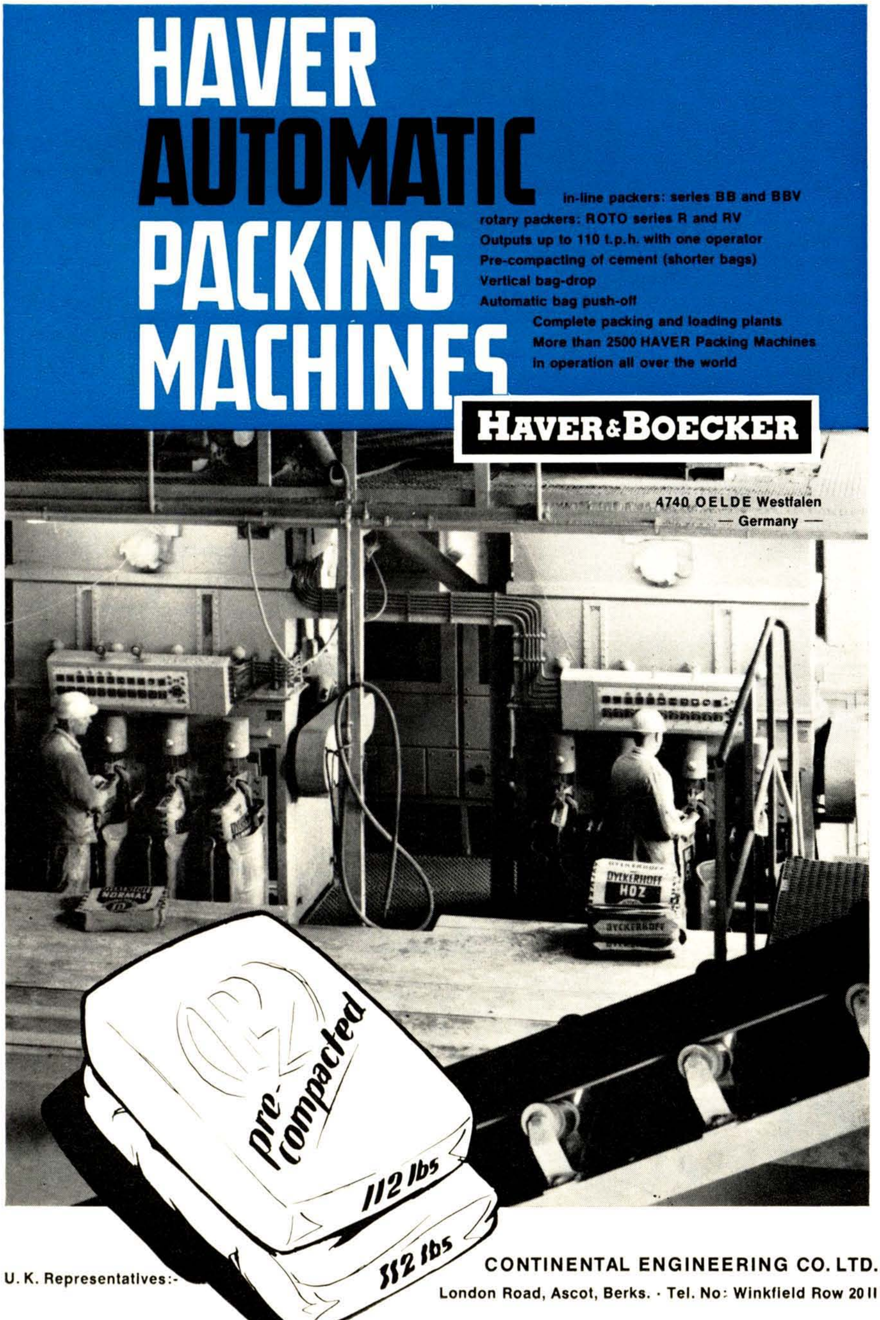
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Extensions to Westbury Cement Works.—II*

In the previous number of this journal, a description and illustrations were given relating to the preparation of the raw materials, the new 500-ft. kiln and ancillary equipment, and clinker storage at the works of The Associated Portland Cement Manufacturers Ltd., at Westbury, Wiltshire. In *Fig.* 13 in the previous article a plan of the works was given. In *Fig.* 14 (on page 40 of this number) is shown one of two Lawrence Scott commutator motors and Turbine-Gears gear-boxes driving the new kiln. The original kiln is seen in the background of this illustration.

In the following, the remainder of the extension is described.

Clinker Grinding.

The system for feeding the new cement mills is the same as in the original installation. The main belts which take the clinker and gypsum from the silos to the cement mills are at ground level, one at each side of the row of silos. Each conveyor delivers directly into the feed-chute of one of the two cement mills, which are side by side and parallel to the original mills. On both sides of each silo there is a variable-speed extractor-feeder of the belt type. The feeders on the three clinker silos discharge directly on to the main belts to the grinding mills.

At the gypsum silo, a Howe-Richardson belt-weigher (*Fig.* 15) is interposed between each extractor and the main conveyor-belts. Another Howe-Richardson belt-weigher (*Fig.* 16) is provided in each conveyor just before it reaches the mill, and gives the combined weight of clinker and gypsum being fed into the mill. Each weigher is linked with the weigher-feeder at the gypsum silo by a Honeywell controller set to give the required ratio of clinker to gypsum. The mill-feed is controlled manually by altering the speed of the clinker extractor-feeders, any change

*Continued from March 1966.

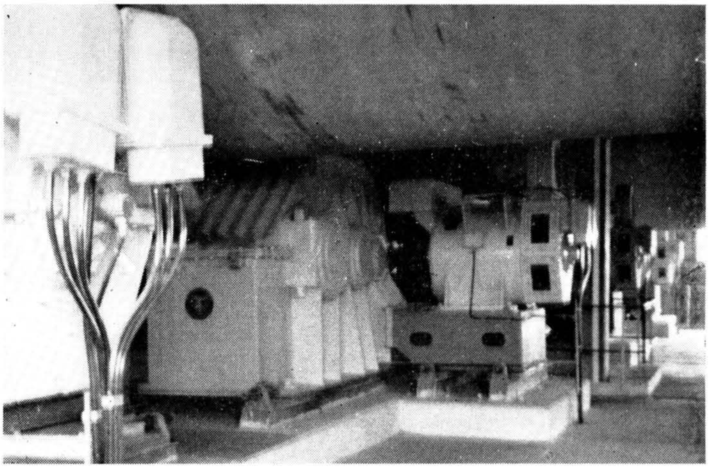

Fig. 14.—Kiln-drive Motor and Gear-box.

being followed up by the automatic control of the proportioning of the gypsum. The control panels (*Fig.* 17) are located in the mill-control cabin.

