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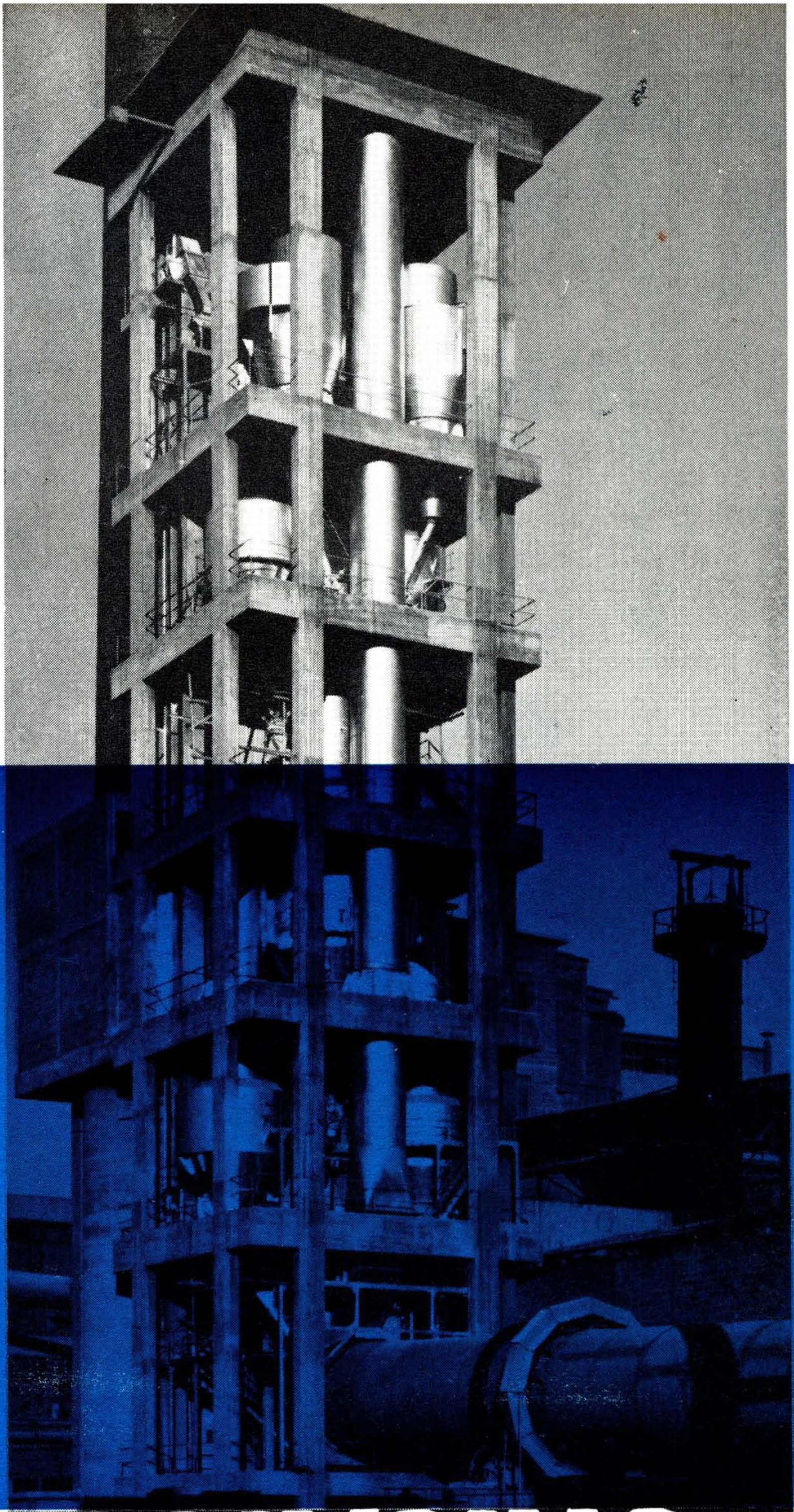

