CEMENT & LIME MANUFACTURE

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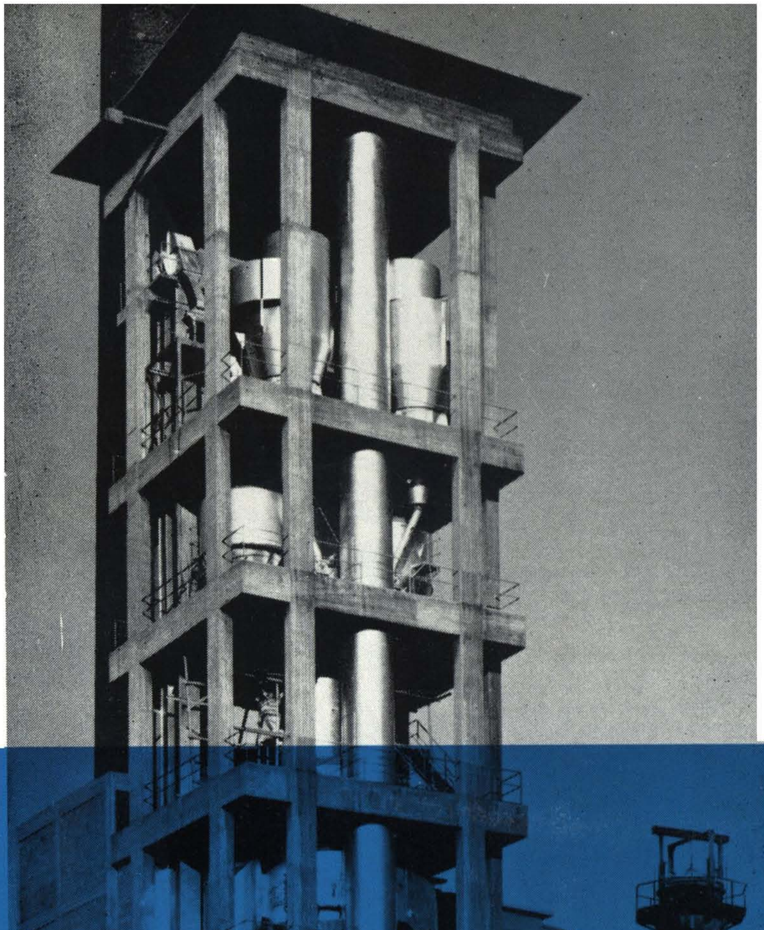

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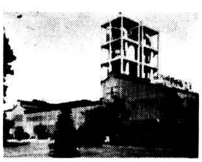

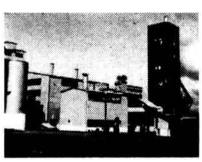

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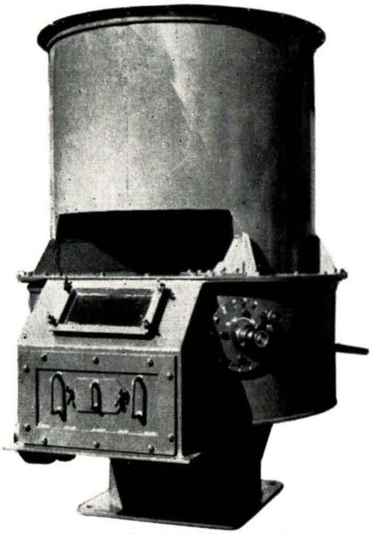

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VOLUME XXXIX NUMBER 5 SEPTEMBER, 1966

The New Weardale Cement Works.*

IN the number of this journal for July last, a description was given of the quarrying operations, the preparation of the raw meal, and the firing section of the new works recently opened by The Associated Portland Cement Manufacturers Ltd., at Weardale, Co. Durham. In the following the processes subsequent to burning are described. Flow-diagrams for each of the sections of the plant from the quarry to the despatch section are given in *Fig* 25 (pages 84 and 85).

Auxilliary Kiln Plant.

ELECTROSTATIC PRECIPITATORS.—Each bed of nodules on the preheating grates absorbs a high proportion of the dust entrained in the gases leaving the kiln. The dust remaining in the gases is extracted by electrostatic precipitators (*Fig.* 18) before the waste gases are discharged via the final fan into the base of the 400-ft. reinforced concrete chimney.

Each of the precipitators, which were supplied by the Western Precipitation Division of Joy Sullivan Ltd., is of the plate type and comprises two chambers arranged in parallel and individually capable of taking the full flow of gas in the event of a fault occurring in the other chamber. The plates, which are of 16-gauge mild steel and are placed 9 in. apart, are interspersed with electrodes of 0·1055-in. diameter plough-steel wire placed at intervals in the direction of flow of the gas. Pneumatic rappers are provided for the plates and the electrodes. High-tension uni-directional current is supplied by totally enclosed silicon rectifier-transformer units equipped with automatic voltage controls of the transistomatic type. Castell locking of the isolators, earthing switches and all entries into the precipitator makes access impossible until isolation and earthing has been carried out.

INSTRUMENTATION AND CONTROL.—Automatic control of the Lepol semi-dry process plant is more complicated than in the case of a wet process. The principle adopted is to control some of the more important variables to pre-determined

*Continued from July 1966.

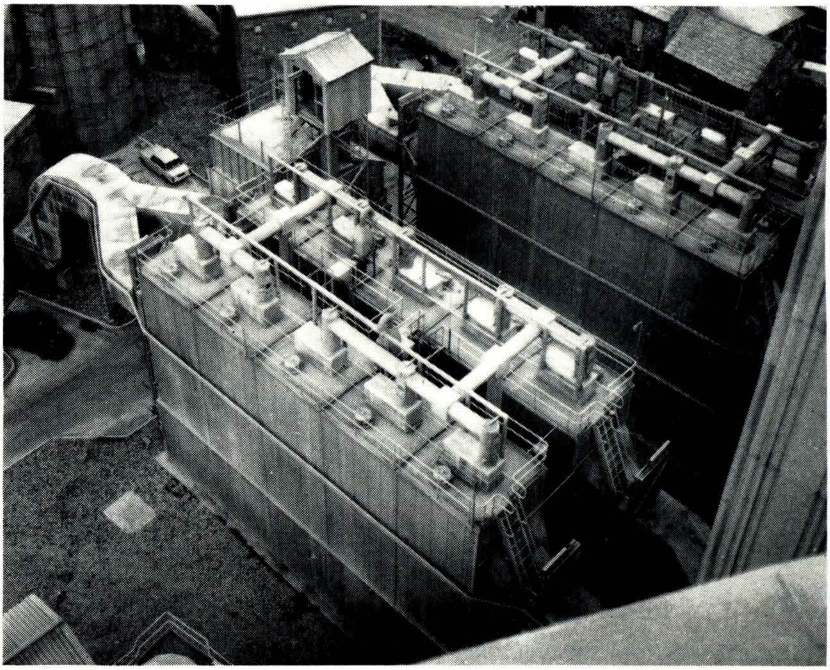
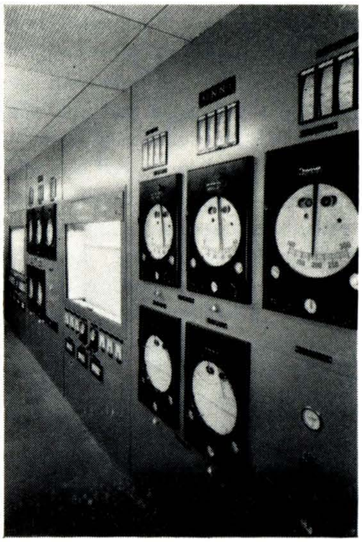


Fig. 18.—Electrostatic Precipitators for Kilns.

Fig. 19.
Kiln
Instrument
Panel.