The two 1,200-h.p. Vickers compound mills are 45 ft. long and 8 ft. 4½ in. in diameter and contain three chambers. The mills operate on open-circuit and are

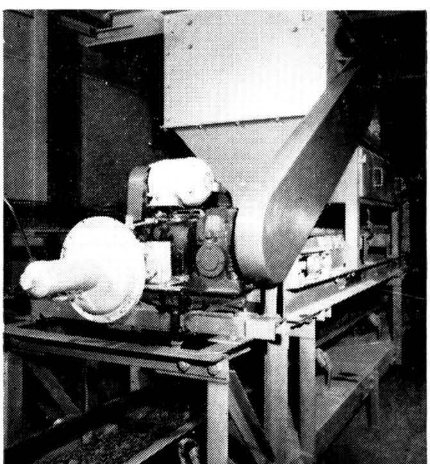

Fig. 15.
Extractor-weigher
for
Gypsum.

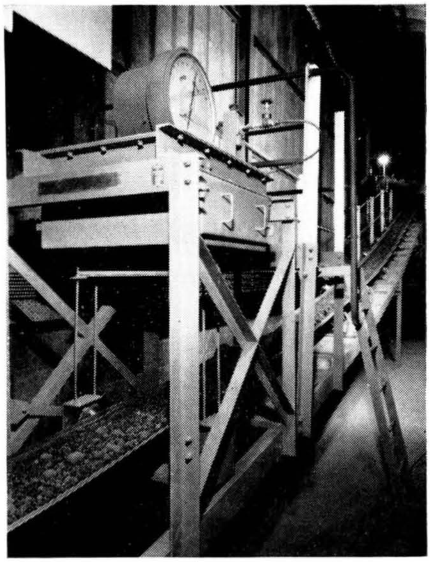

Fig. 16. Combined Clinker and Gypsum Weigher.

cooled by spraying water on to the shells. The discharge from the internal ventilation of each mill is purged through an electrostatic precipitator (*Fig.* 18) similar to, but smaller than, the units provided for the kiln gas. The mills are driven by

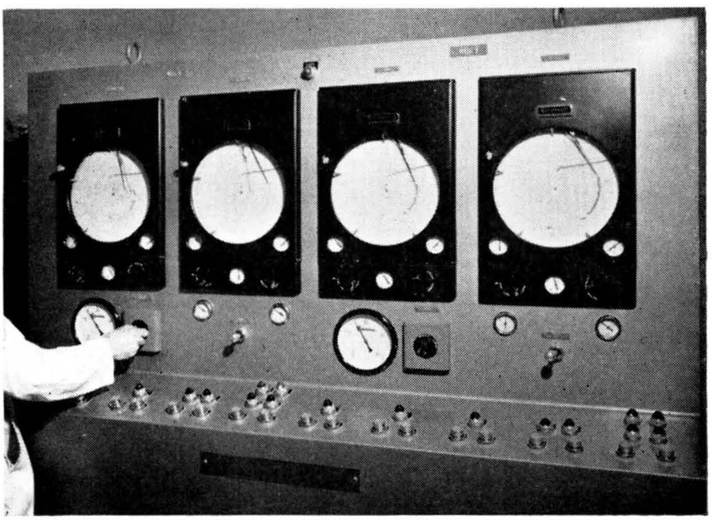

Fig. 17.—Mill-feed Control Panel.

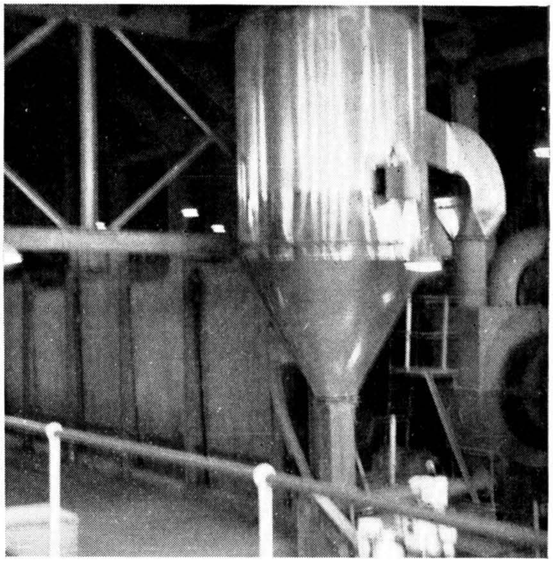

Fig. 18. Electrostatic Precipitator on Mill Ventilating System.

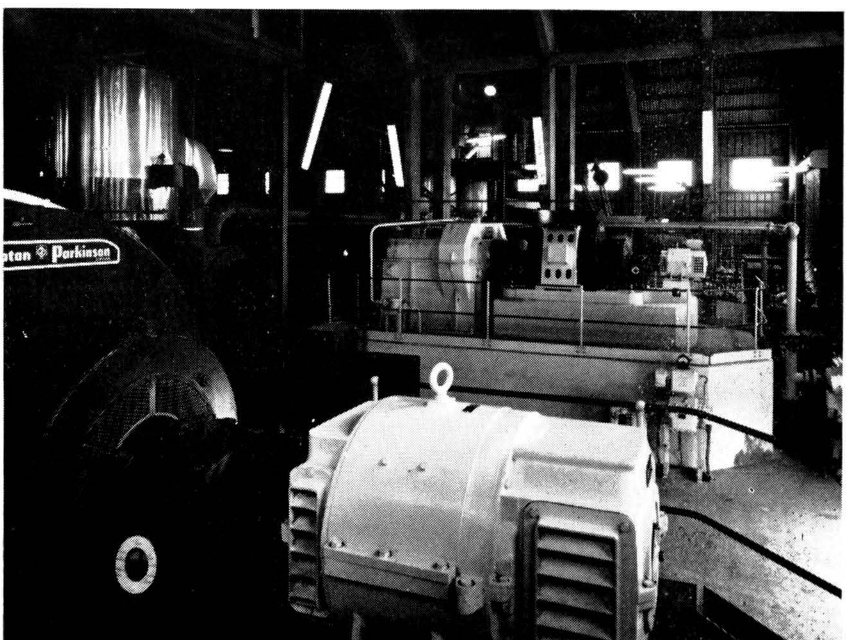

Fig. 19.—Mill Motor and Gear-box.

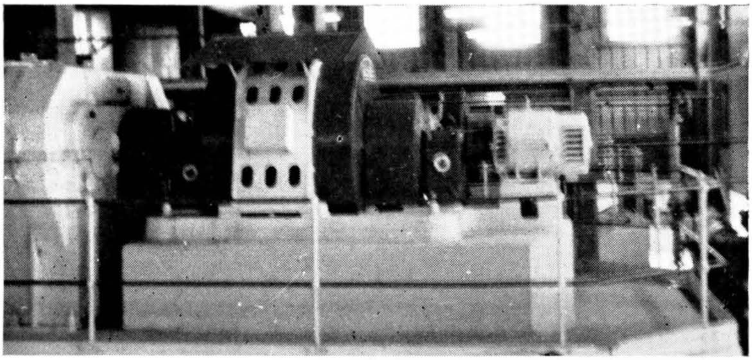

Fig. 20.—Mill Motor and Gear-box.

750-r.p.m. Crompton-Parkinson autosynchronous motors through double-reduction A.E.I. gear-boxes and torsion shafts connected to the discharge-end trunnion of the mill. This equipment is shown in *Figs.* 19 and 20.