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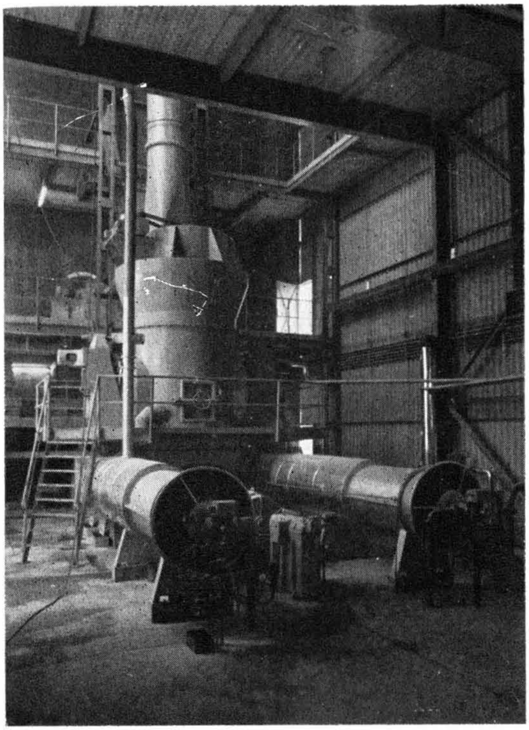

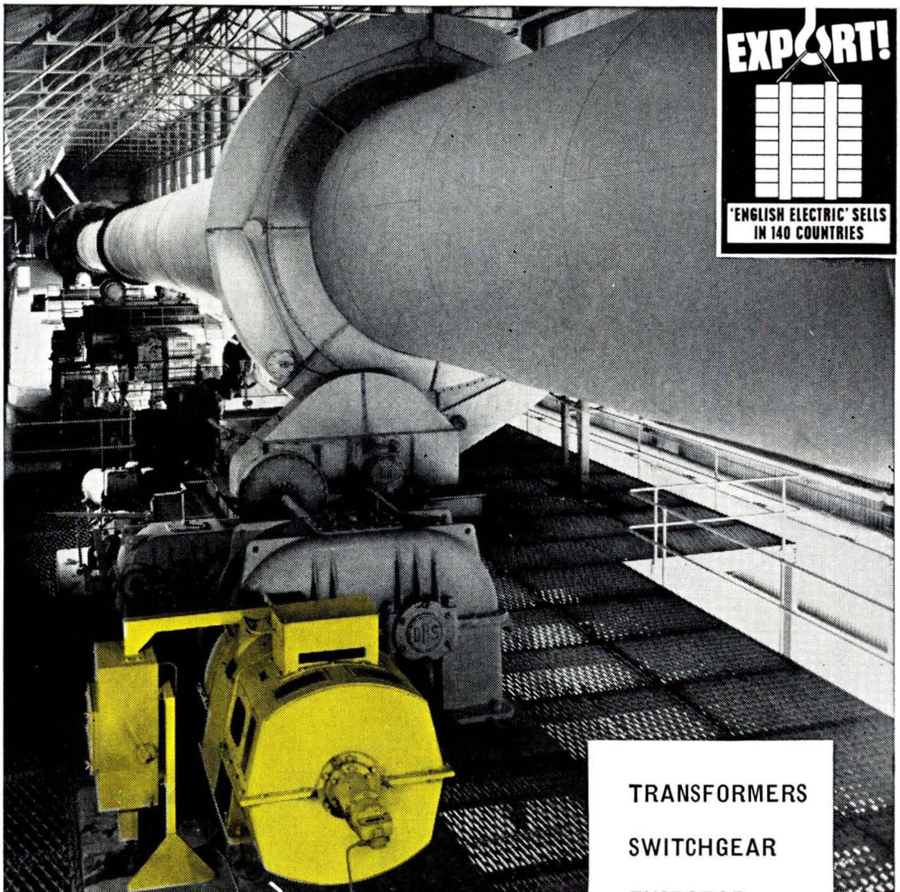

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A New Cement Works in Ethiopia.

CONTRIBUTED BY K. C. BARRELL, M.A., M.I. Mech. E.

THE new cement works of the Ethiopian Cement Corporation (Share Company) at Addis Ababa started production last autumn, and has an annual productive capacity of 60,000 tons of ordinary Portland cement and 10,000 tons of pozzolanic cement. The cement is made from limestone and either clay or " scoria " (a local form of tufa) in a rotary oil-fired kiln operating on the Humboldt process.

The site of the works, which is at a level of 7,500 ft. above sea-level on the outskirts of Addis Ababa and has connections to the main road and railway to Djibouti, is near the centre of the area of demand at Addis Ababa where labour, electric power and many amenities are available. For these reasons this site was selected in preference to one adjacent to the nearest source of suitable limestone which is some 50 miles away in a remote and inaccessible area. There is direct railway connection from the new works to the Corporation's older works about 200 miles away at Dire Dawa. General views of the works are shown in *Figs.* 1*a*, *b*, and *c* on pages 84 and 85.