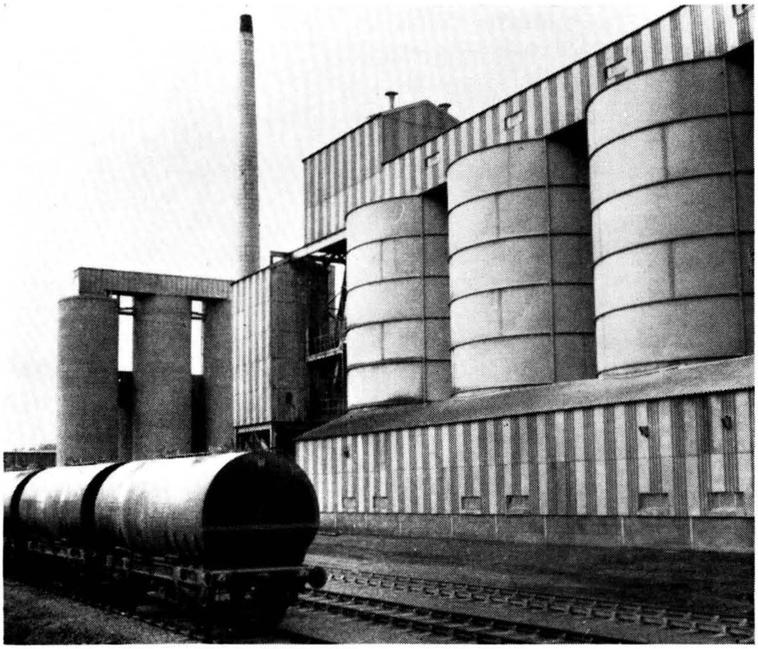


Fig. 20.—Clinker Storage Silos.

levels. This control, coupled with weight control of the nodule input, tends to make some of the disturbing factors affecting the equilibrium of the burning process more uniform.

The variables controlled are the exit temperature of the coal mill, the input of cooler-air, the over-grate pressure balance of the Lepol grate, and the kiln-hood pressure. These controlled variables are recorded together with a number of the other temperatures and pressures throughout the system. Instruments and electric controls are situated in a common cubicle on panels which include mimic diagrams of each kiln and alarm annunciator panels.

The electric control panels are quite separate from the instrument panels, thus avoiding any risk of confusion between the wiring circuits which work on different voltages.

Honeywell Servotronik movements are used to make records of the prime variables in a row across a single wide chart, each instrument having a separate band of the chart with its appropriate scale. The whole of the records are thus obtained on one piece of paper which simplifies daily removal and scrutiny for control purposes. The instruments in the raw-meal preparation section are arranged similarly. The wide-chart opening can be seen clearly in *Fig.* 19 which shows the kiln instrument panel.

Clinker Conveying and Storage.

The clinker grate-coolers are fitted with hammer breakers which reduce oversize pieces of clinker and these then pass with the fine clinker through a drag-chain conveyor onto either of two Clarke-Chapman steel-trough catenary conveyors. Each conveyor has a designed capacity of 200 tons per hour, at a speed of 50 ft. per minute, which greatly exceeds the output from the two kilns, and thus allows for any surge in the discharge. Below the outlets from the coolers, the conveyors are horizontal for a length of 70 ft. Thereafter they are inclined at 5 deg. while passing along a subway below the works road. Following this section, one conveyor is inclined at $17\frac{1}{4}$ deg. and the other at 36 deg. so as to discharge into separate steel distribution hoppers which are arranged for transfer of the clinker into the silos of the grinding mill or to a reserve store. Conveying to the silos is effected by two Bagshawe inclined bucket-elevators having a vertical lift of 65 ft. followed by two 15 in. Redler drag-chain conveyors each 129 ft. long.

The silos are of steel and are 30 ft. in diameter and 55 ft. high. There are eight silos, installed in two rows of four each, having a total capacity of 1,000 tons. Three of each group of four silos are allocated for storing clinker, the remaining one in each group being for storing gypsum. The clinker silos are shown in *Fig* 20.

The gypsum is delivered by road, the vehicles discharging into a hopper at ground level. By means of a short belt-conveyor, the gypsum is fed into one

Fig. 21.—Cement Grinding Mills.

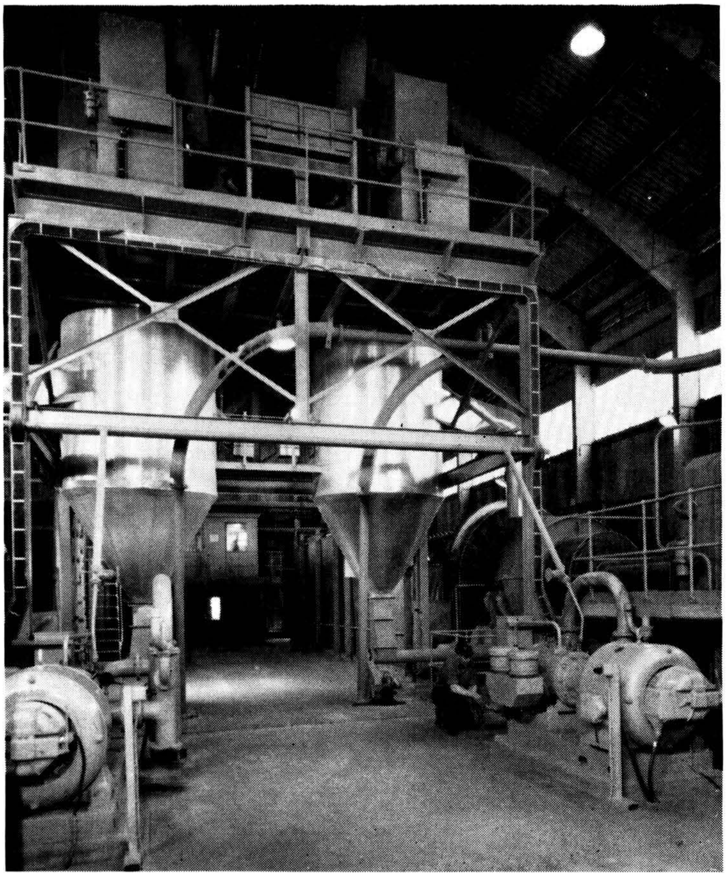


Fig. 22.—Electrostatic Precipitators at Cement Grinding Mills.

of the aforementioned bucket-elevators and drag-chain conveyors while clinker is being handled by the other. The clinker and gypsum are extracted from the bases of the silos by Howe-Richardson extractors which discharge onto four belts, one on each side of the two rows of silos, feeding four cement mills. Weighers are combined with the gypsum extractors. Each belt has a Howe-Richardson weigher giving the combined weight of clinker and gypsum. This weigher is linked with the gypsum extractor-weigher by a controller set to give the required ratio of gypsum to clinker whatever the rate of feed to the mill.

Grinding and Cement Storage.

GRINDING.—Four cement mills are installed in two pairs (*Fig.* 21) in the building which also contains the drive motors and reduction gears.

The mills have shells 45 ft. long and of 8 ft. $4\frac{1}{2}$ in. internal diameter. They are supported at both ends on white-metal self-aligning trunnion bearings of 3 ft. diameter, with provision for longitudinal expansion at the feed end of the mill. Each mill is divided internally into two chambers by a steel grid diaphragm. The feed-end chamber is lined with manganese steel plates and the following chamber is lined with NI-hard plates with helically-pitched ridges constituting a "classifying" lining. The chambers are loaded with steel grinding media of various sizes. Each mill shell is placed under suction by a fan through an electrostatic precipitator, a pair of which are seen in the background of *Fig.* 21 and more clearly in *Fig.* 22. The dust discharges into the main flow of cement from the mill. Each mill is driven by an A.E.I. 1,200-h.p. 3·3-k.v. auto-synchronous induction motor coupled to a double-reduction divided-drive locked-train gearbox transmitting through a speed reduction of 750 to 20·5 r.p.m. The output shaft of the gearbox is coupled by two flexible couplings and a torsion shaft to a flange on the outlet trunnion journal of the mill.