The product of each mill is discharged through a Niagara vibrating screen to a Fuller-Kinyon pump which delivers it to the cement silos.

Cement Storage, Packing and Despatch.

Another four reinforced concrete silos have been added to the original line. Extraction is by " Airslides " into the existing 24-in. screw-conveyor, which has

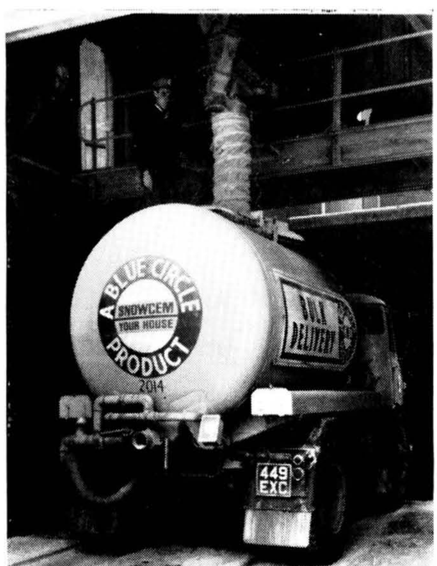

Fig. 21. New Bulk-loading Bay for Road Tankers.

been extended, or into a new 24-in. screw-conveyor which has been installed alongside it. Additional elevating and conveying equipment has been provided at the various loading stations. A new bulk-loading bay for road tankers has been provided (*Fig.* 21), and the bulk-loading bay for rail-wagons has been extended. A Rolltug creeper for marshalling the wagons has been installed in the bag-loading bay. The original twelve-spout Fluxo packer has sufficient capacity to deal with the additional load of bagged cement for road and rail transport.

General.

The additional electrical load is carried by the original substations, with the addition of two Crompton-Parkinson 1000-k.v.a. transformers for 415-v. supply.

The extensions were designed and the erection was supervised by The Associated Portland Cement Manufacturers Ltd. The chimney was designed by Messrs. Oscar Faber & Partners and was erected by the Mitchell Construction Co., Ltd. The main civil engineering contractors were Messrs. A. E. Farr Ltd. The precast concrete frames of the kiln building and clinker store were supplied by Messrs. A. & C. Barvis Ltd., and those for the cement-mill building were supplied by Messrs. F. & D. Hewitt & Co., Ltd. The wash-mill and the clinker store were constructed by Messrs. Ernest Ireland Ltd.

The various items of plant were supplied by the firms named in the descriptions in the foregoing. The MPS coal-mill and the drag-link feeder were supplied by P.H.I. Engineering Ltd. Electric motors, except where specified otherwise in the foregoing, were supplied by Messrs. Crompton Parkinson & Co., Ltd., and The English Electric Co., Ltd. The motor control equipment was supplied by Messrs. George Ellison Ltd., Messrs. Allen West & Co., Ltd., and Messrs. Dewhurst & Partners Ltd.

Opening of Weardale Works.

THE new cement works of The Associated Portland Cement Manufacturers Ltd., at Eastgate, Upper Weardale, Co. Durham, is to be officially opened on June 14, 1966. Production at the works, which has an annual capacity of 600,000 tons, commenced last June.

Silos at Ipswich Works.

FOUR 1,000-ton silos are to be installed at the works near Ipswich of The Associated Portland Cement Manufacturers Ltd. The structures, each of which is 30 ft. in diameter and 55 ft high, are of all-welded construction and are almost identical with the installation carried out last year at the A.P.C.M. works at Westbury, Wiltshire (see the preceding article). The consulting engineers are Messrs. Oscar Faber & Partners, and the main contractors are the Mitchell Construction Co., Ltd. The silos are to be installed by Aberdare Engineering Co.

Hydration of Alkali Minerals in Clinker.

A CONTRIBUTION to the further understanding of the hydration of cement has been made by I. A. Kryzhanovskaya, V. M. Mirak'yan and their co-workers, who published an account of their investigations in the September/October, 1965 number of the Soviet journal, " Tsement," from which the following is abstracted and translated.

The nature of the compounds formed in clinker in the presence of alkalis and their effect on the hardening of cement is still not properly understood. It is known that alkalis in the slurry react first with SO_3 forming sulphates. Alkalis in excess of the molecular equivalent of SO_3 react with other oxides forming $KC_{23}S_{12}$ and NC_8A_3 which changes the mineral compounds in the clinker and has a marked effect on the properties of the cement. With the build-up of high-alkali dust from the filters in the kiln, the probability of alkali compounds forming in the clinker is increased.

The majority of investigators consider that $KC_{23}S_{12}$ represents a solid solution of K_2O in C_2S while NC_8A_3 is a solid solution of Na_2O in C_3A. There is a difference of opinion about the rate and character of the hydration of these complex compounds.

To study the hydration, both the alkali minerals and β—C_2S and C_3A were prepared by calcining synthetic mixtures made from pure reagents. The chemical compositions of the products agreed closely with the theoretical values.

Petrographical examination of the $KC_{23}S_{12}$ showed that in the main the sample consisted of irregular or rounded particles with a relatively low birefringence and a fibrous structure. The refractive indices were 1·702 and 1·695 which agree with the published data. X-ray studies showed that the X-ray pattern for $KC_{23}S_{12}$ was very similar to that for β—C_2S and differed only in the intensity of the lines which is in accord with Nurse's data.(1) The mineral NC_8A_3 appears under the microscope to be rounded to hexagonal in shape with refractive indices of 1·702 and 1·711, birefringence of 0·010 and negative elongation. The X-ray pattern of NC_8A_3 is like that of C_3A but with the following difference: the strong C_3A-lines are split; the 23 deg. 45 min. line with d=1·91Å at 1·89 and 1·92Å and the 29 deg. 36 min. line with d=1·56Å at 1·55 and 1·56Å.

The hydration of the minerals β—C_2S, $KC_{23}S_{12}$, C_3A and NC_8A_3 was studied in pastes of normal consistency and with a water-mineral ratio of 10. The hydrating mineral specimens were treated with absolute alcohol and ether to arrest the hydration. They were finally dried in a chamber at room temperature to constant weight and the amount of chemically combined water was then determined.

In *Table* I, data are presented on the chemically-bound water in the hydrated minerals. The similar amounts of chemically-bound water in β—C_2S and $KC_{23}S_{12}$ and also in C_3A and NC_8A_3 at all ages confirms that the hydration rates are approximately the same and possibly that they form similar reaction products. A computation of the degrees of hydration for the minerals shows that at twenty-eight days they are: for β—C_2S, 17·9 per cent.; for $KC_{23}S_{12}$, 18·8 per cent.; for C_3A

TABLE I.

Mineral	Percentage of chemically bound water with pastes of normal consistency after				Percentage of chemically-bound water with water/mineral ratio of 10 after			
	1 day	3 days	7 days	28 days	1 day	3 days	7 days	28 days
–C_2S	0·32	1·05	1·16	3·11	0·64	0·98	1·48	4·83
$K_{23}S_{12}$	0·50	1·98	2·02	3·20	0·86	2·70	4·40	4·96
C_3A	17·10	18·86	19·52	20·77	21·00	22·30	23·94	24·45
NC_8A_3	12·24	15·78	16·62	18·86	17·76	20·56	21·88	22·39

73 per cent., and for NC_8A_3, 70·9 per cent. The degree of hydration of NC_8A_3 is large even in the first day of hardening while with $KC_{23}S_{12}$ hydration is very slow.