Raw Materials.

The limestone quarry is on the bank of the Mugher River about 50 miles north of Addis Ababa, and to reach it, a road 14 miles long had to be built from the nearest main road. The river runs in the bottom of a deep valley. The only access by road from the top is a rough and precipitous track which is impassable in the wet season. Therefore a spectacular twin-cable ropeway has been installed for the transportation of crushed stone, stores and personnel. The ropeway, a view from one of the buckets of which is shown in *Fig.* 2, is about 6 miles long and rises 3,000 ft. to the roadway at the crest alongside the valley. The journey takes about 50 minutes.

The stone is a high-carbonate white limestone, which, while the quarry is being opened, is drilled on the face with pneumatic hand-drills, shot-fired, and

(a)

(b)
Continued from (a)

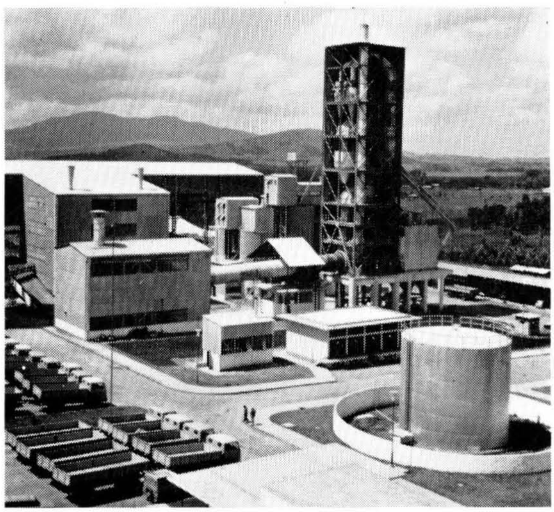


Fig. 1.—General Views of Works of Ethiopian Cement Corporation.

barred down by hand. When the face has been sufficiently developed, the shot holes will be drilled by machine from the top. The stone is loaded by an electrically-operated shovel, having a 1·3-cu. m. bucket, into diesel dumpers holding 4 cu.m. Four dumpers in service normally suffice to transport the required amount of material to the crushing plant which is at the loading station of the ropeway a few hundred yards distant. The stone as tipped from the dumpers into the crusher feed-chute has a maximum size of 700 mm. It is discharged by an apron-feeder into the twin-rotor hammer-crusher which reduces it in one stage to the size required for the mills. The crushed stone is taken by an inclined belt-conveyor to two storage bunkers from the bottoms of which it is discharged into the ropeway buckets. Each bucket has a capacity of 0·4 ton. At the unloading station at the head of the valley, the buckets are emptied either into hoppers or on to a stock-pile, from which the stone is loaded into lorries with trailers for transport to the works. A lorry and its trailer have a combined capacity of 20 tons; both vehicles are of the tipping type, and in *Fig. 1a* some are seen parked at the works.

The electricity for operating the quarry and ropeway is generated at 380 volts 50 cycles 3-phase at the quarry by a pair of Deutz diesel engines and generator of 380-kw capacity. The supply for the motors driving the ropeway, which are installed at the unloading station 6 miles away, and for the shovel in the quarry is transformed up to 15,000 volts for transmission and stepped down again at each site. There are small auxiliary generators for electricity for lighting.

The quarries for the clay and scoria are situated only a few miles from the works. The materials are dug and loaded by a ½-cu. m. diesel-operated shovel into lorries for transport to the works, where they are crushed and delivered to the main material store.

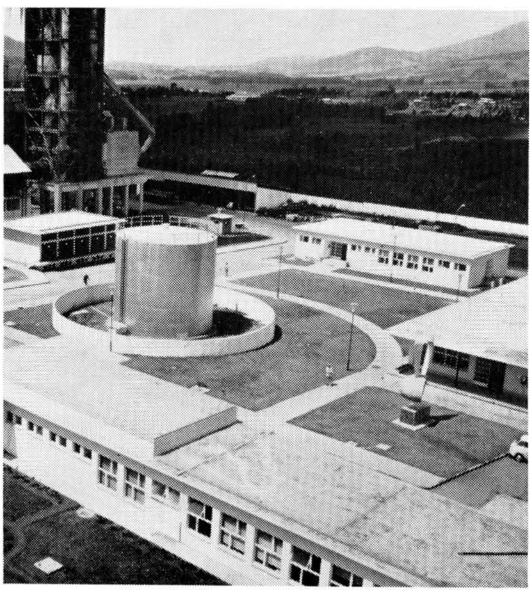


Fig. 1c.
Continued from (b)
(See facing page.)