Cement leaving each mill is passed over a totally enclosed Niagara vibrating screen with a single deck 30 in. by 60 in. Any particles of broken media are extracted, and cement then falls to the inlet of a 7-in. Fuller-Kinyon pump. The

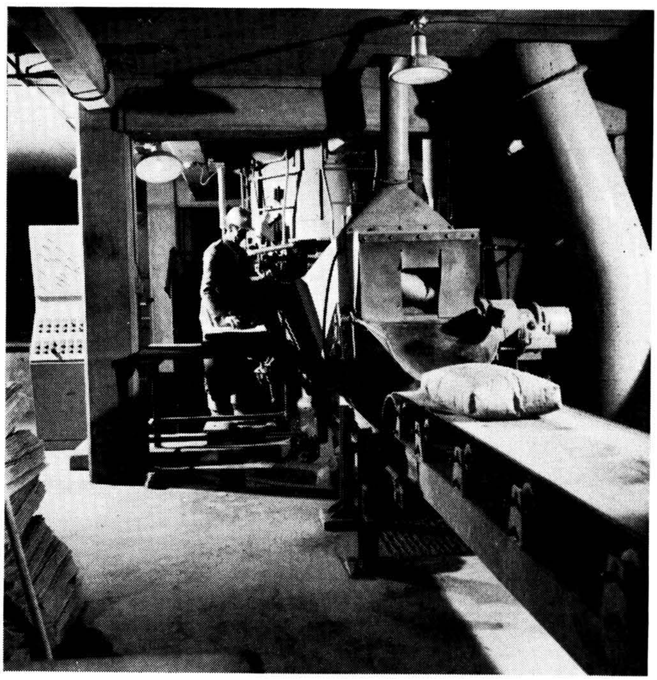


Fig. 23—Bag-packing Plant.

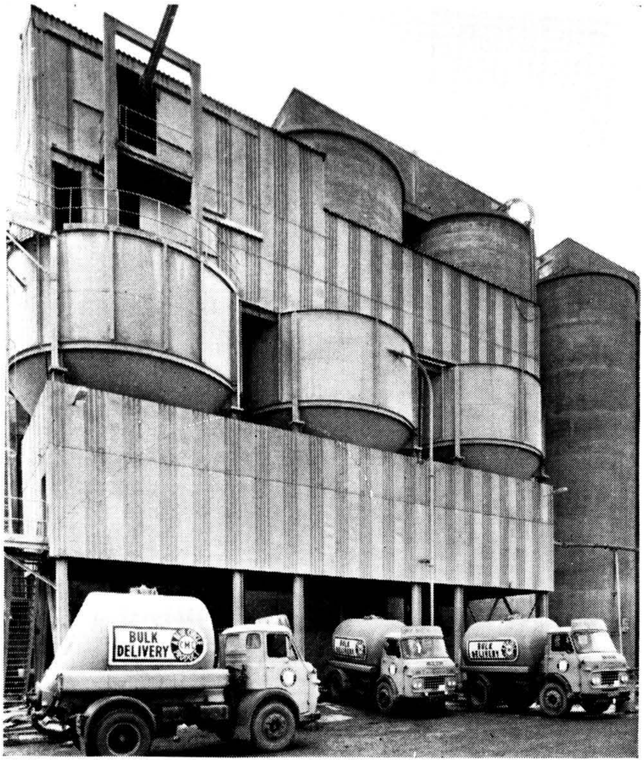


Fig. 24.—Bulk-loading Plant for Road Vehicles.

air required for the pumps is provided by a Hick-Hargreaves rotary compressor. Delivery pipes 5 in. in diameter extend from the mill house and up the exterior of the cement silos to appropriate distribution junctions and valves in the housings over the cement silos.

Storage.—The cement is stored in eight reinforced concrete silos, each of 2,100 tons capacity, installed adjacent to the packing and loading plants. Extraction from each silo is by means of three pneumatic conveyors feeding to either of two 24-in. screw-conveyors between the two rows of four silos. Extraction air, together with that exhausted by the pipe-lines of the Fuller-Kinyon pumps, is passed through filter bags provided in the housings over silos. Following the two screw-conveyors, two elevators of the central discharge type lift the cement for transfer by pneumatic conveyors Thus cement from any silo can arrive at positions suitable for bagging or despatch in bulk by road or rail. Screens are interposed at each terminal point of the mechanical handling system as a protection against any extraneous matter entering the system,

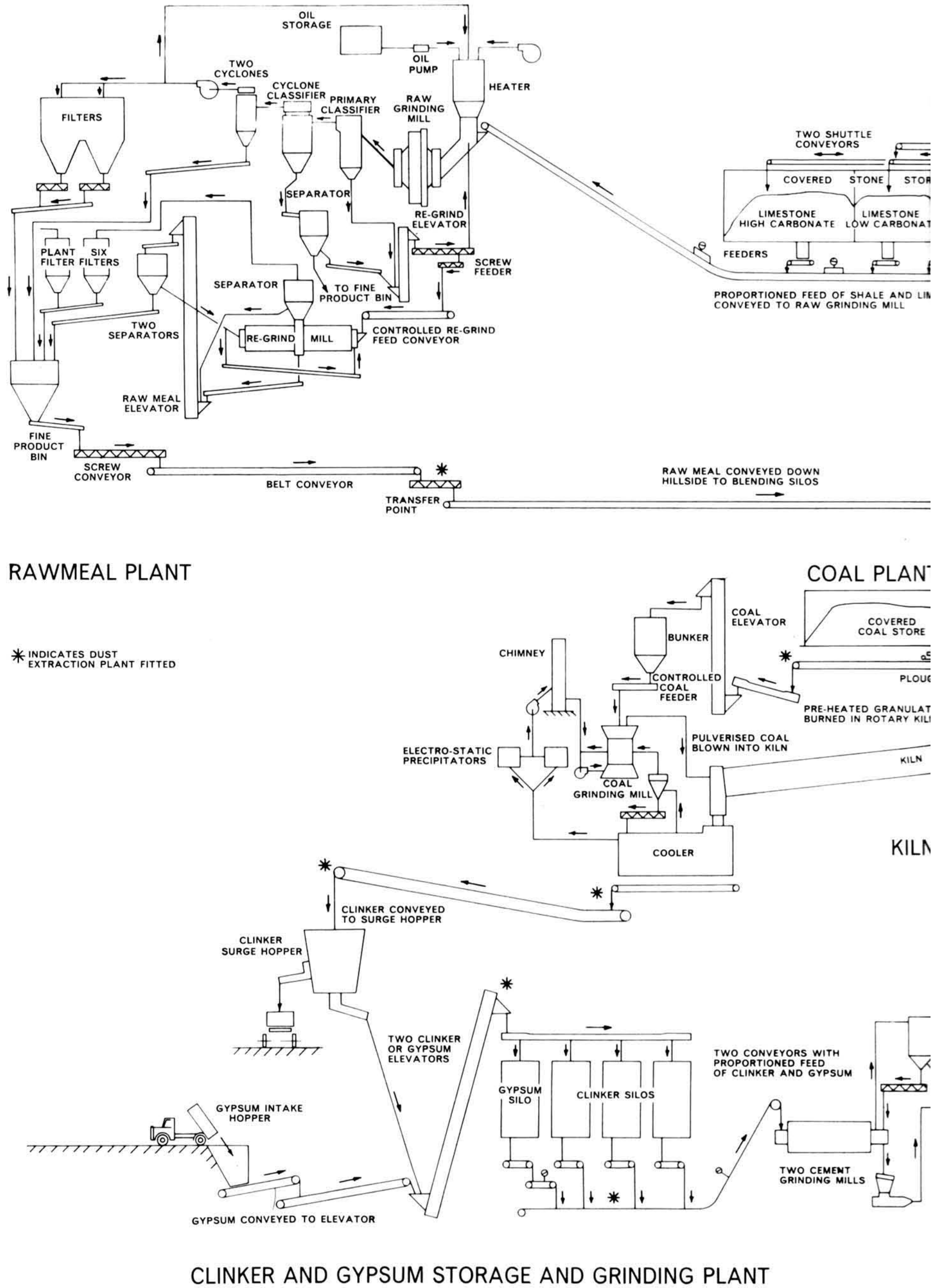
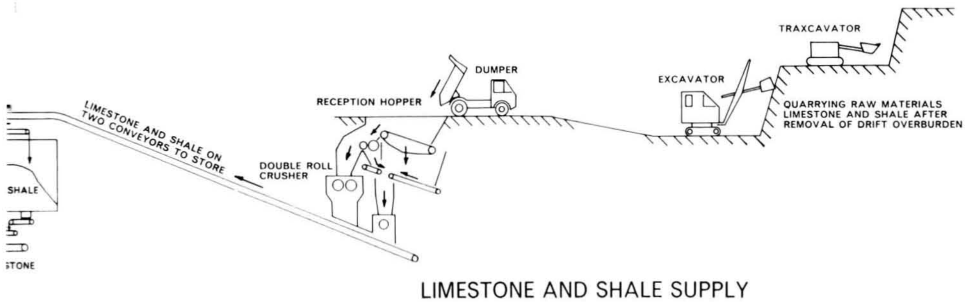
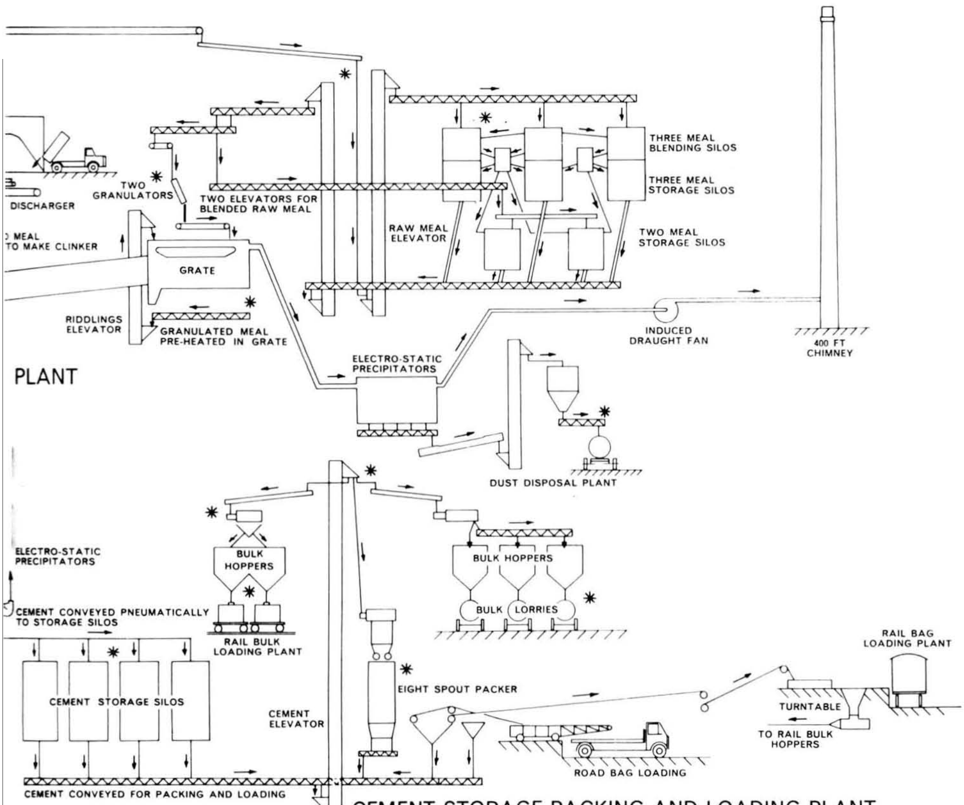