Analyses of the waters taken up by the minerals $KC_{23}S_{12}$, β—C_2S, NC_8A_3 and C_3A when gauged with a water-mineral ratio of 10 are interesting. The water taken up by NC_8A_3 corresponds to the hydration of 72·3 per cent. of the total Na_2O after one day's hardening and to 85·4 per cent after 28-days' hardening.

Most of the excess Na_2O first holds the Al_2O_3 in solution forming sodium aluminate and preventing its hydrolysis and secondly suppresses the solution of lime which has an adverse effect on the development of strength of the cement. No lime is found in the water taken up by NC_8A but the Al_2O_3 in solution is about six times more than in the water taken up by C_3A. Analysis of the water taken up by $KC_{23}S_{12}$ shows that hydration takes place extremely slowly. After one day of hardening only 10 per cent. of the total K_2O in the $KC_{23}S_{12}$ is found in solution, and this increases up to 20 per cent. in twenty-eight days.

It is known that calcium-aluminate hydrate reacts with gypsum with the formation calcium sulpho-aluminate hydrate. As NC_8A_3 resembes C_3A in its hydration properties, it is of interest to study whether calcium sulpho-aluminates are formed as the result of reaction between NC_8A_3 and gypsum. For this work, experiments were carried out on the reactions of C_3A and NC_8A_3 in saturated gypsum solutions. The solution over each precipitate was removed daily and replaced by fresh saturated gypsum solution. The SO_3 content of the liquor removed was measured each time. For three days the daily determinations revealed the absence of SO_3 ions in the solutions. This confirms that the amount of gypsum taking part in the reaction is the same for both C_3A and for NC_8A_3.

Analysis of the solid residues after three days' reaction with gypsum showed that the Na_2O content was 0·17 per cent. compared with the initial amount of 5·8 per cent. of Na_2O. So, as a result of the short three days' hydration of NC_8A_3 in saturated gypsum solution, 97 per cent. of the Na_2O is transferred to solution while the calcium sulphate reacts with the residual calcium aluminate.

Taking into account the experimental results, the reaction for the hydration of NC_8A_3 in the presence of gypsum and calcium hydroxide can be represented by the equation

$$Na_2O.8CaO.3Al_2O_3+9CaSO_4+Ca(OH)_2+31H_2O \longrightarrow 3(3CaO.Al_2O_3.3CaSO_4.31H_2O)+2NaOH.$$

An investigation of the hydrated minerals β—C_2S and $KC_{23}S_{12}$ by DTA did not reveal any differences. This is confirmation of the zeolitic linkage of the chemically-bound water on hydration. The DTA-curves for C_3A after hydration show two endothermic peaks. The first is at 320 to 340 deg. C. and represents the loss of water from calcium-aluminate hydrate. The second is at 490 to 520 deg. C and can be explained by the thermal decomposition of tricalcium aluminate.(2) (3)

The DTA-curves for hydrated NC_8A_3 show four endothermic peaks. The first and second (100 deg. and 180 deg. C.) are possibly due to the presence of hexagonal $C_3A_{aq.}$(4) Similar peaks with C_3A-curves are very weak and it can be taken that with the hydration of alkali calcium aluminate it is more difficult to convert the hexagonal $C_3A_{aq.}$ into the cubic C_3AH6. The third endothermic peak (300 deg. to 340 deg. C) is apparently also due to the loss of water from calcium-aluminate hydrate and the fourth peak (450 deg. to 490 deg. C.) marks the thermal decomposition of the calcium aluminate with the production of free lime as with C_3A.

The similarity of the hydration products of β—C_2S and $KC_{23}S_{12}$ and of C_3A and NC_8A_3 was also verified by electron microscopy. Preparations of β—C_2S and $KC_{23}S_{12}$ were made by Bernard's method(5) and preparations of C_3A and NC_8A_3 by the suspension method.

In the hydration products from $KC_{23}S_{12}$, even after hardening for five hours, comparatively large fibrous crystals of hydrosilicates, partly in the form of spherolites were observed. In addition to these fibres there was a significant amount of fine threads of hydrosilicates and also plates of $Ca(OH)_2$. In preparations one day old, conglomerations of crystals and foil-like plates could be observed. It is also of interest that such conglomerations were also present in the hydration products of β—C_2S but only after hardening for seven days. In the preparations from hydrated β—C_2S, apart from the fine fibres, a characteristic of $KC_{23}S_{12}$, there were also particles which were significantly longer.

Studies on the products of hydration of C_3A are similarly described in many papers. There are hexagonal plates of various dimensions, octagonal shapes generally showing up in specimens seven days old, spherical particles, agglomerates of the fine parts of the gel. The hydration products of NC_8A_3 also consist principally of hexagonal plates, the amount of particles of gel being significantly greater in this case. There is a greater tendency for conglomerates to form with NC_8A_3 from the hexagonal particles. Octagonal particles are not found.

The electron patterns for the hexagaonal plates indicated that they were basically the same from both C_3A and NC_8A_3 hydrates. The most intensive reflections correspond with inter-planar spacings of 2·861Å, 2·464 to 2·466Å and 1·649 to 1·651Å, which is characteristic of C_3AH_8.

Conclusions.

The research which has been carried out on the hydration processes with

$K_2O,23CaO.12SiO_2$ and $NaO_2.8CaO_2.3Al_2O_3$, which are present in clinkers where the molar ratio R_2O and SO_3 exceeds unity, enables the following conclusions to be drawn.

$KC_{23}S_{12}$ hydrate slowly. The water in the hydrated compound is bound zeolitically and, on raising the temperature, is lost in stages. The hydration rate of $KC_{23}S_{12}$ is close to that of β—C_2S. Their hydration products are similar. The growth of the alkalis in solution proceeds slowly with the hydration of $KC_{23}S_{12}$.

NC_8A_3, like C_3A, hydrates rapidly with almost complete transference of Na_2O into solution. The water in the hydration production is bound constitutionally and is given off at 300 deg. to 340 deg. C. NC_8A_3 absorbs gypsum from gypsum solutions and forms calcium sulpho-aluminate hydrate. With the hydration of NC_8A_3 a significant amount of Na_2O is transferred to the liquid phase even in the early days of hardening, which lowers the solubility of lime (CaO) and the conditions for the cement to harden are made worse with increasing Na_2O content. This is an important point with regard to the making of cement from waste materials from the production of alumina which have a high alkali content.

The similarity of the hydration processes with β—C_2S and $KC_{23}S_{12}$ and also with C_3A and NC_8A_3 supports the opinion expressed earlier that $KC_{23}S_{12}$ is a solid solution of K_2O in β—C_2S and NC_8A_3 is a solid solution of Na_2O in C_3A.

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Publication Received.

