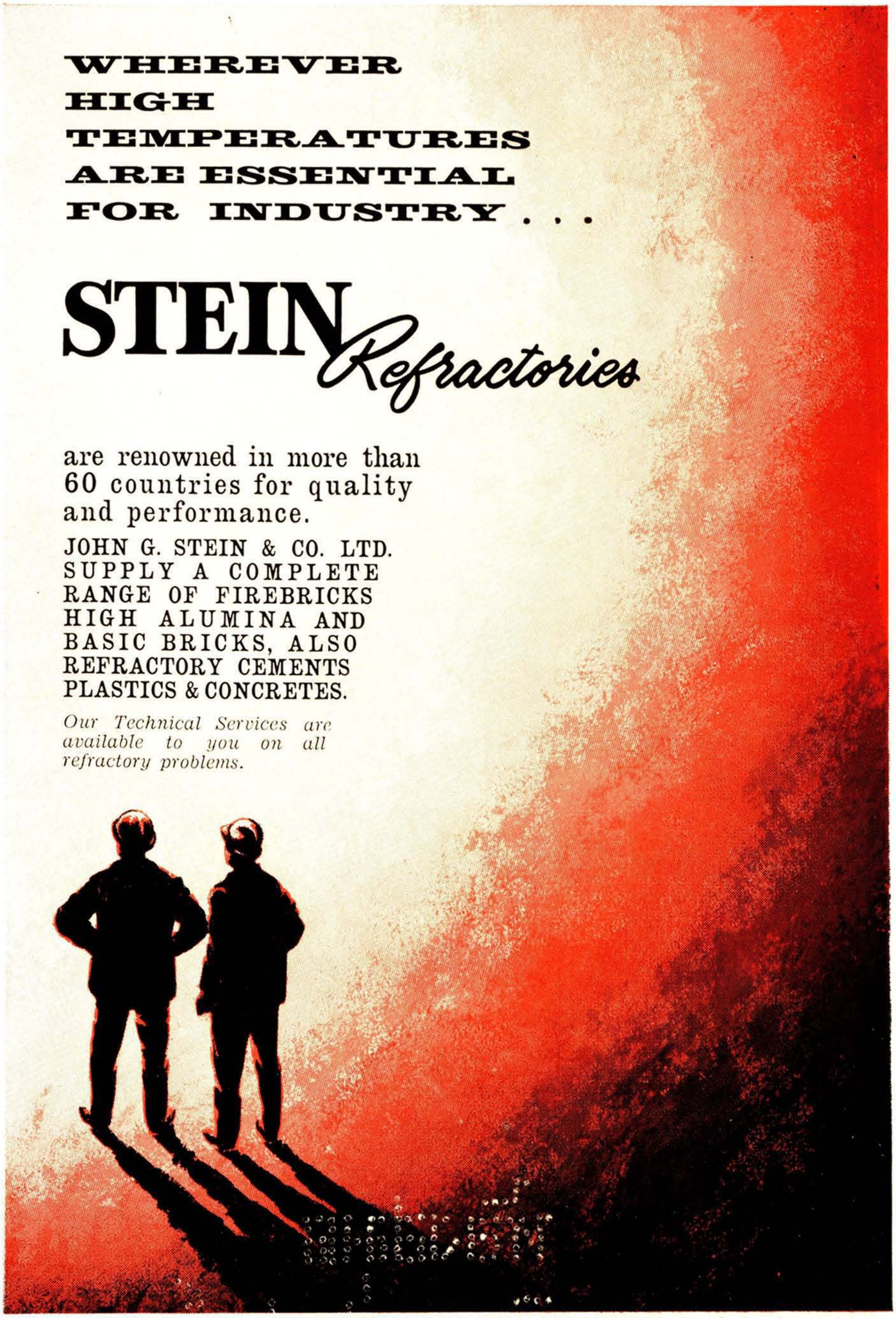
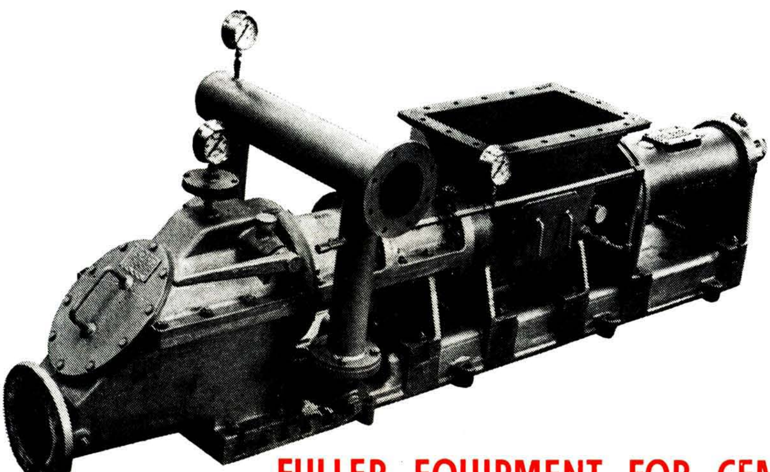
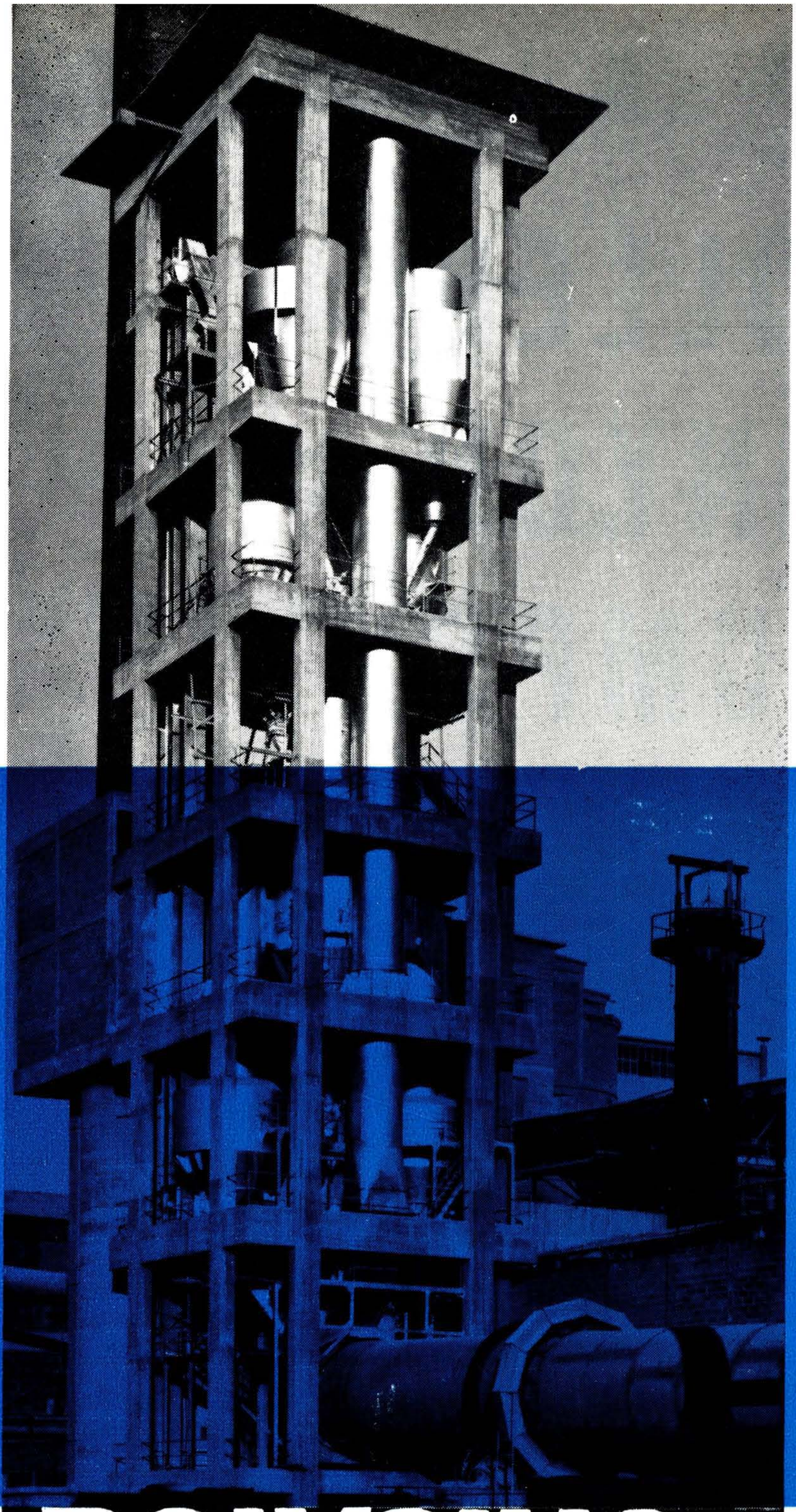
CEMENT
& LIME MANUFACTURE

VOL. XXXVIII. No. 4 JULY, 1965

Price 1s. 6d. per Copy.
Annual subscriptions: Inland 9s. post free.
Overseas 11s. 6d. including postage.
Canada and U.S.A. 2.15 dollars incl. post.