This store, which contains the stocks of limestone, clay, scoria, clinker and gypsum, is served by an overhead crane by means of which the materials are distributed from their points of reception to their respective storage areas, or to the hoppers of the grinding mills. The part of the store in which the limestone is stored is seen in *Fig. 3*.

Raw-Meal Preparation.

The raw mill and the cement mill are housed in one building abutting on to the main store, the feed hoppers of the mills being so placed that they can be charged by the crane in the store.

The raw mill is 2·6 m. in diameter and 5·7 m. long, and is driven by a 700-h.p. 6000-volt motor through a reduction gear-box and girth-gear. It operates on closed circuit with a classifier, hot gases for drying being provided, when necessary, by an oil-fired furnace. The raw-meal is taken by " Airslides " and elevators to a Fuller quadrant blending equipment, the finished meal being stored in two steel silos (*Fig.* 4). The finished meal is transferred by " Airslides " and elevators to a Schenck constant-weight kiln feeder.

Burning and Cooling.

The burning and cooling plant comprises a rotary kiln, a four-stage Humboldt preheater and a 425-Fuller inclined-grate cooler.

The kiln, which is 34 m. long and 2·6 m. in diameter, has a welded steel shell and is carried on two tyres. It is fired with heavy oil through a spill-burner. *Fig.* 5 shows the kiln, looking from the feed-end. The kiln is driven by a commutator motor and there is an auxiliary diesel engine for use in case of failure of electric power. The flue-gases are cleaned in a plate-type electrostatic precipitator, which is seen on the left in *Fig.* 4.

The clinker is transported from the cooler to the main store by a drag-link conveyor.

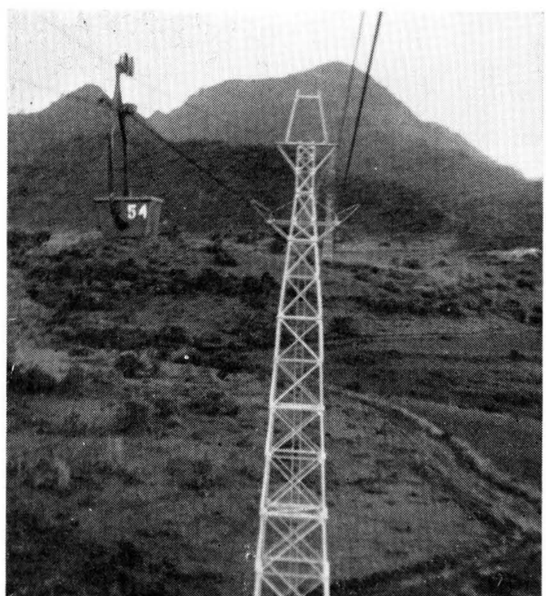


Fig. 2. Overhead Ropeway from Quarry.

Fig. 3. Raw Materials Store.

Grinding, Storage, Packing and Loading.

The layout of the grinding, storage and despatching part of the works is shown in *Fig. 1a*. The clinker-grinding mill is located with the raw mill in a building which can be identified in *Fig. 1a* by the two vent stacks projecting above the roof; these vents are for discharging the mill reek from the filters. The cement mill is similar to the raw mill except that it has a diameter of only 2·4 m. The feed to both mills is by means of manually-controlled table-feeders, and the purge from the circulating-air systems is cleaned in automatic "circular" bag filters, using cold scavenging air. The 6000-volt control gear, the motors, gears and mills are all situated in the same building, without partitions.

The cement is conveyed to the storage silos by "Airslides" and elevators.

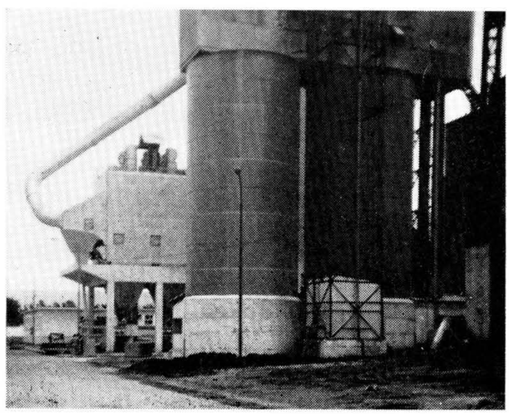


Fig. 4. Silos for Storage of Raw Meal.