Refractories for Cement.—A new brochure produced by the Steetley Group of Companies gives detailed information relating to the application of their refractory products in rotary kilns. Details of installation, techniques, brick sizes, combinations and properties of the full range of various products available to the cement manufacturer are included. Among the data given are some examples of the life of burning-zone linings of standard magnesite-chrome bricks, from which the following are abstracted.

Method of Firing	Length of Burning Zone	Diameter of kiln	Months of service
Oil	30 ft.	9 ft. 10 in.	20
	40 ft.	11 ft. 10 in.	18
	45 ft.	11 ft. 10 in.	45
Coal	17 ft.	12 ft.	36
	19 ft.	12 ft.	40
	20 ft.	12 ft.	43
	25 ft.	12 ft.	39

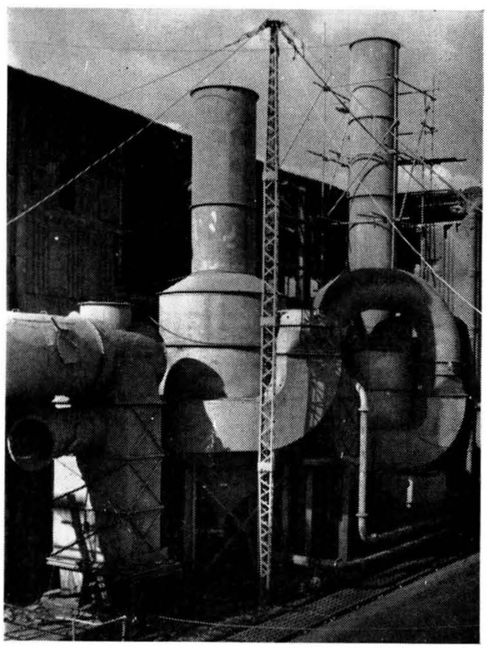
Wet Scrubber for Gas Cleaning.

PARTICULARS have been received of a new plant for the extraction of dust from gas or air flows by means of a wet-scrubbing process. The equipment is suitable for use in many industries, and two scrubbers (*Fig.* 1) have been installed in a cement works in this country for collecting raw-meal dust which is passing electrostatic precipitators. The inlet burden is of the order of 1 grain per cu. ft. at 180 deg. F. It is claimed that the low requirements of power and water with this equipment has resulted in a considerable saving in capital outlay and maintenance costs. The performance chart reproduced in *Fig.* 2 indicates the likely efficiency of operation with burden of various sizes.

The plant, a diagrammatic view of which is shown in *Fig.* 3, is a vertical machine with a narrow waist resembling two cyclone collectors superimposed one on the other. The gases enter the scrubber tangentially through a scroll attached to the lower half. The bottom half of the scrubber is fitted internally with a vertical concentric screen consisting of plates perforated with slots. Both sides of the screen are flushed continuously with water, or other solvent, which is withdrawn from the bottom cone and recirculated from two points, one of which is near the top of the screen and the other at the top of the scrubber inlet.

The hot gas first passes through a spray-header in the inlet duct, where it is cooled and wetted before going to the scrubber itself. As the wet gas is admitted tangentially into the scrubber, it is forced through the perforations of the screen

Fig. 1.



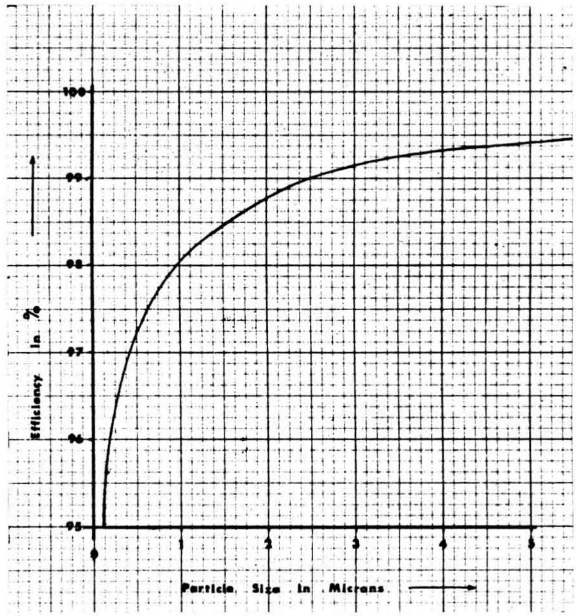


Fig. 2. Performance Chart.

where it is washed by the water flowing over the screen. The wetted solids are washed down into the bottom cone from which they are withdrawn and pumped through a small hydro-cyclone. At this point, the coarser solids are drawn off and sent to a thickener for the removal of excess water, the remainder of the liquor being recirculated to the scrubber.

The energy of the gas, as it passes through the screen, is used to atomise some of the liquor which, continuing to spin, assists diffusion and partition of the gas and is finally forced upwards through the narrow waist, still with a spinning motion. The mechanically entrained water and solids are thus separated from the now cleaned gas which is then passed to a heat recuperator or to atmosphere.

Some particulars of these scrubbers which have been installed in cement works are as follows:

At a wet process works in the U.S.A. a 14-ft. scrubber is fitted to each of the three kilns which are 11 ft. in diameter and 375 ft. long. The scrubbers deal with 160,000 cu. ft. of kiln gas per minute, the temperature of the gas being 550 deg. F. and 60 per cent. of the dust being less than 5 microns. The inlet burden is about 7·5 grains per cu. ft. and the exhaust burden 0·06 grains per cu. ft. The pressure drop is 1·5-in. water-gauge, and the exit temperature is 160 to 170 deg. F.

In the installation illustrated in *Fig.* 1, which is at the works of the Associated Portland Cement Manufacturers, Ltd., at Cauldon Low, Staffordshire, two 10-ft. scrubbers are employed to clean the air discharged from air-swept raw-meal grinding mills at this semi-dry process works. They have been installed after,

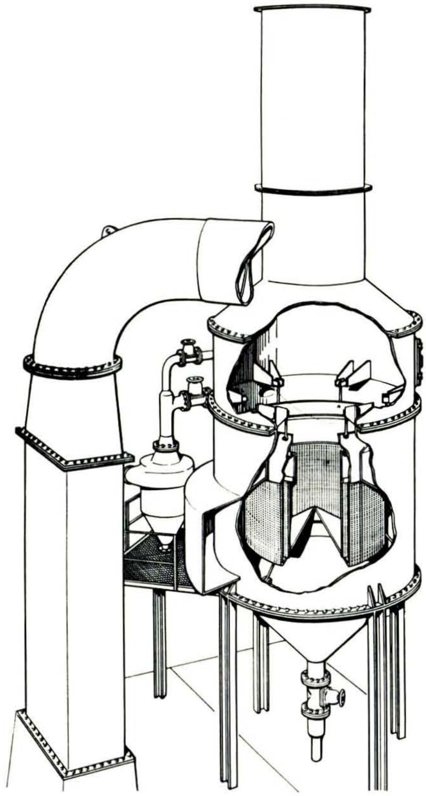


Fig. 3.

and in series with, the electrostatic precipitators originally installed in the circuit. They receive about 50,000 cu. ft. of air per minute at a temperature of 180 deg. F., with a dust burden of about 0·83 grains per cu. ft. The particle size is 98 per cent. below 50 microns and about 40 per cent. below 5 microns. The air is discharged at 120 to 130 deg. F., with a dust burden of about 0·09 grain per cu. ft. The pressure drop is 9-in. water-gauge. The underflow from the hydrocyclone is used in the nodulisers producing the nodules for feeding the Lepol kilns.