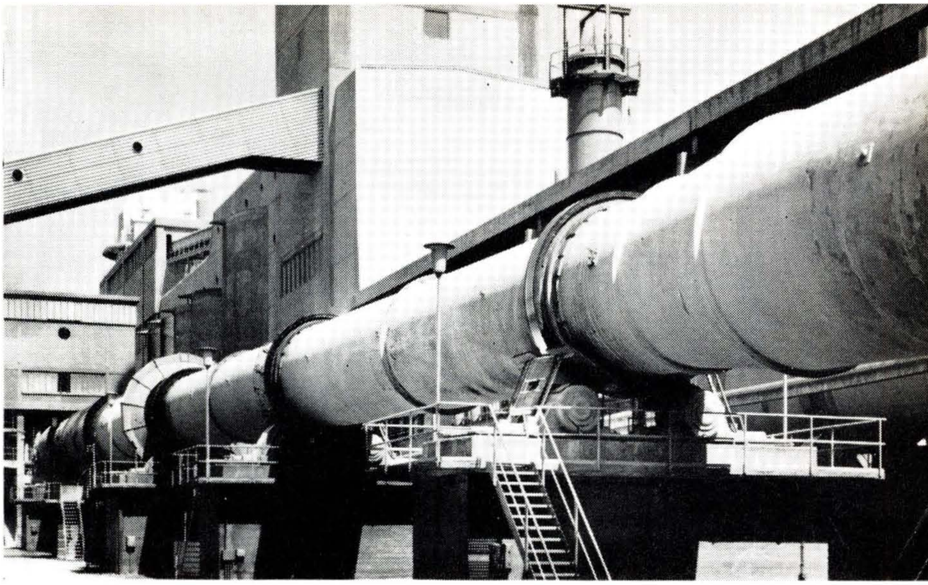

WHEREVER
HIGH
TEMPERATURES
ARE ESSENTIAL
FOR INDUSTRY . . .
STEIN Refractories
are renowned in more than
60 countries for quality
and performance.
JOHN G. STEIN & CO. LTD.
SUPPLY A COMPLETE
RANGE OF FIREBRICKS
HIGH ALUMINA AND
BASIC BRICKS, ALSO
REFRACTORY CEMENTS
PLASTICS & CONCRETES.
Our Technical Services are
available to you on all
refractory problems.





DOPOL kiln
with raw material preheater

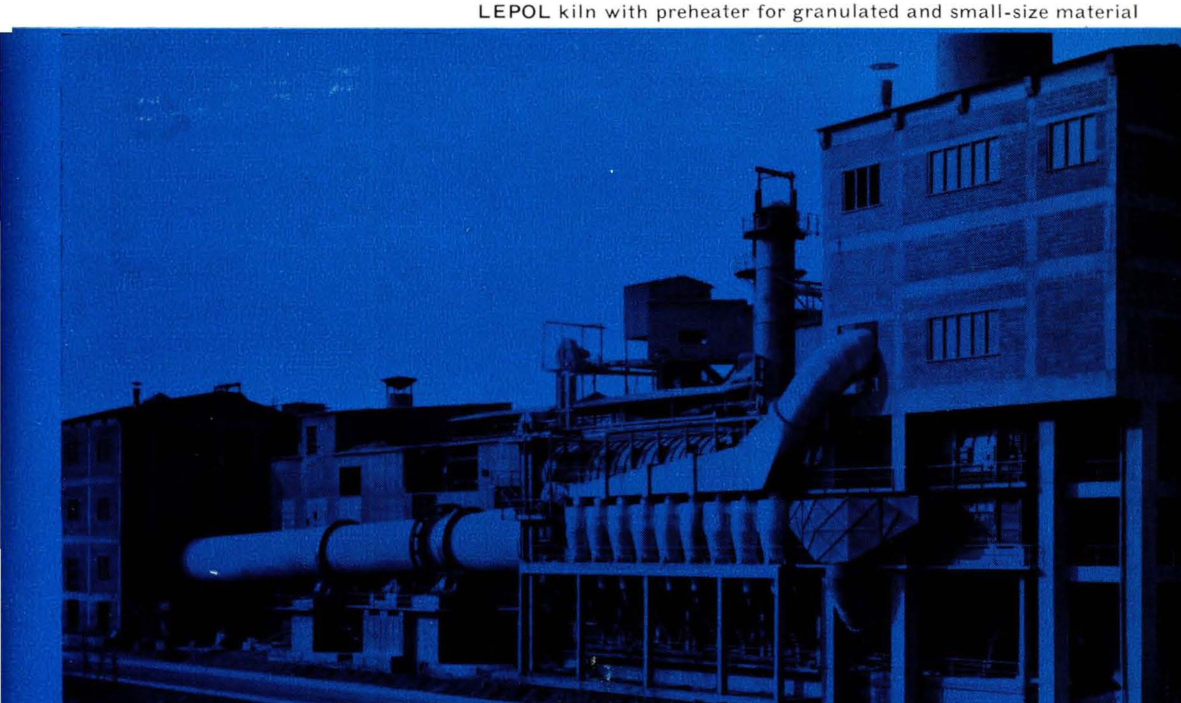
POLYSIUS
engineers
advise you
to choose



Long kiln for wet and dry process

The correct kiln for every raw material

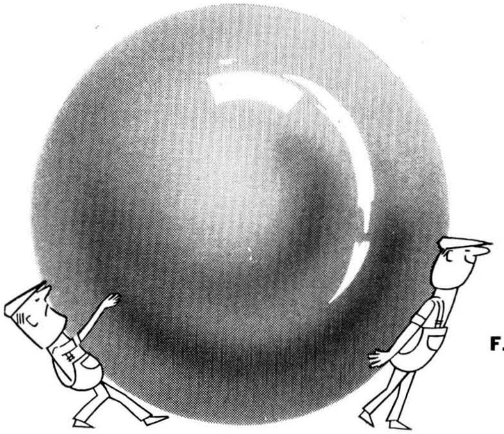
LEPOL kiln with preheater for granulated and small-size material

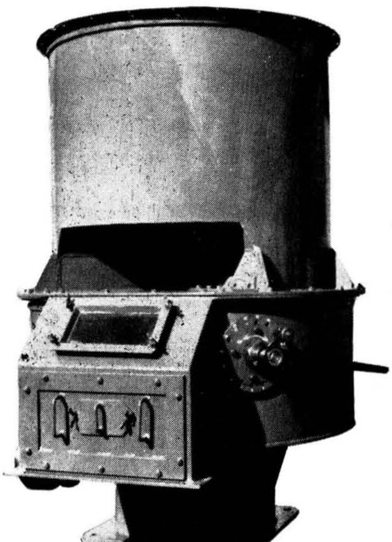


POLYSIUS GMBH
4723 Neubeckum,
West Germany.
Telefon: (02525) 711
Telegramme: Polysius Neubeckum
Telex: 0892 893

POLYSIUS LTD.
London Road,
Ascot, Berks.
Telephone: Winkfield Row 2011
Cables: Polysius Ascot
Telex: 84 102

POLYSIUS S.A.R.L.
13 Rue Auber,
Paris IXe(Frankreich),France
Tél: Paris-Richelieu 87 49
Télégrammes: Polysius Paris
Telex: 21602






EXPORT!
'ENGLISH ELECTRIC' SELLS IN 140 COUNTRIES

CEMENT AND LIME MANUFACTURE

PUBLISHED ALTERNATE MONTHS. PRICE 1s. 6d. A COPY ANNUAL SUBSCRIPTION 9s. POST FREE
$1.75 IN CANADA AND U.S.A

PUBLISHED BY
CONCRETE PUBLICATIONS LIMITED
60 BUCKINGHAM GATE, LONDON, S.W.1

TELEPHONE: VICTORIA 0705/6.
TELEGRAPHIC ADDRESS:
CONCRETIUS, PARL, LONDON.

PUBLISHERS OF
"CONCRETE & CONSTRUCTIONAL ENGINEERING"
"CONCRETE BUILDING & CONCRETE PRODUCTS"
"CEMENT & LIME MANUFACTURE"
"THE CONCRETE YEAR BOOK"
"CONCRETE SERIES": BOOKS.