Fig. 25.—Cement Works





Weardale : Flow Diagram.

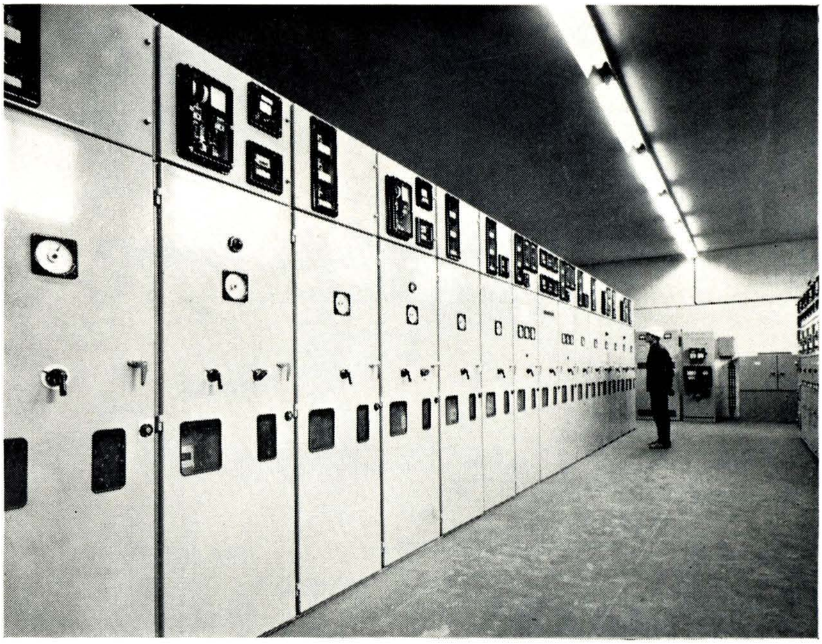


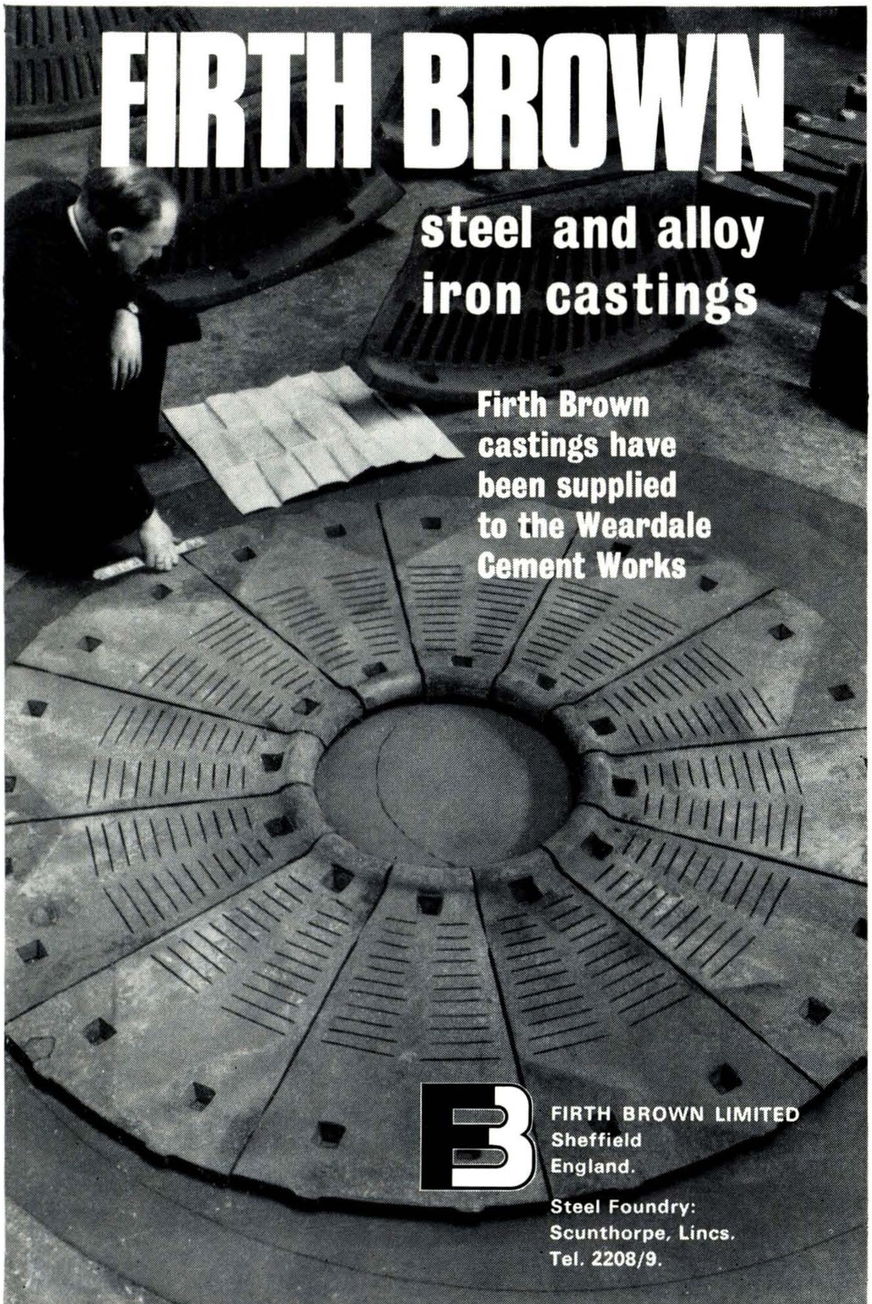
Fig. 26.—Works Main Substation.