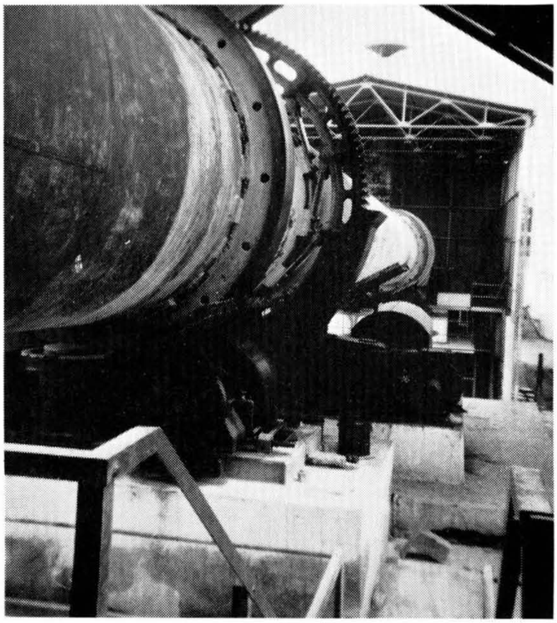


Fig. 5. The Kiln Viewed from Feed End.

There are six silos disposed in two lines of three on each side of a chamber housing the elevator, extractors and blowers, and the conveyor transferring the cement to the packing plant. The silos are of steel and are mounted on concrete bases, a form of construction common to all the other silos.

The packing building is seen to the left of the silos in *Fig. 1a.* In front of this building is the store for bagged cement and the like, and loading bays for road and railway. Cement being delivered from the silos is elevated, screened on a vibrating screen, and packed, by means of a four-spout packing machine, in 50-kg. paper bags. A reversible conveyor delivers the bags either to the road or railway loading bays, where they are loaded by barrows onto the lorries or into the railway wagons.

General.

Gypsum is obtained in Ethiopia and is brought by railway to the works, where it is crushed before being deposited in the main store.

The fuel oil is delivered in railway tank-wagons from which it is pumped to the storage tank seen in the foreground of *Figs.* 1 *a* and *b.*

Electricity is supplied by the Ethiopian Electric Light & Power Authority at 15,000 volts 50 cycles 3 phase by an overhead line terminating in an underground cable at the substation in the works. At the substation, which is seen in *Fig. 1b* just behind the oil tank, it is transformed down to 6000 volts for the mill motors, to 380 volts for the other power requirements, and 220 volts for lighting. The high-tension control cubicles are seen on the right in *Fig.* 6 and the low-tension

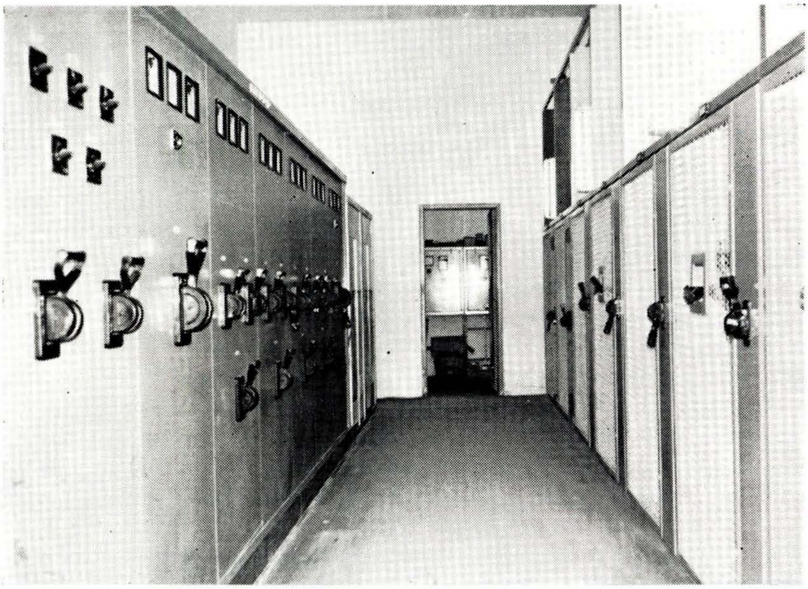


Fig. 6.—Electrical Control Cubicles.

cubicles are on the left. Automatic power-factor correctors are installed which are capable of maintaining the overall works power-factor at a value approaching unity.