VOLUME XXXVIII NUMBER 4 JULY, 1965

Civil Engineering and Building in Cement Works.

THE civil engineering and building work required in the construction of a cement works include the foundations for the plant; the foundations and superstructures of the buildings housing the plant; dust-collectors and chimneys; stores for raw, semi-finished and finished materials; buildings for offices, laboratories, canteens and electrical equipment; roads; and drains and water-supply structures. In the United Kingdom, the largest single building in a cement works is usually the kiln-house but, in tropical and semi-tropical countries, the kiln is often in the open air with a small housing over the burning zone. Since short kilns only are required for use with preheaters of various types, the kiln-house may be shorter than in the case of a wet-process plant, but large buildings are required at a dry-process plant to house the preheaters and nodulisers. Other large buildings required, depending on the cement-making process, include the raw-materials and clinker stores, structures to house the raw-material and cement mills, and a packing house.

Where the raw material has to be crushed, a crusher house is provided either at the quarry or at the works. For a wet-process plant, doctor-tanks and storage basins are required for the slurry, and for a dry-process plant, blending and storage silos are provided for the raw meal.

Some of these structures may not differ in design and construction from similar structures in other industries or for similar purposes. Others, however, are subject to special conditions and some aspects of the design and construction of these special structures are considered in the following.

Foundations and Bases.

The problems arising in the design of the foundations for buildings, silos and tanks are dealt with by the usual methods of structural design, but the bases required for some other parts of the plant present special problems.

KILN PIERS.—The piers supporting a kiln are designed to resist large longitudinal thrusts resulting from the fact that the kiln is laid on an incline, at a

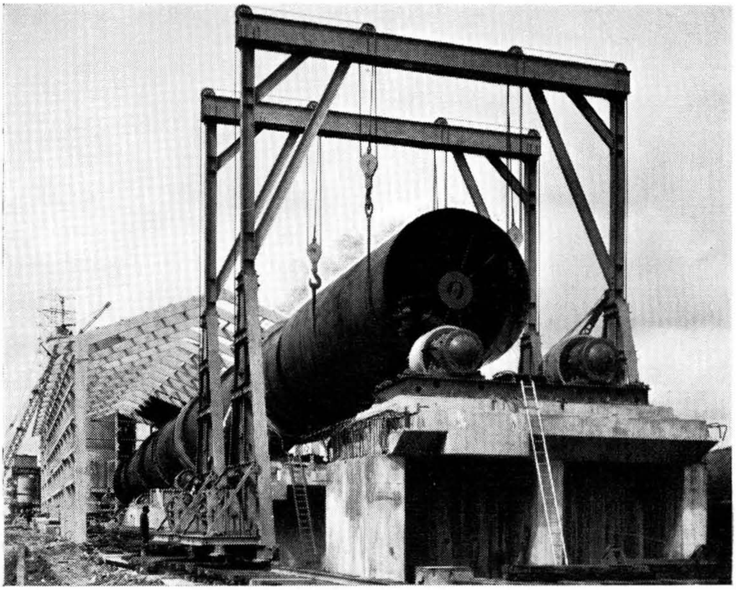


Fig. 1.—Kiln Piers.

slope of usually about 1 in 30. There is also longitudinal thrust when the kiln expands upon being heated up. In assessing the vertical loads on any pier the possibility of the kiln deflecting is taken into account since there is a consequent decrease in the weight carried on some piers and an increase on others. The kiln is supported at each pier on two rollers (*Fig.* 1). In addition to the normal lateral thrusts on these rollers, the piers are designed for extra lateral thrusts due to the possible deflection of the kiln. Ducts are provided in kiln piers for the pipes which supply water to the rollers and bearings and conduct the heated water to the drains or cooling system. Ducts are also provided in the kiln-drive piers for electric cables to the motors.

Since it is essential to avoid differential settlement of the piers, particular care is taken during the investigation of the ground and in the design of the foundations to ensure that there is no such settlement.

MILL AND CRUSHER FOUNDATIONS.—In the design of the foundations for cement-grinding mills and wet mills for the preparation of the slurry, allowance is made for vibration and the loads and overturning moments which occur. The motors driving the mills are usually connected to the gear-boxes and the gear-boxes are connected to the mills by direct shaft drive in which there is only a small allowance for deflection, and therefore the foundations are designed to avoid differential settlement. The motors and gear-boxes are usually bolted to a steel grillage which is embedded in, and fixed to, a single concrete base. Ducts are provided in the bases for electric cables. Where the cement mill is sprayed with water for cooling, concrete trays or basins for collecting the water are provided under the mills.

The bases and foundations of crushers are designed for heavy loads accompanied by vibration and impact, and for large unbalanced loads which may possibly occur.

FOUNDATION BOLTS.—Holding-down bolts for crushers, kilns, mills and their motors and gear-boxes may be up to 1½ in. in diameter, or even larger, the lengths being from about 4 ft. to 6 ft. At the heads of the bolts, anchor-plates or channels are provided and these are embedded in the concrete base. Tubes of steel, concrete, or other suitable material are provided above the head of the bolt and are also embedded in the base; the bore of the tube is normally about 2 in. or 3 in. larger than the diameter of the bolt thereby allowing a certain amount of play in the position of the projecting end of the bolt when fixing the base-plate of the machine. Nevertheless it is important to set the bolts accurately in position in the concrete and not allow this play to be an excuse for inaccurate work. After the base-plates are fixed and packed up on steel wedges, the heads of the bolts are tightened, and the tubes are filled with cement mortar. The space under the machine base is then packed with concrete incorporating small aggregate if the space will allow or, if not, with cement mortar; neat cement grout should not be used.

Tunnels, Basements and Pits.

Tunnels are usually required to accommodate the underground conveyors carrying the clinker to the stores or mills, and for the conveyors in crusher houses.

Fig. 2.—Washmills: Exterior View.

Coolers are normally in a basement known as the cooler pit. Pits also are required for the boots of elevators in the packing building and sometimes for handling coal, crushed stone, clinker and gypsum. Such pits and tunnels are designed and constructed so as to be reasonably impermeable to ground-water and to resist the pressure of the ground and, in the case of tunnels, to carry vehicles and other dead or live loads which may be imposed on the roof. Unless the tunnel or pit is required to contain loose cement, the cost of an external impervious membrane, such as asphalt, is not justified, so long as the quality of the concrete, the method of placing and compacting the concrete, and the method of constructing joints are carefully controlled to give as watertight structure as practicable. Joints are normally provided with a rubber, P.V.C., or galvanised iron water-bar. If the conveyor tunnel is in wet ground, seepage may occur and it is advisable to form a cross-fall in the floor and to provide, throughout the length of the tunnel, a shallow drainage channel leading to a small pump-sump. Even if a channel is not constructed a sump is provided so that the tunnel can be pumped dry if seepage or accidental flooding occurs. For open conveyor trenches, the provision of such a channel is almost obligatory, and a pump-sump is also always provided in an open pit.

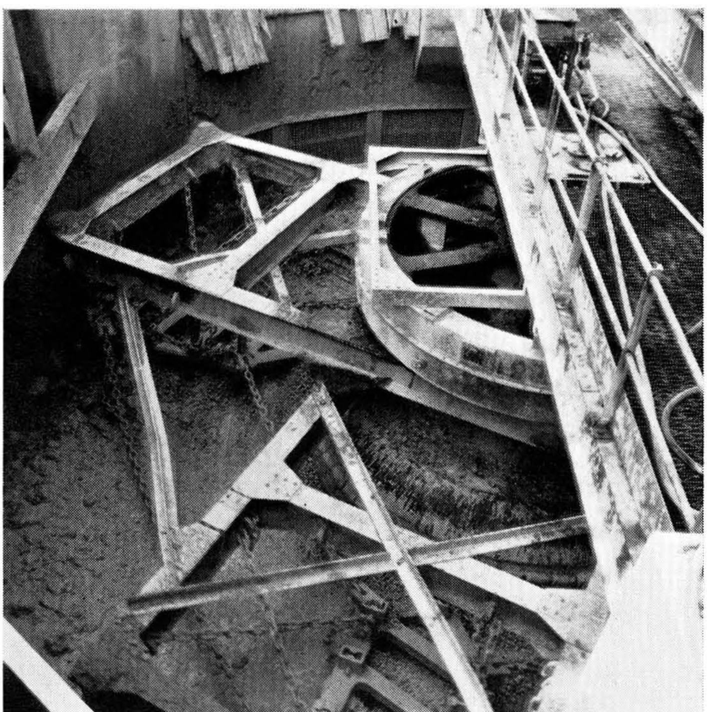


Fig. 3.—Washmills: Interior View.