BAGGING AND DESPATCH IN BULK.—For packing bags, an eight-spout Haver & Boecker packer (*Fig.* 23) is installed. This plant has a capacity of filling 1-cwt. paper bags at the rate of 110 tons per hour. The filled bags are discharged on to a 24-in. flat belt-conveyor which, by means of ploughs, can distribute either to one of the three retractable belt-conveyors, supplied by Messrs. J. Darnley Taylor, Ltd., for loading lorries, or on to a turntable from which they are taken by sack-barrows to rail box-wagons.

For bulk loading, the cement is passed into three elevated hoppers (*Fig.* 24) from which vehicles standing below can be loaded quickly.

Rail bulk-wagons stand on a weighbridge while they are being loaded from pneumatic conveyors. All the loading points are fitted with dust-collection equipment returning the collected cement into the respective loading hoppers.

Most of the output of this works is dispatched in bulk in block trains composed of " Presflo " wagons, many of which are owned by A.P.C.M. Ltd. Some special light-alloy cylindrical tank wagons (*Fig.* 20) are also provided. The trains proceed to distribution and packing depots at various places in the North of England. For shunting, rail traffic is handled by a diesel-hydraulic Vanguard locomotive of 175 h.p. The works sidings are, however, laid out for use by British Rail locomotives so that assembled trains of empty and filled wagons can be easily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handled into and out of the works, thereby ensuring a speeding turn-round of traffic.

Water and Power.

Water Supply.—Water for nodulising and cooling machinery is obtained from surface drainage and by extraction from the nearby River Wear. All water is stored primarily in two interconnected concrete-lined ponds of 100,000 and 160,000 gallons capacity. Circulation is effected by three, and one standby, centrifugal pumps through two 9-in. low-level mains into a 20,000-gallon header tank situated in the top of the granulator building. The pressure of water at any part of the works is therefore practically constant. All cooling water, together with storm water, is returned by the works drainage system to the ponds. By arrangement with the Wear and Tees River Board, supplementary water is taken from the River Wear by a separate smaller pump, and surplus water which may be collected at times is passed into the river. Water for drinking purposes, canteen, laboratories and the like, is obtained from a separate water main connected to the local water authority's supply.

Drainage.—A complete soil drainage system is installed at the works and connected to a sewage treatment plant.

Power Supply.—The supply of electricity from the North Eastern Electricity Board is fed into duplicate 66/20 k.v./15 m.v.a. transformers installed in a substation adjacent to the main entrance to the works. From this point, 20-k.v. underground cables feed two A.E.I. 20/3·3 k.v. transformers located in the works main substation (*Fig.* 25). Each is rated at 6/7·5 m.v.a. and each is fitted with manually-operated off-load tap-changing having steps of $\pm 2\frac{1}{2}$ per cent. and ± 5 per cent., delta-star wound, incorporating Bucholz and winding temperature protection. Power is received and distributed from the main substation at 3·3 k.v. using Whipp & Bourne air-break circuit-breakers rated 150 mvA, each breaker being solenoid-operated from either a rectifier or battery source of 110 volts d.c.

In addition to the main substation, three other substations have been established, namely, one at the Aerofall mill, crusher and kiln. The Aerofall mill and crusher substations are on the hillside. The former is fed via duplicate feeders about $\frac{1}{2}$ mile long and comprising two three-core 0·3-sq. in. cables, which are underground except where they cross the road, river and railway by means of the conveyor gantry. The medium voltage distribution system is derived from eleven 3·3 k.v. 433-v. hermetically-sealed transformers supplied by London Transformer Products Ltd. Three of these transformers are installed in the main substation, three in the Aerofall mill substation, and one in the crusher substation. All these transformers are of 750 k.v.a. The remaining four are of 1,000 k.v.a. and are installed in the kiln substation which is located near the kiln plant. All these eleven transformers are fitted with manually-operated off-load tap-changing switches with $\pm 2\frac{1}{2}$ per cent. and ± 5 per cent. settings, and are suitable for parallel operation within their group. Whipp & Bourne medium-voltage switchgear is installed, and comprises spring-operated air-break circuit-breakers for the incoming and bus-section duties, together with outgoing fused-switch units.

The 3·3-k.v. motors are controlled by air-break circuit-breakers incorporating P. & B. Gold M4A relays. The 415-v. drives are grouped into multi-starter boards using Baldwin & Francis air-break contactors. Automatic synchronising equipment is fitted to the Salient-pole synchronous motors driving the 1,800-h.p. and 1,200-h.p. mills.

Centralised control consoles equipped with semi-graphic mimics, indicator lamps, alarm and monitoring devices and the like are provided to operate all the plant drives.

Acknowledgements.

The design of the works was undertaken by the Central Engineering Department and Northern Area Engineering Office of The Associated Portland Cement Manufacturers Ltd. The consulting engineers for the civil engineering work at the quarry were Messrs. Oscar Faber & Partners.

The main civil engineering contractors were Tarmac Civil Engineering Ltd., and Mitchell Construction Co., Ltd.; the work undertaken by the latter firm also included the construction of the 400-ft. concrete chimney. The piled foundations were installed by Messrs. A. Waddington & Son Ltd. The main contractors for the administration building, which has an area of 12,000 sq. ft. and is of conventional construction, were Messrs. G. Stephenson (Builders & Contractors) Ltd. This building was erected in four months. The precast concrete components for the coal store, mill and grinder building, the garage at the quarry, and the buildings for the general stores and fitting shop were supplied and erected by Messrs. F. & D. M. Hewitt Ltd. The structural steel work, amounting to over 1,000 tons, for the limestone stores, crusher house, Aerofall mill house and other works at the quarry was supplied and erected by Messrs. Wright Anderson & Co., Ltd.

In addition to the various suppliers of auxilliary plant named in the foregoing description of the works, the following firms were concerned with the supply of the plant. The Lepol kiln plant, the Recupol coolers, the regrind mills and the turbo-air-separators were supplied by Polysius Ltd. The Aerofall mill was supplied by Messrs. Ashmore Benson, Pease & Co., Ltd., and the 1,200-h.p. cement mills by Vickers Armstrong (Engineering) Ltd. The mechanical erection was carried out by Messrs. Ashmore Benson, Pease & Co., Ltd., Staffordshire Public Works Co., Ltd., and Installation & Manufacturing Contractors Ltd. The electrical installations were by Messrs. H. J. Couzens Ltd.

Brochure Received.

Fives Lille-Cail and the Cement Industry.—A 56-page booklet describing the operation of four factories of the Fives Lille-Cail organisation, which undertakes all manufacturing operations of plant for the cement and other industries, from making the steel to assembling the plant. The descriptions relating to cement plant apply to grinding and burning and auxiliary plant, and are illustrated by examples of plant installed at various works throughout the world.

Heat Generated in the Hardening of Magnesite Cement.

An important study by the U.S. National Bureau of Standards provides what is thought to be the first published figures on the amount of heat generated in the setting of magnesium-oxychloride cement. Formed by the action of concentrated magnesium-chloride solution on active magnesium oxide, cements of this type are extensively used in industry, but they generate much more heat in the process of hardening than does ordinary Portland cement, and this may in some applications cause serious difficulties. The heat evolved by a large mass of magnesium-oxychloride cement could easily raise the temperature to well above 100 deg. C. Being a good conductor of electricity, this cement is particularly suitable for non-sparking flooring in works manufacturing explosives and the operating theatres of hospitals. Other applications include floors of office buildings, stores, ships and railway carriages. Because it absorbs neutrons more effectively than does Portland cement, it is also used for the heavy protective walls required in atomic-energy work. Although well established, some users of magnesite cement report unfavourable results. The mechanisms of the difficulties that have arisen are not well understood, but it is likely that some instances of unsatisfactory performance have resulted from non-uniform methods of preparation and application. No generally accepted standard specification for the preparation and application of magnesium-oxychloride cement have yet been adopted in the U.S.A. (There is in Great Britain, a British Standard Code of Practice CP204, "Insitu Floor Finishes," which includes a section on magnesium-oxychloride flooring; a revised edition of this Code was published recently.)