The plant is called the CVX wet-gas scrubber and is manufactured under a U.S.A. patent by Techno Handling, Ltd., which firm is the licensee in the United Kingdom.

Congresses and Symposium.

Chemical Engineering Congress and Exhibition.

THE Fourth Congress of the European Federation of Chemical Engineers is to be held at Olympia, London, from June 15 to 24, 1966. (A preliminary notice and brief particulars of the technical programme were given in this journal for January last.) Collaborating authorities are the Ministry of Technology and the Institution of Chemical Engineers. The Secretariat is at the Institution of Chemical Engineers, 16 Belgrave Square, London, S.W.1, from which office can be obtained a booklet giving full particulars of the Congress and a summary of each of the papers to be presented. The main theme of the Congress is the " Interaction of Technology and Economics in Process Plant".

Concurrently with the Congress, there will be an International Chemical and Petroleum Engineering Exhibition, which will also be held at Olympia.

Chemical Engineering Congress 1967.

THE 1967 European Meeting of Chemical Engineering and the Fifteenth Achema Congress is being organised to be held at Frankfurt-am-Main from June 21 to 29, 1967. Preliminary booklets have been issued in English, German, French, Italian, and Spanish and may be obtained gratis on application to DECHEMA Deutsche Gesellschaft für chemisches Apparatewesen E.V., 6 Frankfurt (Main) Postfach 7746.

The Congress comprises a programme of lectures and technical discussions dealing with the following subjects.

Conducting reactions on a technical scale. Chemical transformations in fluidised and fixed beds. Exit-gases, effluents, and waste products. Low-temperature technology. Sealing problems in chemical technology. Rapid methods and automation in analysis. Chromatographic methods. Measurement techniques. Process control. Material and corrosion problems with new chemical or modified processes. Plastics as structural materials for chemical plant. Applications of methods of operational research to problems of chemical technology.

The associated exhibition will demonstrate works' methods and equipment, construction of plant, accident prevention and packaging.

International Symposium on Cement Chemistry.

THE Fifth International Symposium on the Chemistry of Cement is to be held in Tokyo in October, 1968. It is being organised by the Japan Cement Engineering Association. The subjects of the working sessions will include the chemistry of cement clinker, the hydration of cement, the properties of cement paste and concrete, and admixtures and special cements. The official language of the working sessions will be English and all papers will be written and delivered in English, as will also the discussions.

Those interested in the Symposium can obtain further information from The Organising Secretariat, c/o Japan Cement Engineering Association, 1 Akasaka-Daimachi, Minato-ku, Tokyo, Japan.

An Early Cement Kiln.

It is not generally known that there was once a thriving cement industry at Sandsent near Whitby, and that "dogger" stone was quarried (or mined) in the cliffs along the coast in this part of Yorkshire. The cement works at Eastrow, Sandsent, was owned by John Griffiths. Five men were employed at the kiln to mine, in the cliff face below Lythe church, for the stone which produced the cement. The kiln, which was about 20 ft. high, was built of stone and had a conical brick interior. It is still standing as shown in the accompanying illustration, and is near the car park at Eastrow. Most of the ancillary buildings have collapsed; all that remains of them is the cooper's hut where the barrels to hold the cement were made, and the remnants of the water-wheel which drove the grinding mill.

The stone occurs in a band in the cliffs, and drift mining was first undertaken just behind Sandsent railway station, and later below Lythe church, where the mining was carried out 200 ft. down the cliff face and penetrated inwards so far as to be under the church itself. The stone was extracted with picks and shovels, and it was then carried to the entrance of the workings and hauled up the cliff face by a crane and deposited on a flat ledge about 50 ft. from the top. Here it was transferred to a flat truck which was hauled up a ramp to the top by horses. It was then loaded on to farm wagons in loads of 30 cwt. each, and taken down Lythe Bank along the seafront to the kiln. One Christmas, the workings collapsed and a new drift was opened at Kettleness farther along the coast.

Stone was also collected from the beach, where it had fallen from the cliff, and in fine weather small boats called "cobles" were loaded with the stone. Other stone was collected from the beach at Saltwick, at the other end of Whitby bay, and brought to Eastrow in a coble. Smaller amounts were found in Eastrow beck, and the collector was paid 4*d.* per basket. There were two kinds of dogger stone, one being known as "cheese dogger" because of its smell when broken; the latter stone was of no use for making cement.

At the kiln the stone was broken into pieces 4 in. to 6 in. in size and placed in layers with wood and a sprinkling of coal until the kiln was filled. The kiln was lit on a Friday afternoon and burned until Monday morning, when the workmen began to dig out through the two archways at the base. The grey stone had become yellowish in colour, and broke easily. It was screened out from the ash. Any unburnt stone went back into the next charging of the kiln.

The next stage in the process was to grind the burnt stone to a powder, first, by means of coarse stones, and then through a fine mill. The resultant yellow powder was then packed into sacks and barrels, the latter being made at the cement works. Power for grinding the stone came from a water-mill, just below the kiln. Water was led through wooden troughs for a mile through Mulgrave Woods, weirs being provided to regulate the flow. The mill-wheel also worked a saw-bench to cut up timber for estate use and for the wood required to fire the kiln.

The finished cement is reported to have set fairly quickly. It would set in water, and was very useful for the construction of Sandsent sea-wall, for it would set firmly before the tide could wash it out again. It was also used for the bottom of wooden ships, and much was sold to a large national cement concern which, it was said, used to mix it with its own product. Production at Eastrow ceased in the early 1930s, when cement produced by modern methods made it uneconomical to carry on.

The foregoing was contributed by Mr. J. Tindale.

Cement Industry Abroad.

Philippines.—The English Electric Co., announced recently that the firm had been awarded the contract by the Republic Cement Corporation of Manila, for the supply of electrical equipment and motor drives for the third extension of the Corporation's cement works at Norzagaray, about 30 miles north of Manila. The extension will increase the daily productive capacity of the works to 50,000 bags. It is estimated that the total annual output will be 6,000,000 bags, which is about five times the output when the original works began operation in 1957. The first and second extensions were completed in 1959 and 1963 respectively.