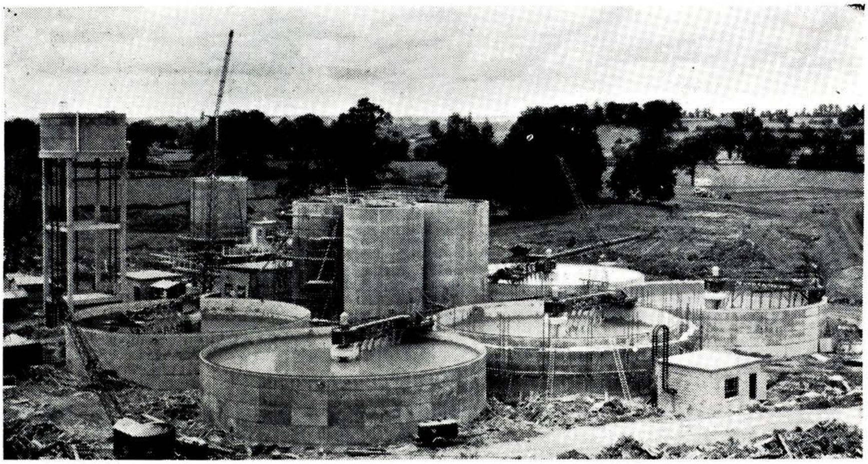


Fig. 4.—Slurry Doctor and Storage Tanks.

Storage Structures.

Washing, Blending and Storage of Slurry.—Washmills such as those provided in wet-process works are illustrated in *Figs.* 2 and 3. The basins are massive reinforced concrete structures. Since there are generally flints or other stones in the material in the roughing mill, the basin is lined with granite setts or steel rails to resist the abrasion.

A slurry-mixing tank, known as a doctor-tank, is generally a reinforced concrete structure about 50 ft. high and supported on concrete columns, with a conical bottom, the outlet from which is above ground level. A slurry storage basin is normally 60 ft. to 90 ft. in diameter and up to 15 ft. deep. It is designed as a liquid-retaining structure, the weight of the slurry being considered to be about 100 lb. per cu. ft. Care is exercised in making the construction joints in order to avoid leaks. Slurry doctor-tanks and storage basins constructed of reinforced concrete are illustrated in *Fig.* 4.

Storage Structures.

Storage of Stone, Gypsum and Clinker.—The choice of the type of structure for a store for loose materials depends on the quantity of material to be stored, the degree of mechanisation of handling, and on the area of ground available. The walls of ordinary buildings for storing materials on the ground (where no pressure is imposed on the walls) are normally clad with asbestos-cement sheets attached to framed structures, which also support the roof. The roofing sheets are, for reasons of safety, generally of reinforced asbestos-cement. For operational or other reasons some structures for storing materials are of unusual shapes.

In a cement works with an annual productive capacity of 200,000 tons or 300,000 tons of cement, it is normally desirable to store about 10,000 tons of crushed stone, 2000 tons of gypsum and 10,000 tons of clinker. An economical form of structure for this purpose is a building of about 70 ft. span, with a sheeted roof, but without walls. A typical building of this type is illustrated in *Fig.* 5. The material is fed into the store by a conveyor. Reinforced concrete cross-walls are provided to separate the various materials. An overhead travelling grab-crane is provided and this picks up the material and drops it into the appropriate section of the store.

Reinforced concrete hoppers with the necessary feeders are provided at the side of the store into which the grab-crane drops stone and shale for the raw-mills. Double hoppers are also provided into which the grab-crane drops clinker and gypsum for feeding into the cement mills. It has been found that the cheapest way of dealing with the abrasion of the concrete slabs by these materials is to provide a cover of 3 in. to 4 in. of concrete over the reinforcing steel. After a few years, some wear may occur, but the wearing surface can then be made good readily with pneumatically-applied cement mortar reinforced with a steel mesh. The lower parts of the columns supporting the roof are subjected to abrasion from the contained materials, and blows from grabs, bulldozers and vehicles. They should therefore be of reinforced concrete with steel angles protecting the corners, or, if of structural steelwork, they should be encased in concrete throughout that part of their height likely to be subjected to such damage; the corners of the encasement should be protected as for reinforced concrete columns. Steel columns are not, however, desirable unless so protected as they are liable to suffer corrosion due to moisture in the contained materials; paint or other protective coating

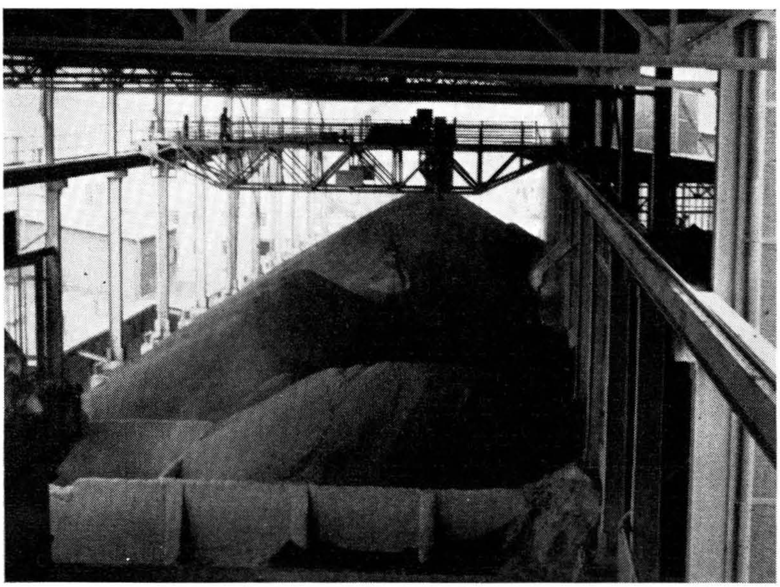


Fig. 5.—A Clinker Store.

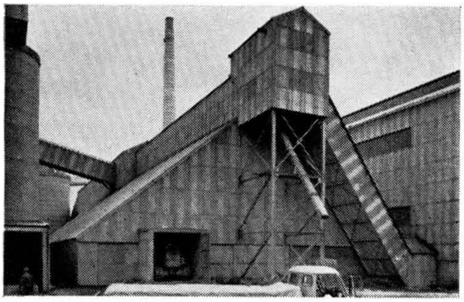


Fig. 6.—Clinker Store.

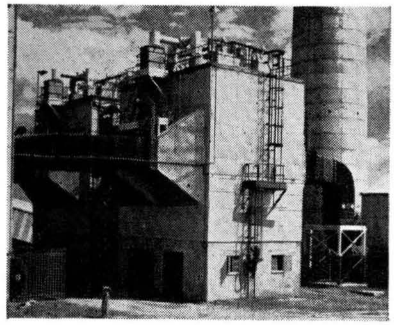


Fig. 7.—Electrostatic Precipitators

applied to the steel is soon rubbed off. It is essential that the columns supporting the crane rails, and the foundations of these columns, should be so designed that no lateral deformation is likely since any such deflection might cause the crane rails to be moved out of line and might possibly result in the collapse of the crane. Another form of housing for a 5,000-ton heap of clinker is shown in *Fig.* 6.

COAL STORAGE.—Elevated bunkers for the storing and handling of coal are not now normally provided owing to the large quantities and high costs of coal required to be stored. In recent years, structures of two other types have been provided. In one, the coal is discharged into the apex of a conical structure (*Fig.* 8) and withdrawn by means of a conveyor in a tunnel under the heap of coal. The other type is a rectangular building in which the coal is discharged from a conveyor in the ridge of the pitched roof and withdrawn by means of conveyors in a longitudinal tunnel under the floor of the store. As in the case of raw-meal and clinker stores, a bulldozer is used to move material on the fringes of the heap towards the extraction conveyor or grab-crane.

The superstructures of conical stores have been built of structural steelwork, but future structures of this type may have precast concrete superstructures in order to reduce maintenance costs, the superstructures of rectangular stores having generally also been constructed in this manner for the same reason. Both these types of structure are also used for the storage of crushed stone and clinker.

CEMENT SILOS.—Silos for the storage of cement are normally built of reinforced concrete and the walls are often built with the aid of continuously-sliding forms. Such forms not only result in a considerable saving of constructional time, but the appearance of the silos is likely to be better than when the walls are built by the use of other methods of shuttering. Examples of continuously-sliding forms used in the construction of cement silos are given in "Design and Construction of Formwork for Concrete Structures," by Wynn and Manning, and in "Reinforced Concrete Water Towers, Bunkers, Silos and other Elevated Structures," by Gray and Manning.