In the Bureau's study, nine representative commercial magnesite cements were investigated and, in addition, some laboratory-mixed pastes consisting only of magnesium oxide (MgO), magnesium chloride ($MgCl_2$) and water, in various proportions, were also investigated.

The heat generated in the commercial cements during the first eighteen hours of hardening, during which time heat generation is substantially complete, was found to be about 190 calories per gramme of magnesium oxide. For the laboratory-made pastes of various proportions, a wide range of values was obtained, varying from 135 to 320 calories per gramme of magnesium oxide. The low heats of hardening measured for some of these pastes support the conclusion of previous investigators that free MgO may remain in such pastes.

Three different calorimetric procedures were adopted. The heats of hardening of the laboratory pastes, which contained no inert or filler material, were determined indirectly by a heat-of-solution method similar to that used for Portland cement. The heat of solution of a sample of the hardened paste was determined in hydrochloric acid (2·00 normal). Using similar HCl solutions, the heat of solution of the magnesia and the heat of dilution of the magnesium-chloride solution used in preparing the paste were also determined. The difference between the sum of these last two values and the heat of solution of the hardened sample is the heat evolved during the hardening of the paste. This indirect heat-of-solution method used for the laboratory pastes requires that the materials be soluble in the acid and that the paste be analysed chemically.

To determine the heats of hardening of the commercial cements, two direct methods were used. In the first, samples of the cement were allowed to harden in corked vacuum flasks while their internal temperatures were recorded. Electrical calibration of the flasks permitted the heat evolved by the cement to be calculated from the recorded temperatures. Because the cement in the vacuum flasks reached temperatures up to 100 deg. C., a second set of direct measurements was made in a Lerch conduction calorimeter. In this apparatus, the heat generated by the cement flows over a calibrated path into a water-bath at constant temperature. Because of the more rapid flow of heat from the specimen, the Lerch equipment permits the cement to harden at lower temperatures than do the vacuum flasks; the temperatures reached by the cement in this instrument were only a few degrees above the temperature of the room. The path of the flow of heat was a brass tube, one end of which was in contact with the cement and the other end of which was maintained at the temperature of the water bath. Resistance thermometers attached to the tube permitted the temperature drop along the tube to be recorded. From the recorded differences of temperature and from the electrical calibration of the instrument, it was possible to calculate the amount of heat evolved by the cements.

British Standard for Sulphate-resisting Portland Cement.

A NEW British Standard B.S.4027, "Sulphate-resisting Portland Cement", was issued recently.* The specification is based on experience gained in the sixteen years which have elapsed since sulphate-resisting cements were first manufactured.

The physical requirements for sulphate-resisting Portland cement are identical with those for ordinary Portland cement, as specified in B.S.12, except that finer grinding is required. A direct test of resistance to sulphates can only be achieved by prolonged storage of specimens in sulphate solutions, and thus is not suitable for a standard test. It is known, however, that Portland cement has a considerable degree of resistance to sulphates if the content of triculcium aluminate does not exceed $3\frac{1}{2}$ per cent., and this limit has therefore been included in the new Standard.

In addition to fineness and chemical composition, the Standard stipulates the requirements regarding manufacture, sampling, manufacturer's certificates, marking, and the use of the cement in tropical climates. The compressive strength, setting time and soundness are specified. Appropriate methods of test are given in appendices.

Details of the requirements of the Standard are given in the following.

FINENESS.—The fineness is to be such that the specific surface is not less than 2,500 sq. cm. per gramme.

CHEMICAL COMPOSITION.—The lime-saturation factor is to be not greater than 1·02 and not less than 0·66 when calculated from the expression

*Obtainable from the British Standards Institution, 2 Park Street, London, W.1. (Price 10s).

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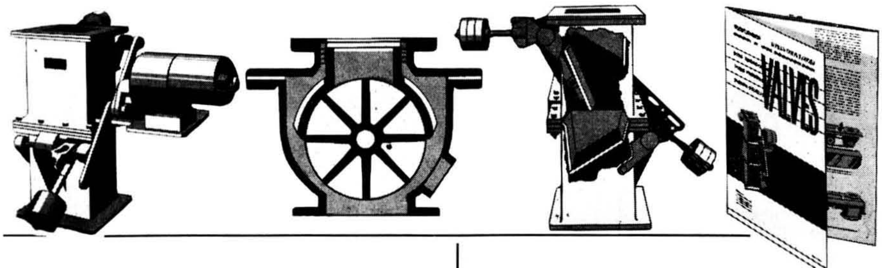

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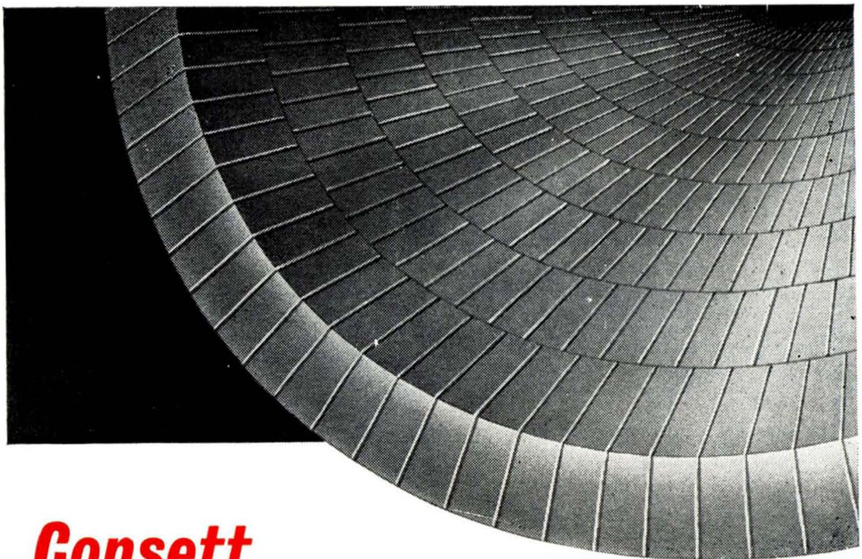


$$\frac{(CaO) - 0{\cdot}7(SO_3)}{2{\cdot}8(SiO_2) + 1{\cdot}2(Al_2O_3) + 0{\cdot}65(Fe_2O_3)}$$

The symbols in brackets refer to the percentage (by weight of total cement) of the oxide, excluding any contained in the insoluble residue.

The tricalcium-aluminate content C_3A is to be not greater than 3·5 per cent. when calculated from the expression $2{\cdot}65(Al_2O_3) - 1{\cdot}69(Fe_2O_3)$. The symbols have the same significance as for the lime-saturation factor.

The percentages of Al_2O_3 and Fe_2O_3 are determined by methods described in the Standard. If the result of this calculation is below 3 per cent., the cement is deemed to comply with the requirements without a repeat determination. If the result is above 3 per cent., the determination is to be repeated from the beginning. If both the results are at or below 3·5 per cent., the cement is deemed to comply with the requirements. If one of the two results is above 3·5 per cent., the determination is to be carried out a third time and, if two out of the three results are at or below 3·5 per cent., the cement is deemed to comply with the requirements. If two out of the three results are above 3·5 per cent., the cement is deemed not to comply with the requirements.

Results of the tricalcium-aluminate determination which differ by more than 0·2 per cent. from the laboratory average result, are to be discarded and the determinations repeated. If agreement is still not reached, the cement is to be retested in accordance with the foregoing procedure by an agreed independent laboratory, and the results then obtained are to be accepted.

The weight of magnesia is not to exceed 4·0 per cent.

The content of total sulphur in the cement, expressed as SO_3 is not to exceed 2·5 per cent.

The total loss on ignition is not to exceed 3 per cent. for cement to be used in temperate climates or 4 per cent. for cement to be used in tropical climates.

COMPRESSIVE STRENGTH.—The average compressive strength of three mortar cubes or of three concrete cubes are to be as for ordinary Portland cement.

SETTING TIME.—The initial setting time is to be not less than 45 minutes, and the final setting time not more than 10 hours.