The motors in the new installation are four 1,500-h.p. synchronous induction

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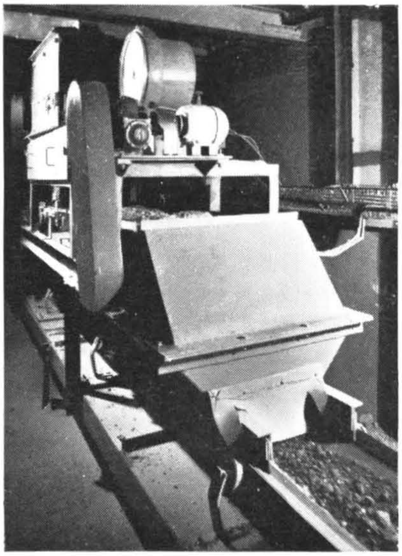
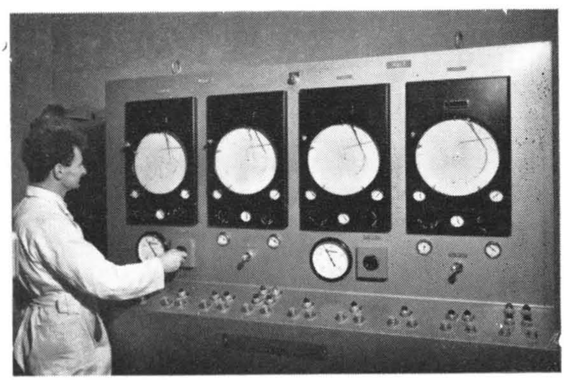


Gypsum Weigh Feeder comprising Extraction Conveyor and Weigh Feeder Conveyor

Mill Feed Control Panel showing Clinker and Gypsum Recorder/Controllers



Materials handled include: limestone, clinker, gypsum, raw meal, chalk, shale, pyrites, clay coal, etc.

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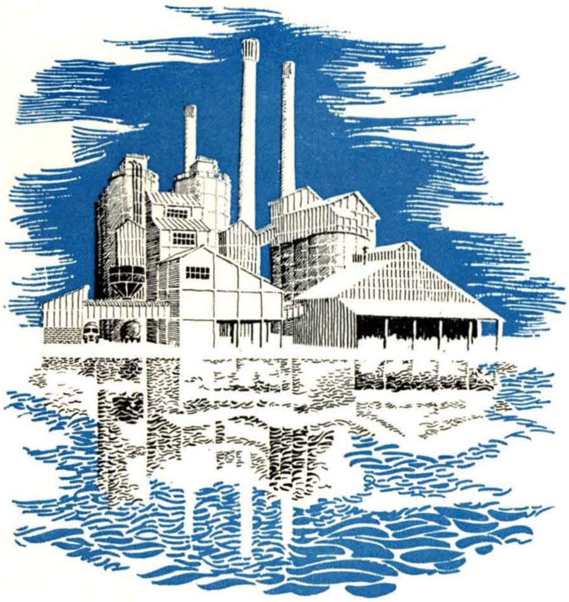
To be economic the production of portland cement must be a continuous uninterrupted process. All of Vickers equipment, whether a component or a complete plant is designed and made to ensure reliable, continuous and profitable plant operation.



World demand for cement continues to rise, bringing with it the requirement for more manufacturing plant—extensions to existing works, complete installations. More and more, particularly with developing countries, the requirement is for turnkey projects, complete plants ready for operation as soon as the labour force moves in.

Vickers is uniquely placed to meet any requirement for cement-making machinery. A special Division, devoted exclusively to the Industry, is composed of experienced chemists, designers and engineers, backed by world-renowned engineering facilities.

A Complete Service

Experienced design engineering teams are available to travel to any part of the world to discuss projects on the spot. The closest liaison is maintained with all leading cement producers, keeping Vickers abreast of world cement market trends and requirements.

Manufacture and Design

The works are at Barrow-in-Furness, Lancashire, England, whilst other engineering and manufacturing facilities are available at Vickers works and associates in Australia, Canada, India, South Africa and Vickers licensee in Spain. Full advantage is taken of this engineering capacity, enabling kilns and grinding mills of the largest capacity and rating so far in use anywhere in the world to be offered to customers. Up to the present day Barrow Works alone has made and delivered over a hundred and twenty kilns and a hundred and fifty grinding mills.

A specialist staff of chemists and engineers is concerned with the development and application of new equipment and techniques, many of which have been initiated by Vickers.

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Construction and commissioning on site is carried out under the surveillance of Vickers engineers, and local labour employed during this period can be trained to operate the factory.

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Vickers have been producing specialised machinery for the cement and allied industries for over forty-five years. Equipment has been supplied to leading manufacturers in many parts of the world and an extensive service network has been built up. Plants operating in Australia, Belgium, Canada, Ceylon, Hong Kong, India, Mexico, New Zealand, Rumania, South Africa, Zambia, have all provided experience in meeting varying conditions of operation.

Further information

For further information please contact the Cement Machinery Division (Sales), Vickers House, Millbank Tower, Millbank, London SW1. Telephone: TATE Gallery 7777. Cables: Vickers London.

Technical queries to

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Cement Machinery Division
Engineering Group
Vickers-Armstrongs
Barrow Engineering Works
Barrow-in-Furness Lancs England
Tel: Barrow 3366. Ext 129

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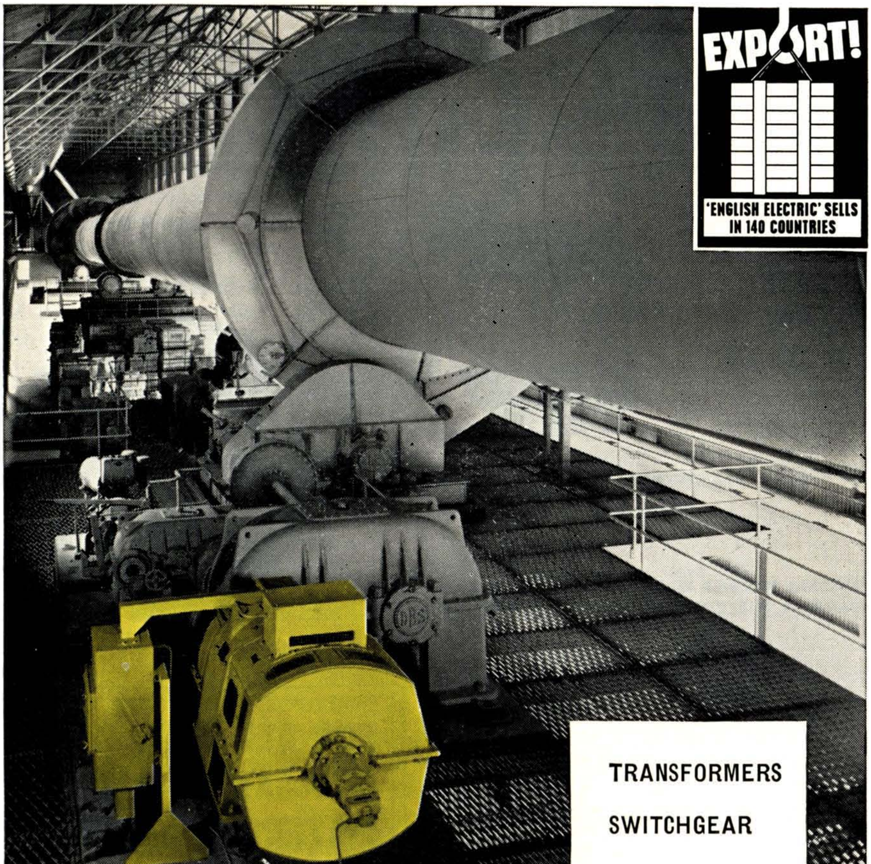
motors for the raw-mill and cement-mill drives, a kiln-drive motor of 100 h.p., a 900-h.p. motor for the raw-mill blower, a 500-h.p. motor for the kiln-exhaust fan, a 700-h.p. motor for the crusher, and a number of smaller motors down to 1 h.p. There is also a main transformer, high-tension switchboard and switchgear for the outdoor substation, four distribution transformers, six low-tension distribution boards and motor-control centres, and a main control desk at which there will be given indications of the state of production in the other two extensions to the works.