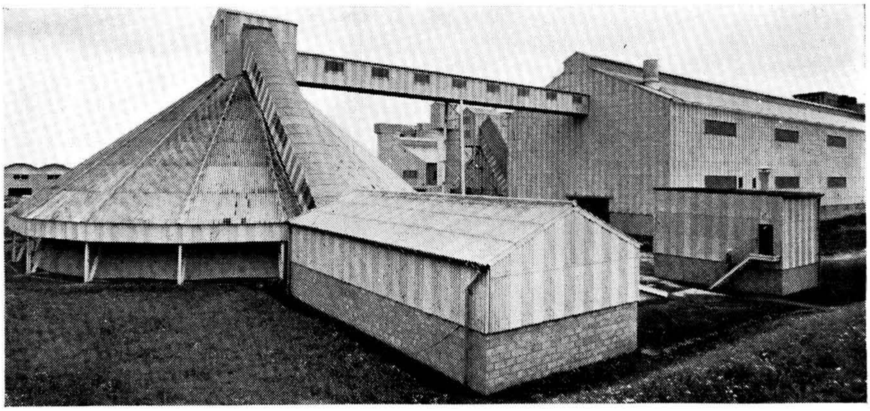


Fig. 8.—Conical Structure for Coal Storage.

The major problem in the design of cement silos is assessing the pressures exerted by the cement on the walls. Several factors have to be taken into consideration when estimating the magnitude of these pressures and exact values are difficult to determine, but practical investigations are proceeding.

When a silo is being filled, the cement in the upper part is in a semi-fluid state. As the cement settles and it loses the air with which it is mixed when it enters, it attains its greatest weight of about 90 lb. per cu. ft., but the horizontal pressure tends to be reduced. The pressures exerted by cement in silos is dealt with in " Oscar Faber's Reinforced Concrete," by J. Faber and F. Mead. Cement is usually extracted from modern silos by local air-entrainment and is discharged into a conveyor in a trench at the side of the silo. The cement near the outlet of the silo is withdrawn first and the cement in the silo tends to " funnel," leaving the material more remote from the outlet, standing with an almost vertical face which sometimes extends for heights of 30 ft. or more. After a time, this bank of the cement collapses and exerts a suddenly increased pressure on the wall of the silo which results in local bending, both horizontally and vertically. As a result of studies of this action, the earlier arrangement of providing reinforcing steel bars in a single layer in the middle of the concrete wall has now generally been discarded, because many silo walls built in this manner were found to be cracked above the outlets. The total number of reinforcing bars required are now generally divided between two layers, one near each of the inner and outer faces of the wall, and in this manner greater resistance to bending is provided. Provision is generally made to enable the silo walls to expand and contract without restraint when the silo is filled and emptied, otherwise cracks may occur.

The supports for the air-conveyors for extracting the cement should be solid concrete walls. It has been found that the air-conveyor apparently supports a

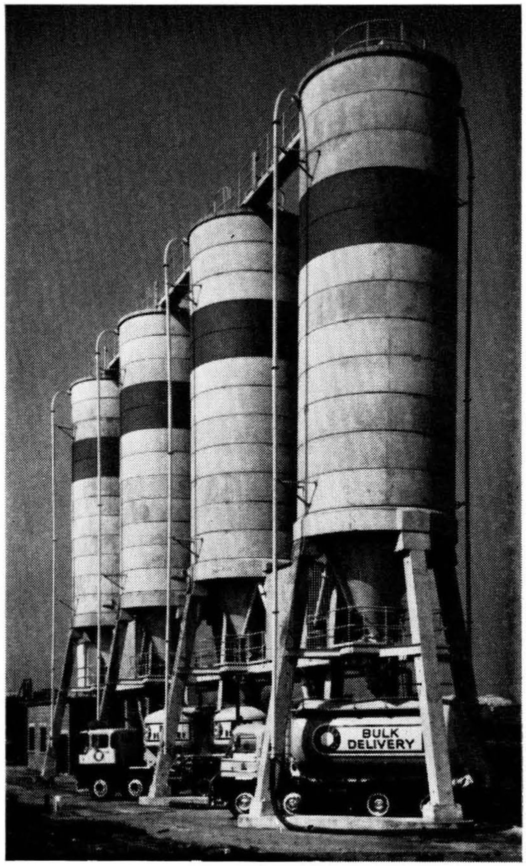


Fig. 9. Precast Concrete Silos at a Cement Distribution Depot.

wedge of cement which results in it having to carry a very large load. When the air-conveyors are supported only on beams, it is found that the beams almost always become overloaded and may fail. Where conveyors pass through the walls, sliding joints should be provided. Walls supporting conveyors inside the silo shouldn't be attached to the walls but a gap or expansion joint provided. The space between the walls supporting the conveyor should be filled with a material having properties similar to cement; dry sand is suitable. The top of the sand filling should be sealed with a layer of bitumen-sand compound which will not restrain the walls. This arrangement avoids an abrupt change of pressure on the walls at the surface of the filling, but extra vertical reinforcement in the walls at this level is desirable to make certain that cracks do not occur. As there are horizontal and vertical layers of reinforcing bars at both faces of the wall, it is found that 8 in. is generally the best minimum thickness for ease of placing the concrete and to provide the necessary resistance to bending. If continuously

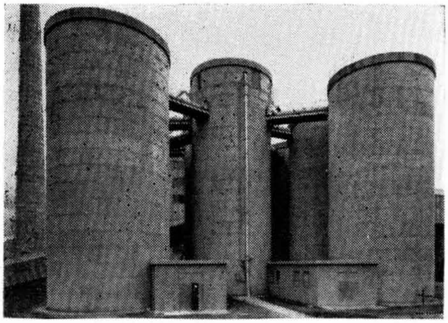


Fig. 10. Raw-meal Blending Silos.

sliding forms are used, the aggregate should be gravel not exceeding ¾ in. in size and with a large proportion of rounded stones; such material should be used in preference to crushed stone as the sharp edges and corners of the latter tend to catch in the sliding forms, resulting in a poor surface and a tendency to weaken the concrete. Since the walls must be watertight, the concrete mixture used is 1:1.6:3.2 or 1:1½:3.

A form of silo of which a number have been erected recently at cement-

Fig. 11. Kiln House (low-level building), Preheater Building, and Blending Bunkers.

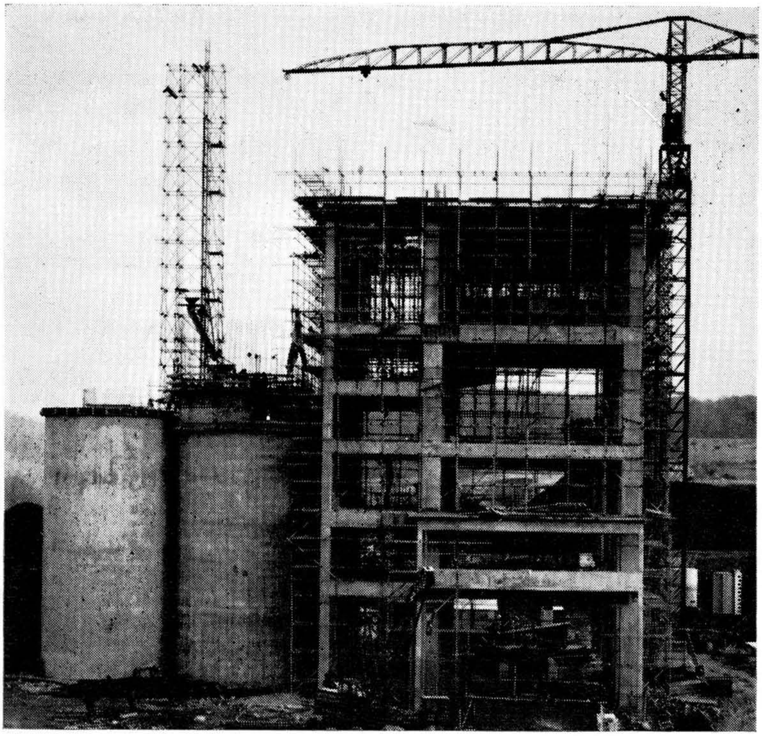


Fig. 12.—Preheater Building and Blending Bunkers in course of Construction.

distribution depots is that shown in *Fig.* 9. The feature of these structures is that they are constructed of precast concrete rings of 13-ft. diameter. The hopper bottoms are of steel. Each of the four silos has a capacity of 180 tons, but some similar structures at other depots have capacities of 250 tons each.