SOUNDNESS.—The cement, when tested for soundness by the method described in the Standard is to have an expansion not exceeding 10 mm. If the cement fails to comply with this requirement, a further test is to be made using another portion of the same sample after it has been aerated by being spread out to a depth of 3 in. (76 mm.) at a relative humidity of 50 to 80 per cent. for a total period of 7 days; the expansion of this aerated sample is not to exceed 5 mm.

CEMENT IN TROPICAL CLIMATES.—The temperatures specifically mentioned in the methods of test are applicable to temperate climates. Cement intended for use in tropical climates may be tested at temperatures exceeding 68 deg. F. (20 deg. C.) but not exceeding 95 deg. F. (35 deg. C.).

Note.—The Blue Circle Group have published a revised data sheet relating to sulphate-resisting Portland cement and having special reference to the new British Standard.

Pozzolanic Cements in India.

A publication, entitled " Special Report No. 1—Pozzolanic Clays of India: Their Industrial Exploitation & Use in Engineering Works," was issued recently by the Indian Central Road Research Institute (Copies are obtainable at Rs. 13.00 per copy from the Director, Central Road Research Institute, New Delhi-20, India). One section of this 300-page book deals with pozzolanic cements. After dealing with the method of production of this material in other countries, the Report continues with an examination of suitable materials available in India and gives an account of the extent to which pozzolanic cements are made in that country.

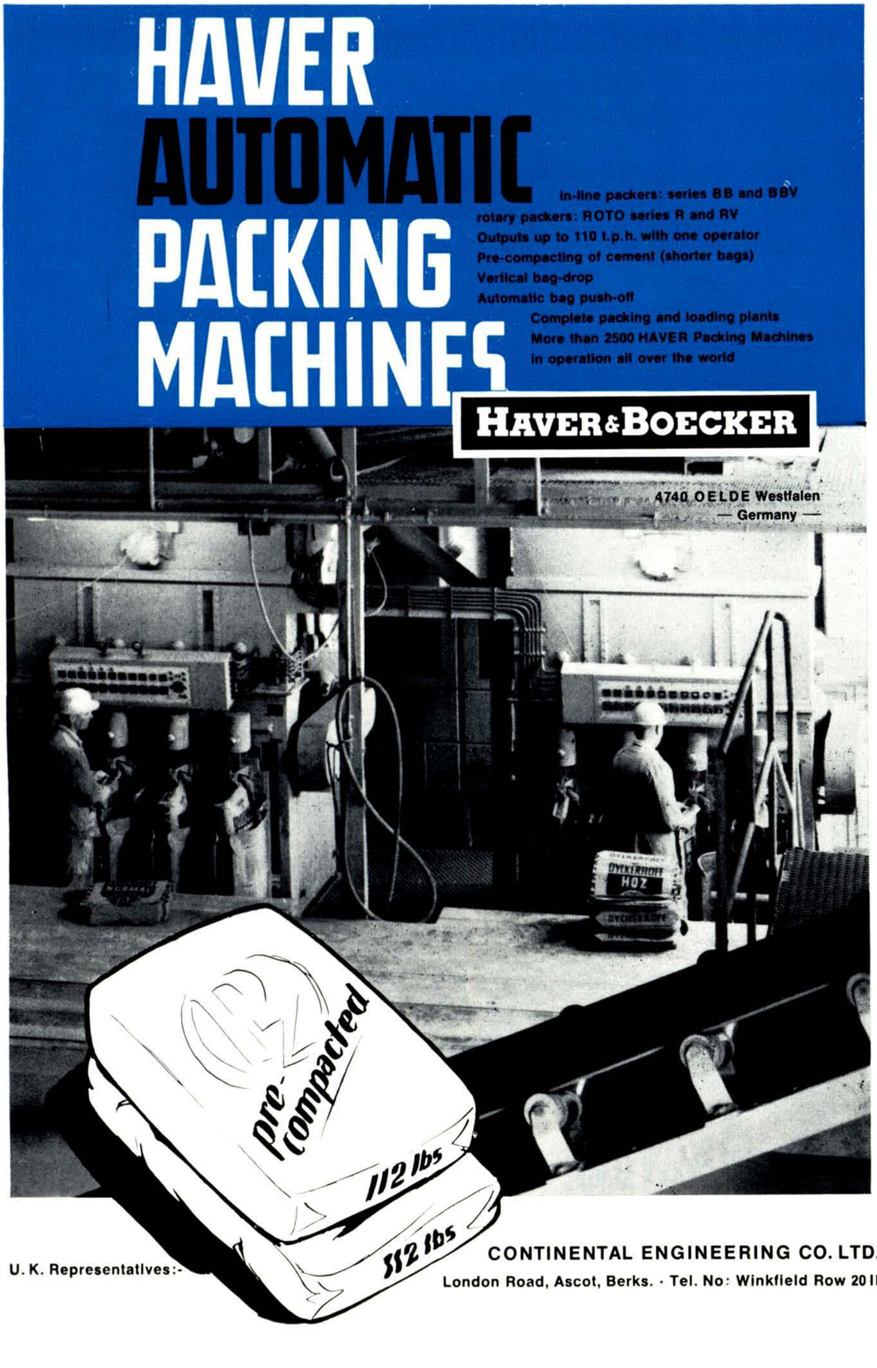
A number of deposits of very reactive clay yielding pozzolanas with lime reactivity of at least 2,000 lb. per sq. in. have been located, and work connected with the development of special pozzolana cements has been undertaken at the Institute. Results show that by using highly reactive " surkhi "* to replace 20 per cent. of the cement in a mortar or concrete, a pozzolanic cement is obtained which has the same early-strength properties as the corresponding ordinary cement and has higher chemical resistance. Experience indicates the necessity of intergrinding pozzolana and cement clinker to produce pozzolanic cement in preference to the current method of mixing the pozzolana with the cement and aggregates when making concrete, and in preference to the establishment of blending centres to achieve the unsatisfactory task of mixing dry cement and pozzolana.

The only example in India of large-scale manufacture (about 100 tons per day) of clay pozzolana carried out under controlled calcination has been at Bhakra dam in the Punjab. The pozzolana plant was associated with a 400-ton-per-day cement plant producing together 500 tons of pozzolanic cement per day. The procedure was as follows.

The raw shale was first reduced to ¾-in. size. It was calcined in a rotary kiln at 1400 to 1600 deg. F. (760 to 870 deg. C.) and remained to soak at this temperature for two hours in a refractory-lined 15-ton soak pit. This operation was found to improve calcination. The material was then carried on a drag-chain conveyor and cooled on the way to the grinding unit by a spray of water limited in volume to keep the material dry enough for grinding. The calcined material was ground to a specific surface of 4500 sq. cm. per gramme (Blaine).

The shale deposits at Bhakra contain bands of sandstone, siltstone and overburden mixed with the shales. During excavation, the sandstone and overburden could be rejected but the siltstones were thoroughly intermixed with the shales. They were, however, removed to a great extent by hand-picking off the raw-feed belt, but about 3 to 6 per cent. was always left in the shale. From the point of view of pozzolanic activity, this amount of siltstone was found to be deleterious. The raw shale as excavated was a mixture of dust and lumps. Before feeding it into the kiln, the lumps were reduced to ¾-in. in a jaw-crusher. Calcination and grinding were greatly affected by the condition of the raw material, granular material