Switzerland.—What is claimed to be the most modern cement works in Europe, and which has cost about £5,000,000 and took two years to build, commenced operation in April last. The works is at Cornaux near Neuchatel in Western Switzerland. Initially the annual productive capacity will be 2,000,000 tons, but the works is designed for a two-stage rise in production to 600,000 tons. It is estimated that in 1966, some 160,000 tons of cement will be produced and sold.

The works were built by Juracima S.A., a firm which was founded in 1961 and is associated with the Jura Cement Fabriken Aarau-Wildegg. The plant is centrally controlled and employs ninety workers. The main product will be Portland cement, but there will also be produced a high-resistance "Granite" cement which at three days, has the same strength as Portland cement at twenty-eight days.

The site is on the western bank of the River Zihl between Neuchatel and the Lake of Biel and is well placed for despatch of the cement and for long-term supplies of raw materials. The limestone is quarried and crushed in the nearby Jura Mountains by plant having a capacity of 200 tons per hour, and is transported by a belt-conveyor 2,150 m. (about 7,000 ft.) long. The conveyor passes through a tunnel 400 m. (about 1,300 ft.) long. One hundred tons of marl per hour is being obtained locally. There are three raw-materials silos, each of which has a capacity of 2,100 tons. The raw materials mill has a capacity of 60 tons per hour. The materials are mixed and processed, 13 per cent. of water being added. The homogenising silo, which has a capacity of 3,200 tons, is 43 m. (140 ft.) high. The kiln is 54 m. (177 ft.) long and is in the open air. It produces 700 tons of clinker daily, and consumes annually about 20,000 tons of heavy oil and 20,000,000 to 25,000,000 kwh. of electricity. Seventeen modern filter plants are installed to deal with dust. The chimney is 80 m. (261 ft.) high. The clinker store has a storage capacity of 32,000 tons, and the gypsum silo has a capacity of 400 tons. The cement mill produces 45 tons an hour, and the cement is stored in three silos which are 42 m. (137 ft.) high; each has a capacity of 2,800 tons. The cement can be despatched in bulk or in bags.

Cement production in Switzerland, which was 600,000 tons in 1939, increased to 4,000,000 tons in 1965. Four cement works have been established since the end of World War II. The centre of the industry is in Canton Aargau, where three works provide about 40 per cent. of the requirements. These works have to despatch most of their output from the northern part of Switzerland to other parts of the country. The new works at Cornaux is better situated geographically both from the point of view of transport and availability of raw material.



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Book Reviews.

Analytical Techniques for Hydraulic Cements and Concrete. (Philadelphia: A.S.T.M. 1966. Price $4.75.)

This book was recently published as document STP 395 by the American Society for Testing and Materials. In one hundred pages, it covers more or less thoroughly, the complex subject of analysing cement and concrete, and includes the analytical processes necessary to solve many of the problems created by innovations in the cement and concrete industries. The trend in these industries is to modify Portland cement by incorporating materials that, when interground in very small amounts with the cement clinker, assist in the grinding operation or improve the storage properties of the cement. Other materials, when added in very small quantities to the concrete during mixing, improve some of the properties of the concrete. It has, therefore, become necessary to develop means of identifying and determining the amounts of the materials added to cement or concrete and of studying the physical characteristics of hardened concrete containing admixtures. The analytical processes, which are described in detail, provide the means of determining the nature of the minerals and of the organic materials in cement, of revealing the properties of hydrated-cement paste, and of determining the causes of failures of hydrated-cement paste to perform satisfactorily.

Mikroskopie des Zementlinkers. (Dusseldorf: Beton-Verlag GmbH. 1966. Price 54 DM.)

The feature of this book of seventy-six large pages is the collection of some 151 clear photographic illustrations of sections of cement clinkers as viewed under the microscope. The illustrations and accompanying text, which is entirely in German, is based on the work of several German investigators including F. Gille, I. Dreizler, K. Grade, H. Kramer and E. Woermann. The specific magnification (mainly around 1000) of the sections is stated under each of the photographs which make up this "picture atlas." This is a book that should be found to be useful not only in a cement company's research department, but as an excellent visual source of information for students of cement chemistry.

Crushing and Screening Plant for British Cement Works.

At the works at Clitheroe, Lancashire, of Ribblesdale Cement Ltd., a new plant is being installed to deal with the difficult limestone containing shale and sticky boulder clay. The equipment will include a Pennsylvania reversible impactor and four Hewitt-Robins "Eliptex" horizontal screens. A feed of minus 8-in. limestone will be passed at the rate of 700 tons per hour to the two primary double-deck screens which will be 8 ft. wide and 16 ft. long. These will remove the minus $\frac{3}{4}$-in. material, the remainder being passed along conveyors to a 150-ton surge bin. A variable-speed apron-feeder 78-in. wide, installed below the surge bin will feed the impactor which is designed to reduce the minus 8-in. plus $\frac{3}{4}$-in. limestone down to a nominal $\frac{3}{4}$-in. product at a rate of up to 600 tons per hour. The crushing plant is designed to operate in closed-circuit with two secondary double-deck screens also 8 ft. wide and 16 ft. long which handle the re-crushed stone. The pairs of primary and secondary screens have top decks arranged for scalping purposes only. Another 78-in. variable-speed apron-feeder and another impactor are also to be installed as stand-by equipment. Attention has been paid to the design of the surge bin and chutes in order to minimise the adverse effect of the adhering clay, and for this reason the lower decks of the screens are to be equipped with electric mesh heating.

Two similar double-deck " Eliptex " horizontal screens are to be installed at the works of the Ketton Portland Cement Co., Ltd., near Stamford, Lincolnshire. These machines will be arranged in series and are designed to separate minus $\frac{3}{4}$-in. limestone at a rate of 700 tons per hour.

The equipment described in the foregoing is being supplied by Fraser & Chalmers Division of G.E.C. (Process Engineering) Ltd. Messrs. Thos. W. Ward Ltd., are installing the plant.

Two of the largest primary impact breakers in the world are to be supplied by Sheepbridge Engineering Ltd. (a member of the Sheepbridge Engineering Group) to Messrs. Thos. W. Ward Ltd., for installation in the two cement works mentioned in the foregoing. Each crusher is a 60-in. by 72-in. Sheepbridge-Kennedy double rotor cuber impact breaker and weighs 100 tons; each is driven by two 300-h.p. motors. The machines will reduce 40-in. cube quarried limestone and shale to a 5-in. product at the rate of about 700 tons per hour.

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