RAW-MEAL BLENDING AND STORAGE SILOS.—Silos for the blending and storage of raw material are illustrated in *Figs.* 10 and 11. When the material is at rest in the silos, it behaves in much the same way as cement but when it is being mixed and agitated by air, it behaves as a fluid, and blending silos must be designed accordingly, allowance being made for excess air pressure. The covers of access manholes in the top of the silos must be fixed down to prevent them being lifted off. Air-filter venting arrangements are provided. The structures in *Fig.* 10 comprise two concrete blending tanks each having a capacity of 1,135 tons, and from which the raw meal is pumped into one of the six adjacent 1,565-tons silos.

Raw-meal storage silos are normally emptied by local air-entrainment at the bottom and are designed in the same way as described in the foregoing for cement silos. At some works, it has been found desirable to erect the blending silos above the storage silos giving a structure having a total height of about 120 ft.; as shown in *Fig.* 10, Blending and storage silos for raw-meal are normally built in reinforced concrete and, if of sufficient height, continuously-sliding forms are used for the construction of the walls, as in the example in *Figs.* 11 and 12.

(*To be continued.*)

Cement Industry in Europe.

Hungary.—It is planned to raise the annual cement production of Hungary to 3,000,000 tons by 1970, 5,200,000 tons by 1975, and 6,000,000 tons by 1980. The total production in 1963 was 1,800,000 tons, and was estimated to be 2,300,000 tons in 1964.

The largest works, the Danube Cement & Lime Works, which has a capacity of 1,000,000 tons annually and was opened in 1963, is to be extended this year to produce an extra 350,000 tons a year.

A new works with an eventual annual capacity of 600,000 tons is to be established during 1966-70 at Bélapátfalva, near the northern border with Czechoslovakia. A works near Eger in the same area, and another at Pecs in the south are to be established later.

Expansion of the Lábatlan cement works, near Tatabánya in the north-west, has now been completed. Reconstruction started in 1952, when the annual output was 180,000 tons of cement and 40,000 tons of lime. At present the annual capacity is 520,000 tons of cement and 120,000 tons of lime.

About 90 per cent. of the cement produced in Hungary is consumed within the country, the population of which is at present about 10,000,000 but is expected to rise 12,000,000 by 1980.

Poland.—A new cement works at Warta, in Dzialoszyn, has been opened. This is the sixth large works to be put in operation in Poland within the past twenty years. The ten existing cement works have also been extended and their productive capacities increased. Poland produces 7,700,000 tons of cement annually at present, and in 1964, 1,000,000 tons were exported to various countries.

The Warta works is one of the largest in the country. After reaching its full productive capacity in 1966, it will supply 1,000,000 tons of cement annually. During the present trial run, four rotary kilns, each having a length of 150 m., will produce 200 tons of cement daily. The buildings took over three years to erect and the assembly of the plant was completed within $2\frac{1}{2}$ years. New methods of building and erection made it possible to shorten the time, compared with that scheduled, by five months, in which time 400,000 tons of Portland cement could be produced, and at that same time, the building costs were reduced to 110 million zlotys. This works is the first of its type to be largely equipped with Polish plant. Imported equipment amounts to about 15 per cent., whereas in earlier works it represents 60 to 70 per cent.

Electronic equipment for the automatic control of a cement mill has been constructed at Institute of Binding Building Materials in Poland. The equipment will be tested on an industrial scale at the Odra cement works.

Developments in Cement Chemistry in U.S.A.

Two of the several improvements in the practice of cement chemistry developed by the U.S.A. National Bureau of Standards are described in the following.

Pure Compounds for the Investigation of Portland Cement.

THE National Bureau of Standards recently supplied the Highway Research Board with batches of calcium-aluminate sulphates which are claimed to be the first ever to be prepared free of carbon dioxide. These pure compounds should prove of value in research laboratories where the properties of the constituents of Portland cement are being investigated, and they should also be of aid in improving methods of identifying the compounds in Portland cement.

The two compounds, calcium aluminate monosulphate ($3CaO . Al_2O_3 . CaSO_4 . 12H_2O$) and calcium aluminate trisulphate ($3CaO . Al_2O_3 . 3CaSO_4 . 32H_2O$), play a significant role in controlling the setting rate of Portland cement, and they occur when concrete is destroyed by exposure to sea-water or sulphate-containing waters. Although purity is not a characteristic of the compounds when they appear in cement, it is essential to study them in pure form. Carbon dioxide, which is one of the impurities most difficult to avoid, forms carbonates that look and act like the calcium-aluminate sulphates and enter into solid solutions with them, changing such fundamental data as planar atomic spacings, unit cell dimensions, and refractive indices. Normal precautions in the past have managed to keep the CO_2-content of the calcium-aluminate sulphates as low as 0·2 per cent., and occasionally 0·1 per cent., but no lower. The pure materials now supplied were produced with a CO_2-content of 0·0 per cent., and possibly 0·00 per cent. for the monosulphates.

The apparatus designed and used to eliminate the CO_2 consists of three units: a closed precipitation system; a closed filtration system; and a glove-box enclosure for storing and conditioning the materials, in which the atmosphere is kept free of CO_2, and in which an airlock permits transfer of materials into and out of the box without contamination of the air inside the box.

The basic problem in the precipitation of the monosulphate was to bring together large quantities of dilute solutions (200 litres of calcium hydroxide and about 2 litres of aluminium sulphate) within a short time and to keep them free of CO_2. With only 58-litre bottles available for storing the solutions and mixing the reactants, it was necessary to mix four batches of reactants and to allow the precipitate to accumulate in the reaction bottle, meanwhile drawing off the spent liquor between batches. The process had to be performed quickly inasmuch as the monosulphate is unstable and, if left in solution, changes after about seven hours to the trisulphate. Moving large quantities of liquid rapidly requires rapid movement of equal volumes of air, but the effective removal of CO_2 from the air requires slow passage through CO_2-free air, trapping it in 50-litre pockets, and moving the trapped pockets of air back and forth as the solutions displaced them by gravity in a closed system. This principle was followed in preparing the solutions directly in the original reagent bottles in the case of the aluminium sulphate, mixing them, drawing off spent liquor, and filtering them.

The filtration medium was a large sintered-glass funnel, equipped with a special oversize rubber stopper and capable of being closed off from the laboratory air both at the inlet and outlet. The entire sealed assembly of filter funnel and filtered precipitate was transferred to the glove-box containing a CO_2-free atmosphere, so that the material never came in contact with the laboratory air. In the glove box, the precipitate was transferred to a desiccator containing crystals and saturated solution of $MgCl_2 . 6H_2O$, in which an atmosphere of 33 per cent. relative humidity can be maintained. The precipitate was dried under these conditions to constant weight, the hydrates formed thereby containing the quantity of H_2O indicated in the formulae.

As essential as preparing the materials in a CO_2-free atmosphere was the necessity of keeping them uncontaminated by CO_2 during shipment to the co-operating research laboratories. Still inside the glove-box, the samples were packed in glass vials. The entire vial was then sealed in a glass tube containing calcium oxide as an absorbent of carbon dioxide.

Determination of MgO.

The 8-hydroxyquinoline method for determining magnesium oxide in Portland cement has recently been improved. The original method gave consistently high values of the MgO-content and poor reproducibility of the results. Studies showed that double precipitation with 8-hydroxyquinoline would give more accurate results. The improved procedure replaces the more lengthy phosphate referee method of performing a second analysis. The improved method is said to be accurate within 0·3 per cent. of MgO at the 2- to 5-per cent. MgO levels. This accuracy can also be obtained at MgO levels below 2 per cent. by including a few extra stages in the procedure. The new method, which has been developed by the U.S.A. National Bureau of Standards, should provide cement manufacturers with a more effective means of controlling the composition of their products.

The 8-hydroxyquinoline method, upon which the new and improved technique is based, is an optional procedure described by U.S.A. Federal and A.S.T.M. specifications for determining MgO-content in cement. Optional methods provide a shorter and more convenient means for making routine analysis than the so-called referee methods. These specifications also describe an ammonium phosphate method (referee) for determining the MgO-content. Although this referee method is more accurate than the currently specified optional 8-hydroxyquinoline method, it requires two to three days for a determination. Because of the time involved, the specifications permit the use of the optional method. Experience has shown, however, that this rapid procedure produces higher results for MgO than the referee method. Difficulties therefore arise when the optional method is used where the MgO-content is close to the specified limit of 5 per cent., in which cases accurate analysis is essential in determining whether the limit has been exceeded.