The works is well provided with ancillary buildings such as workshops, laboratory, administration offices and first-aid room, which are to be seen in *Fig. 1c.*

The plant was designed by Messrs. Ingra of Zagreb, which firm supplied and erected the mechanical and electrical equipment with the exception of the Humboldt preheater, the Fuller cooler and quadrant blending plant, certain electric motors and similar items. The ropeway was supplied by Messrs. Badoni of Lecco, Italy. The construction of the building and civil engineering work was carried out by the Ethiopian Cement Corporation with the assistance of local contractors.

Cement Works in Australia.

Western Australia.—The second unit of the Rugby Portland Cement Co.'s works in Western Australia, which began production in the summer of 1964, more than doubled the productive capacity of the works.

Tasmania.—A complete Humboldt dry-process plant is to be installed by Messrs. Humphreys & Glasgow Ltd., at the Railton works of the Goliath Portland Cement Co., Ltd. The annual production of the new plant will be 300,000 tons.

Correlation between the Strengths of Cement and Concrete.

IN the Bulletin (New Series No. 26, March 1965) of The International Union of Testing and Research Laboratories for Materials and Structures (RILEM), A. MARKSTAD and R. RUDJORD report on an " Investigation into Cement Testing Methods and into the Correlation between the Strength of Cement and that of Concrete." The following is a summary of the report.

Three different methods of cement testing were investigated in regard to reproducibility. One skilled operator tested a standard Portland cement ten times by each of the methods, that is thirty tests were made. At twenty-eight days, the coefficients of variation for compressive strength were found to be about 2 per cent. for cement tested by the RC method, about 3 per cent. by the earth moist-mortar method, and about 4 per cent. by the wet-mortar method.

An investigation into the reproducibility of results obtained by the RC method conducted in four different laboratories showed a coefficient of variation of 3·4 per cent. in compressive strength and 4·2 per cent. in bending strength.

An evaluation of the compressive strengths obtained from the testing of 191 cements during the years 1946 to 1959 showed that the correlation between the earth,moist-mortar and wet-mortar methods was not satisfactory.

The compressive strengths of forty-two cements determined by the RC method and the wet-mortar method were compared. It was not possible by these methods either to characterise the cements in the same way and sequence. Among other reasons for the disparity may be the effects of the varying contents of gypsum and the different finenesses of the cement, as it was shown that the three methods of testing responded very differently as regards these factors. The authors' conclusion is therefore that the strengths obtained by testing concrete must be the basis for the selection of the best method of testing cement.

The strengths obtained with seven different cements each of which were used in making three concretes of different cement content, were compared with strengths obtained by testing the cements in accordance with three different methods of cement testing. Of these methods the RC method gave the highest coefficient of correlation.

Cement Works in Ghana.

The official opening of first cement plant in Ghana, Africa, a clinker-grinding works, took place in May last. The plant, which has an annual productive capacity of 200,000 tons, actually went into production at the beginning of this year. Under an agreement with the Ghana Goverment, The Associated Portland Cement Manufacturers Ltd., is responsible, for a number of years, for the technical management of the plant and the supply of the clinker. Supply of the clinker will form a valuable long-term export from Britain. The contractors for the new plant, which was installed in the record time of seven months and which is situated in the Port of Tema, are Messrs. Parkinson Howard (Tema) Ltd., working in co-operation with The Associated Portland Cement Manufacturers Ltd.

Civil Engineering and Building in Cement Works—II.*

Buildings.

The superstructures of some buildings, such as those housing the crushers, present no particular problems in design or construction but others have to be given special consideration.

KILN HOUSES.—Houses for kilns are becoming larger and taller owing to the larger kilns now being installed. Precast reinforced concrete frames, as shown in *Fig.* 13, are now frequently used. The illustration in *Fig.* 14, shows a kiln house in U.S.A. in which prestressed precast concrete double-T slabs and beams are used in the construction of the roof which is supported on a reinforced concrete structure. Elsewhere, notably in Mexico, reinforced concrete shell roofs are adopted for kiln houses and similar structures; the building with this form of construction shown in *Fig.* 15 is in Sweden.