*Until recently, " surkhi " was the term applied to crushed brickbats. A superior material is now prepared by calcining selected clays rich in reactive materials.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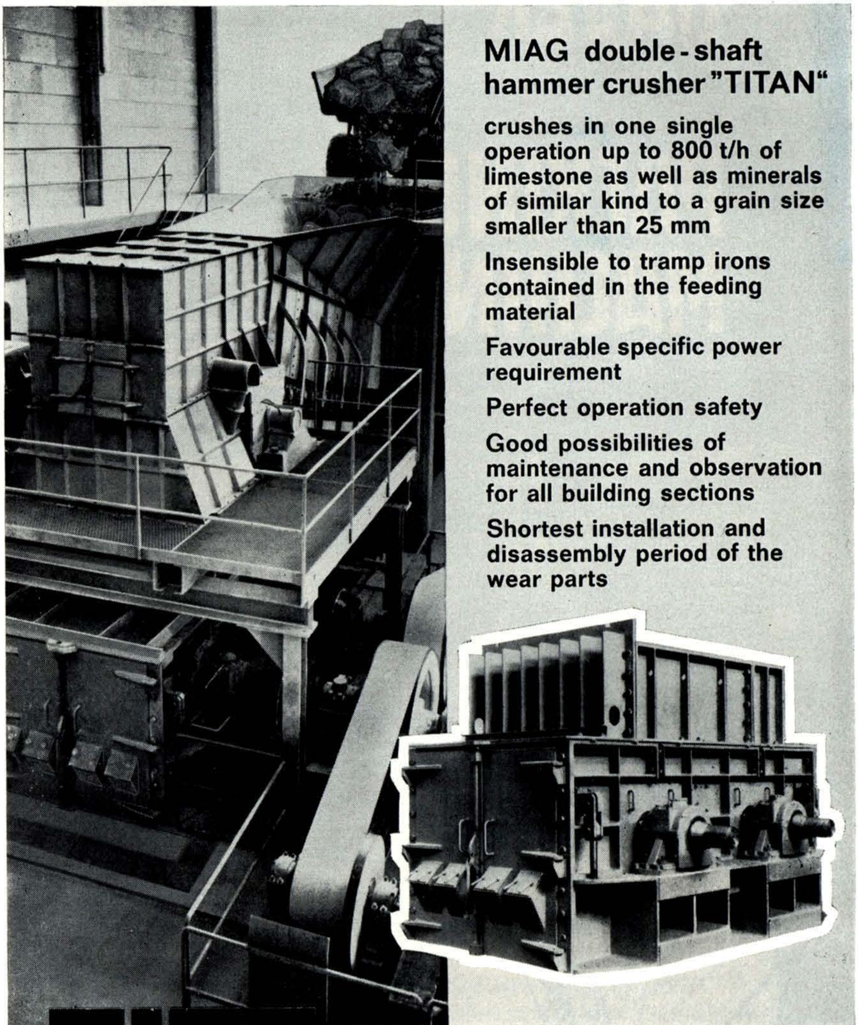
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being easier to handle during calcination than the dust. The shale acquired pozzolanic activity only when it was calcined at the previously stated temperatures for about two hours. The kiln was an oil-fired rotary kiln 100 ft. long which dealt with about $5\frac{1}{2}$ tons of material per hour. The temperature at the firing end was about 1700 deg. F. The kiln rotated at 1 r.p.m., at which speed, and due to the inclination of the kiln, it took about 58 minutes for the material to travel from one end to the other. The temperature of the material at the discharge end was about 1600 deg. F. The temperatures in the kiln and soak pit were recorded by radiation-type pyrometers and thermocouples. The oil consumption in the kiln was about 8 to 10 gallons per ton of material.

The calcined material, after being cooled, was stored in a 1100-ton silo. The grinding mills were of two types and three in number. One was a 20 ft. by 5 ft. double-compartment ball-mill, capable of grinding about 2·5 tons of material per hour to the required fineness. The first compartment contained large balls which did most of the disintegration. The second compartment contained smaller media which pulverised by attrition. The second type of ball-mill of which there were two, was a single-compartment type 10 ft. by 5 ft. and used "cylpebs" as grinding media. Before being fed into the ball-mills, the material was disintegrated in hammer-mills. Each ball-mill had a hammer-mill attached to it. However, the hammer-mills were found to be unsuitable for this operation since the hammer, sieves and corrugated lining plates were easily worn out and had to be replaced frequently. The average output was about 2·5 tons of material per hour. The total maximum output in a day from the three ball-mills was about 120 tons. The ground pozzolana was stored in silos from which it was taken by lorries to a batching plant where the pozzolana was batched with the other materials to produce pozzolana concrete.

The foregoing process for preparing pozzolana could, up to the stage of grinding, be adopted for a cement works producing pozzolana cement. In this case, the calcined pozzolana could be interground with cement clinker in the proper proportions to yield pozzolana cement conforming to the Indian Standard Specification No. 1489-1962.

Rotary Kilns of Large Capacity.

A Kiln having a capacity of 3,000 tons per day is to be added to the eight kilns existing at the Obourg cement works in Belgium. The diameter of the new kiln will be 7 m. (23 ft.) to 6·25 m. (20 ft. 6 in.), and the length will be 202 m. (663 ft.). Two other large kilns of 165-m. (541 ft.) length having capacities of 1,400 and 1,600 tons per day were installed at this works in 1953 and 1954 respectively. A kiln 167·5 m. (about 550 ft.) long, also having a daily productive capacity of 1,600 tons, was installed in the 1960's in the works at Alhandra, Portugal. Other large kilns include one of 1,700/2,000-tons daily capacity in the United Arab Republic, and one of 2,500-tons capacity in the Atchinsk works in the U.S.S.R.

All the foregoing large kilns were supplied by the Fives Lille-Cail organisation of France.

The welded shells of the largest kilns are made of open-hearth steel having different mechanical properties for different sections of the shell. The tensile strength of the steel for the heaviest sections and for the burning zone is 42 to 50 k.g. per sq. mm. (27 to 32 tons per sq. in.), that of the remaining part being 37 to 44 kg. per sq. mm. (23·5 to 28 tons per sq. in.).

Combined Sulphur and Cement Production.

A NEW thermal method of processing sulphur, which combines the production of sulphur with that of cement and which has been developed successfully in laboratory tests, is to be tried out on a commercial scale at the Goleszow cement works in Poland. Clay is added to the limestone remaining after the sulphur has been extracted, and the resulting mixture is used for the production of the cement.

A New Concrete Journal.

THE recent formation of The Concrete Society is an important event in the development of the concrete industry in Britain and, in particular, in the life of our contemporary journal "Concrete & Constructional Engineering," which, during the past sixty years or so has always aimed to represent the activities of all aspects of the cement and concrete industry—design, construction research, materials, plant and equipment. When the then un-established Concrete Society decided that it would have to issue a journal for its members, it was felt that there was no need for two journals having this same aim and it was natural, in the best interest of the industry, for some form of collaboration to be considered.

It has therefore been decided that, from the end of this year, "Concrete & Constructional Engineering" will cease to be published as such, as will also "Structural Concrete," the journal of the Reinforced Concrete Association. In their place, commencing in January 1967, Concrete Publications Ltd. will publish, on behalf of the Concrete Society, a new journal entitled simply "CONCRETE" which will incorporate "Concrete & Constructional Engineering" and "Structural Concrete," and will be the journal of the Concrete Society. The new journal, which will be of the international A4 size, will give news of the Society, report on its activities, publish its papers and reports, and will include some of the well-known features of "Concrete & Constructional Engineering" such as the articles on theoretical and practical design.

All members of the Concrete Society will receive copies of CONCRETE, but for non-members in the U.K. and abroad, the charge will be four shillings per copy (plus postage).

The prepaid subscription rate will be 50s. (9 dollars in Canada and U.S.A.) per annum including postage. Readers of "Cement & Lime Manufacture" who are not members of the Concrete Society and wish to subscribe to the new journal should communicate with the Publishers (not the Society) at 60 Buckingham Gate, London, S.W.1. Specimen copies of the new journal will be available in January.

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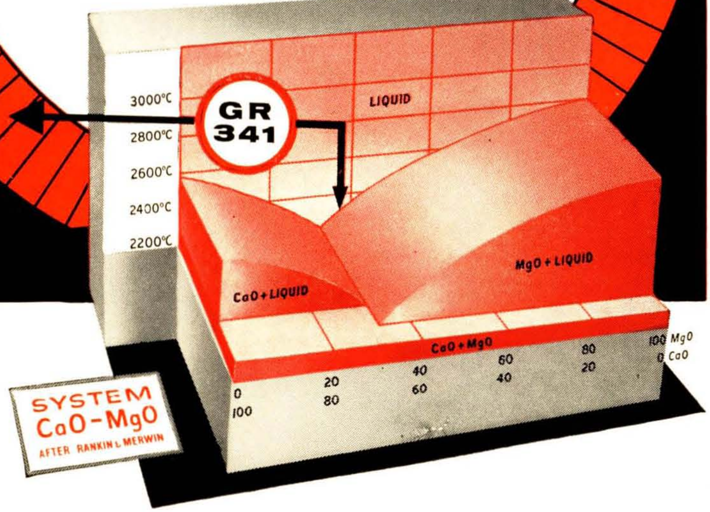

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