The reason for the differences between the results of the two procedures was investigated in an effort to refine the optional method by increasing its accuracy and the reproducibility of results between different operators. Various conditions of precipitation with 8-hydroxyquinoline were studied, and a mathematical analysis of the resulting data indicated that a double precipitation technique would yield more accurate results. Laboratory studies were undertaken which showed that the double precipitation of magnesium with 8-hydroxyquinoline gave better reproducibility than the single precipitation method used in the original procedure. The double-precipitation method was also shown to be equal in accuracy to the more lengthy referee method.

The improved 8-hydroxyquinoline method is normally used following preliminary separations of SiO_2, R_2O_3, Mn_2O_3, and the double precipitation of CaO. In this method the combined filtrates reserved in the CaO-separation are first acidified. The solution is corrected for volume, heated, and made just ammoniacal with ammonium hydroxide (NH_4OH). Then 8-hydroxyquinoline is added, followed by an additional amount of NH_4OH (4 ml. per 100 ml. solution). The resulting precipitate of magnesium oxyquinolate is filtered and dissolved in hot hydrochloric acid.

To cause a second precipitation, the solution is made just ammoniacal to methyl red, and hot water is added to adjust the total volume. Then 8-hydroxyquinoline is used again, and after the addition of NH_4OH, magnesium is once more precipitated as magnesium oxyquinolate. This precipitate is filtered and dissolved with hot HCl to yield magnesium chloride and the 8-hydroxyquinoline equivalent of the magnesium.

The MgO-content is determined indirectly by titration, as already specified in the current optional procedure. After cooling the solution to 25 deg.C., a standard $KBrO_3$-KBr solution is added to brominate the 8-hydroxyquinoline equivalent of MgO. With the further addition of potassium iodide, free iodine, equivalent to the unused bromine is released. The iodine is titrated with sodium thiosulphate ($Na_2S_2O_3$). The percentage of MgO-content is then calculated on the basis of known factors which include the MgO equivalent of the $Na_2S_2O_3$ solution, the volume of $Na_2S_2O_3$ solution equivalent to the volume of $KBrO_3$-KBr used, and the amount of $Na_2S_2O_3$ consumed by the excess $KBrO_3$-KBr which was not required to react with the magnesium oxyquinolate.

As already stated, the results are accurate within $\pm 0 \cdot 03$ per cent. MgO at the 2- to 5-per cent. MgO-levels. To obtain comparable accuracy at lower levels, the MgO is determined by difference. Thus, if the solution does not show a precipitate within 15 minutes, a known amount of MgO is added to bring the MgO-level within the 2- to 5-per cent. range. The difference between the amount of MgO determined and the amount added to the solution gives the amount present in the original sample to the required degree of accuracy.

Dust in Cement Works.

THE problems associated with the collection and disposal of dust in the kiln-gases and grinding mills at cement works continue to be dealt with by various organisations. Some developments in this respect are described in the following.

Unit Construction of Precipitators.

A NEW approach to the design of electrostatic precipitators for cement works has, it is claimed, been adopted with success for installations in Canada, Mexico and U.S.A. The plant (*Fig.* 1) comprises a series of separate units each of identical construction, and each a self-contained precipitator. A number of units are assembled and bolted together end-to-end to make a precipitator of the size and rating required to deal with the volume of gases from the kiln. The units are usually arranged in two series in parallel, with two gas passages, so that one half of the installation can operate at times when the other is undergoing maintenance. The internal parts of each unit are interchangeable and fitted with lifting lugs so that a crane can remove equipment vertically through the top. A trough, in which the dust is collected and removed from the installation by screw-conveyors, is provided by means of hoppers of the " Kalco " design, which are bolted on to a shell for easy removal or replacement when necessary. The shell consists of a number of identical welded panels, so designed that, in the event of localised corrosion, the affected panel can be cut out and a new one rapidly installed. All ducts, air-line and low-voltage conduits are equipped with quick-fastening connectors so that erection at the cement works or replacement is quickly and cheaply effected. A silicon rectifier has also been developed for use with the electrostatic precipitators and automatic control devices are provided to ensure that the plant operates at maximum productivity and highest efficiency.

It is claimed that these precipitators are most suitable for cement works

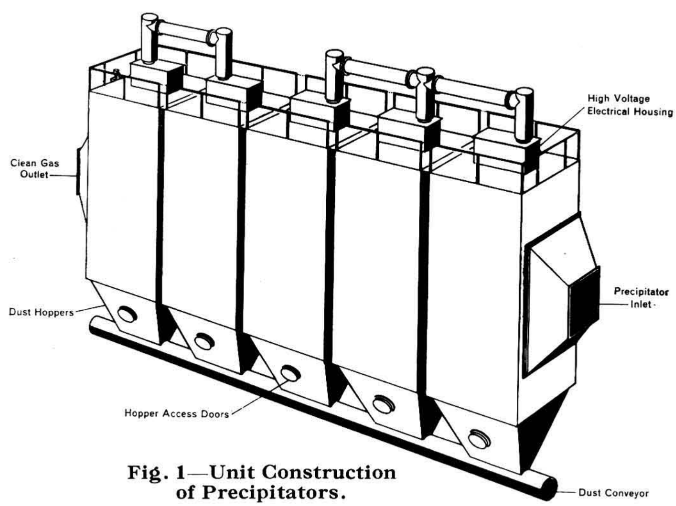
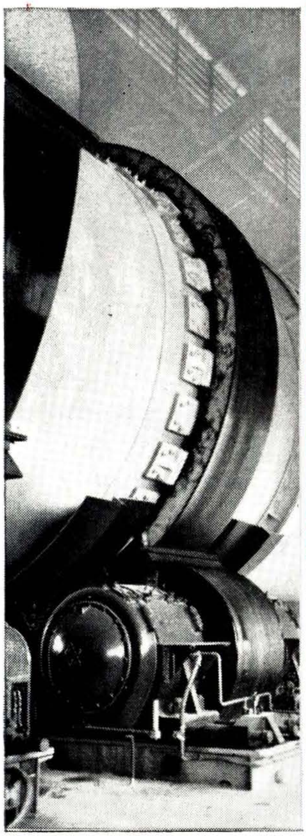
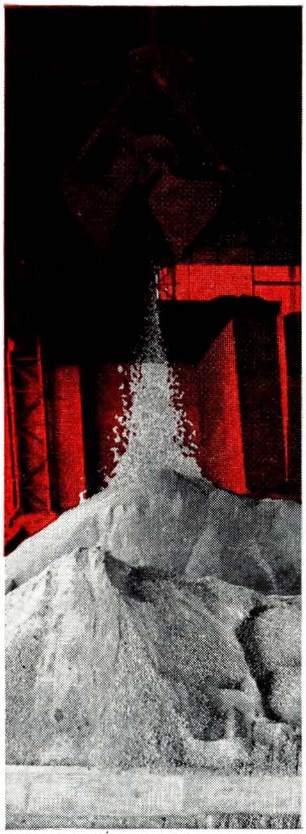
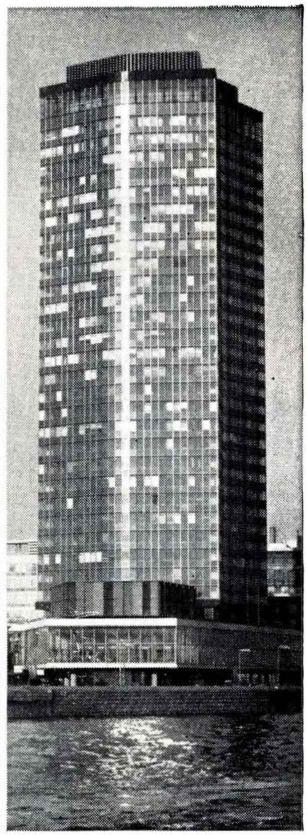


Fig. 1—Unit Construction of Precipitators.







Vickers House, Millbank

Making the MACHINERY that makes the CEMENT that makes PROGRESS

Vickers Cement Division make machinery that makes cement. World demand for Portland cement increases yearly. Vickers help to meet the demand by design and erection of new plant and the modernisation or extension of existing plant for manufacture of cement—a basic raw material of progress essential to a growing economy.

VICKERS cement-making plant

Complete Wet or Dry Process Plants · Grinding Mills · Kilns · Ancillary Equipment

Vickers Limited Engineering Group Cement Machinery Division Sales Office Vickers House Millbank Tower Millbank London SW1

EB48A

where corrosion of internal parts presents a problem and where a high degree of gas-cleaning is mandatory. Instead of the replacement of the internal parts of a precipitator being a major work of reconstruction requiring probably several weeks, the unit construction method enables the period to be reduced so that the entire precipitator need not be out of service for more than two or three days.

The precipitators are obtainable in the United Kingdom through the Western Precipitation Division of the Joy Trading Corporation, London.

Dust-control Equipment.