In the United Kingdom, walls and roofs are sheeted and ventilation is ensured by providing ample louvres for incoming air just above the level of the floor

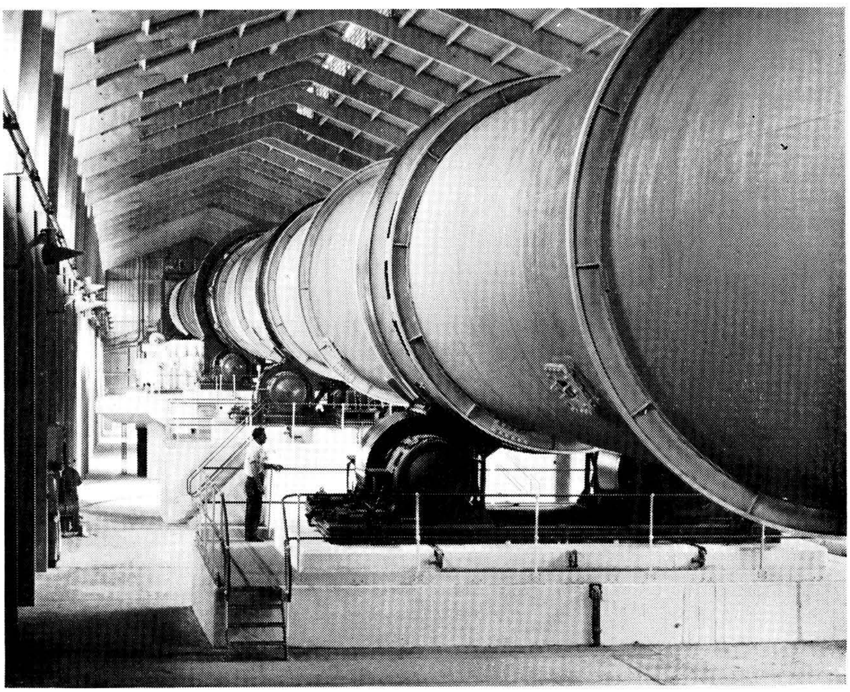


Fig. 13.—Kiln House with Precast Concrete Frames.

*Continued from the number for July 1965.

Fig. 14.—Kiln House with Prestressed Concrete Roof.

together with continuous louvred jack-roof ventilators. It is also usual to leave a gap of about 2 ft. between the top of the wall sheeting and the roof sheeting, and to arrange the roof sheeting to overhang the walls by 2 ft. or 3 ft. The kiln building has to be high enough to avoid overheating the roof structure.

MILL HOUSES.—In mill houses, particularly in cement grinding mill houses where water is sprayed on the mills to cool them, adequate ventilation is also essential and continuously louvred jack-roofs are necessary.

STRUCTURES FOR DRY-PROCESS WORKS.—Multi-storey concrete framed buildings with concrete floors are required for the buildings housing the preheater where the Humboldt dry-process is used, and for the noduliser buildings where the Lepol process is used. The building for the Humboldt plant may be as high as 160 ft. as in the examples in *Figs.* 11 and 12 (see pages 72 and 73 of this journal for July last.

PACKING BUILDINGS.—Buildings in which the cement is packed for despatch are usually constructed with reinforced concrete floors and frames and with walls of

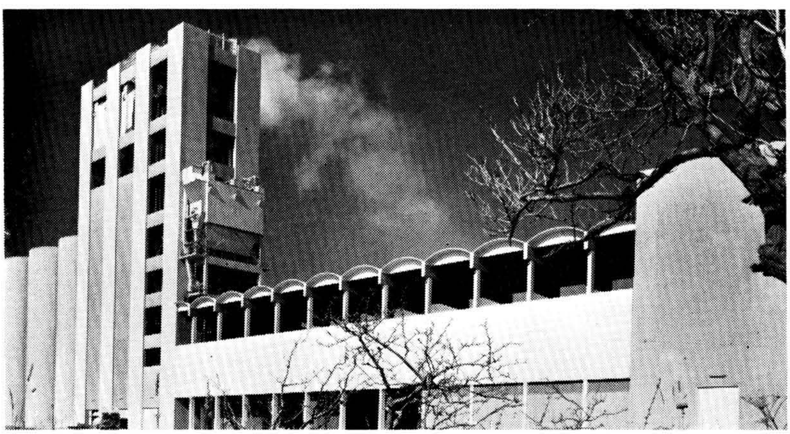


Fig. 15.—Kiln House with Barrel-vault (shell) Roof.