A new type of dust-control equipment was installed at the Barnstone works of The Associated Portland Cement Manufacturers Ltd., in order to improve the extraction and filtration of cement mill No. 2. A filter of the ordinary simple fabric type had been used previously but the new plant (*Fig.* 2) is a filter of unusual design which is claimed to give a continuously-rated performance with a high degree of efficiency of filtration. The filter elements are pads and are so shaped that the space is utilised to the maximum. Cleaning by compressed air is employed.

The filter was installed for one mill to deal with 1,800 cu. ft. per minute at 120 deg. F. With a filtration velocity of 5 ft. per minute, a pressure drop of less than 3 in. watergauge was obtained. After some weeks of satisfactory operation, a

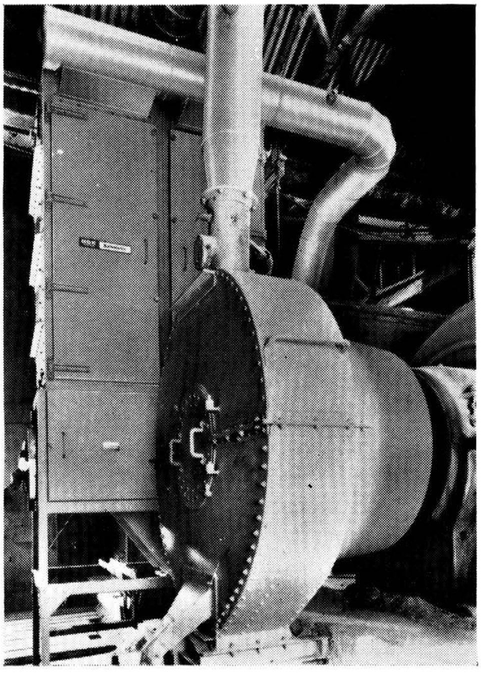


Fig. 2. Dust Collector at Barnstone Works

second mill was included in the system, increasing the total flow of air to more than 3,000 cu. ft. per minute, and the restriction to 3.5 in. water gauge. The new filter proved capable of handling this increased amount of dust. Some 30 tons of cement per week are now retained by the filter and returned to the plant on a continuous basis, a performance which has now been maintained for two years. Although no repairs to the filter have yet been necessary, the plant is designed to allow maintenance to be carried out from the clean side of the filter. It is also claimed that incidental costs have been reduced by rendering unnecessary the need for periodical cleaning of the roof in the vicinity of the original filter as was required previously.

The new filter is called the " Dalamatic " and was supplied by Dust Control Equipment Ltd.

Re-processing Cement Dust.

Laboratory tests have been completed at the Tatabánya Cement & Lime Works, in north-west Hungary, on two new types of cement-dust extractors. Equipment of one type reclaims dust of 50-micron size from the cement grinding mills. This dust can then be re-processed, resulting in a daily saving of several tons of cement. The other installation removes dust at the firing stage, where the high lime content of the dust may be injurious to health.

Industrial Archaeology.

IT has been announced that, under the auspices of the Industrial Monuments of London Project, a series of books on the industrial archaeology of the British Isles is to be published during the next year or two. One of the volumes will deal with London and the author is seeking the co-operation of those who may know of items of equipment, machinery or buildings which are of historic interest, either by virtue of their age, their role in an industrial development, or because they have survived a major change in technology.

An official definition of an industrial monument, as agreed between the Council for British Archaeology and the Ministry of Public Work and Building, is: " Any building or other fixed structure—especially of the period of the Industrial Revolution—which either alone or in association with plant and equipment illustrates or is significantly connected with the beginnings and evolution of industrial and technological processes, including the means of communication."

Whereas information on public buildings and the like is available, there is a shortage of information on private industry, particularly manufacturing industry, in which there must be very many items of particular value in relation to this project.

Any reader of this journal who has knowledge of any items that might be of interest should write direct to Mr. Aubrey Wilson, 34 Sackville Street, London, W.1.

TO SPEED THE SECOND INDUSTRIAL REVOLUTION

a complete automation service

FOR INDUSTRY

with widespread established roots

EXPORT!

'ENGLISH ELECTRIC' SELLS IN 140 COUNTRIES

Considering automation? Look first to the roots. A successful system depends not only on advanced techniques, but also on mature understanding of industrial processes and practicabilities. For this, experience is vital.

The facilities of the English Electric Group have been developed over many years, progressively bringing the latest systems techniques to developing industries.

Make a good beginning—with
ENGLISH ELECTRIC AUTOMATION LIMITED

Write to:
Industrial Applications
& Automation Group,
The English Electric Company Limited,
Stafford, England.

'ENGLISH ELECTRIC'
AUTOMATION

IA.4

The Associated Portland Cement Manufacturers Ltd.

THE following comments on the activities of The Associated Portland Cement Manufacturers Ltd., at home and abroad, are abstracted from the Chairman's statement which was presented at the Annual General Meeting held in London last month.

The capacity of the new works at Weardale is being doubled, thus making the annual productive capacity 600,000 tons. The first kiln at this works has just started production and the second is expected to be in production in the autumn of this year. The new 500-ft. rotary kiln at Westbury works also started production recently. The capacity of the works at Dunstable is to be increased by 400,000 tons. Further major extensions and new works are under consideration.

In Australia, the interests in New South Wales and Victoria have been merged into a holding company. The Associated Portland Cement Manufacturers (Australia) Ltd., which concern has acquired the shares of The Commonwealth Portland Cement Co., Ltd., the principal subsidiaries of which, both wholly owned, are Metropolitan Portland Cement Proprietary Ltd., and Standard Portland Cement Co., Ltd., the latter company having been taken over earlier in the year. The acquisition of Standard Portland Cement Co., Ltd., which operates a 235,000-tons works at Charbon, increased the Group's works in New South Wales to three. The holding company also acquired the shares of The Victoria Portland Cement Company Proprietary Ltd., which Company's works in Victoria commenced production in February last. Demand for cement remained strong throughout the year and all works sold their full production. Plans are in hand to expand productive capacity in New South Wales and Victoria.

In British Columbia, the associate company, Ocean Cement & Supplies Ltd., and Canada Cement Co., Ltd., in which A.P.C.M. Ltd., have a substantial shareholding, recorded increased business.

In Malaysia, notwithstanding Indonesian confrontation, trade remained good and Malayan Cement Ltd., sold its full output.

The construction industry in Mexico had a busy year. The new kiln at Mixcoac works came into production late in 1964, and further modernisation of the remainder of the plant is in progress. The capacity of the Atotonilco works is being doubled to 600,000 tons a year.

In New Zealand, The Golden Bay Cement Co., Ltd., and Waitomo Portland Cement Ltd., recorded gratifying results. Expansion of the Golden Bay works is in hand. The second bulk-cement sea-going carrier, M.V. *Ligar Bay* (see this journal for March 1965), came into service during 1964, and transports supplies to the major distribution areas around the coast.

The South African subsidiary, White's South African Portland Cement Co., Ltd., experienced a busy year, and plans for further expansion are being implemented. Durban Cement Ltd., in which White's has a substantial interest, produced to capacity during 1964.

In Kenya, A.P.C.M. Ltd., are shareholders in The East African Portland

Cement Co., Ltd., which in spite of a further decrease in the construction industry, increased its trading. The British Standard Portland Cement Co., Ltd., which operates a 400,000-tons vertical-kiln plant at Mombasa, increased its export trade considerably, and an order has been placed for a new 250,000-tons rotary kiln. In association with this Company, A.P.C.M. Ltd., are participating in a new 130,000-tons works which is being erected near Dar-es-Salaam in Tanzania, and which is expected to be in operation next year.

In Rhodesia, The Salisbury Portland Cement Co., Ltd., again increased its share of a depressed market but, until the political future of Rhodesia is clarified, conditions in the building industry are likely to be increasingly difficult.

The West African Portland Cement Co., Ltd., of Nigeria, completed its programme to double its kiln capacity to 450,000 tons a year.

An agreement has been made with the Government of Ghana to assist them to establish a clinker-grinding plant at Tema having a capacity of 200,000 tons of cement a year.

An initial investment in the cement industry on the Continent has been arranged in association with Compania General de Asfaltos y Portland Asland and other interests. The capacity of a works at Cordoba is being increased by the installation of a new kiln which will be in production early next year. Meanwhile the existing plant remains in operation.

MISCELLANEOUS ADVERTISEMENTS

Printed in Great Britain by CORNWALL PRESS LTD., 1-6, Paris Garden, Stamford Street, London S.E.1.
Published by CONCRETE PUBLICATIONS, LTD., 60, Buckingham Gate, London, S.W.1, England.