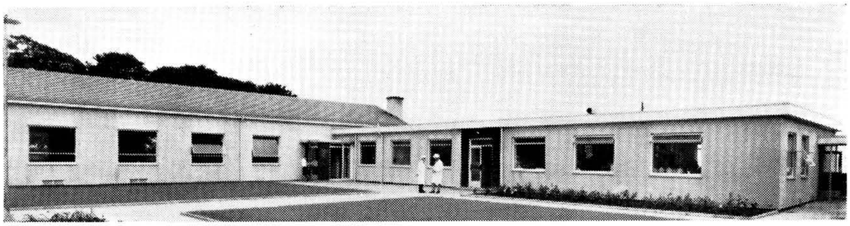


Fig. 16.—Buildings for Offices, Laboratories and Canteen.

asbestos-cement sheeting or concrete blocks. The cement-loading buildings, and the store attached there-to for special cements and other products, are usually of composite cast-insitu and precast reinforced concrete construction. The long roof beams of the loading canopies are now often constructed of prestressed concrete as their length makes this type construction desirable in order to reduce their size and weight.

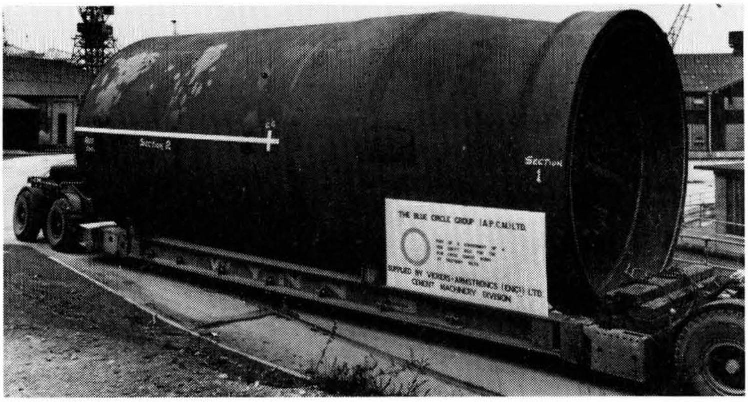
SUB-STATIONS.—An electrical sub-station incorporating transformers is normally provided by, or for, the electricity authority outside the works. The walls of the sub-station are generally built with hollow concrete blocks or of cavity blockwork. A concrete roof with a covering of asphalt or roofing felt is provided. Insulator supports are generally of precast concrete. One or two electrical sub-stations with transformer compounds are generally required inside the works. The brick walls and concrete roofs of these buildings are constructed similarly. Air filters and heaters are generally provided to prevent deterioration of the electrical equipment due to dust and damp. Reinforced concrete blast-walls are provided around transformers, and concrete basins are provided under the transformers to contain the oil in the event of leakage.

SERVICE BUILDINGS.—Office buildings, laboratories and canteens are usually built with cavity walls of concrete blocks, rendered on both sides, and may be provided with an attractive proprietary finish. Single-storey buildings are preferable for ease of access but restricted conditions on the site may make two-storey buildings necessary. Typical single-storey buildings for offices, laboratories and canteens are shown in *Fig.* 16.

Workshops, fitting shops and stores for machine parts are generally constructed with one of the proprietary systems for concrete buildings, incorporating precast concrete frames and insulated wall panels. The roof covering is generally of asbestos-cement sheeting which is insulated where required.

(To be concluded)

500-ft. Kiln at Westbury Works.



THE new kiln installed in the works of The Associated Portland Cement Manufacturers Ltd., at Westbury, Wiltshire, is 500 ft. in length and is said to be one of the largest and most fully-automated cement kilns in the world. The kiln, which will increase the annual productive capacity of the works by 300,000 tons, was delivered in fifteen loads which had to travel 280 miles by road from the maker's works in the north of England, each journey taking about eight days. The accompanying illustration shows a section, 41-ft. long and weighing some 40 tons, loaded on one of the special vehicles employed in the transportation of the larger parts of the kiln.

The kiln is due to be in full operation this year and has already been started up. Basically the instrumentation repeats the scheme designed for the initial 450-ft. kiln installed in the Westbury works when opened two years ago. A central panel provides the means for recording, indicating and controlling at optimum values the several variable factors necessary to be considered to ensure a continuous flow of product of high quality and, at the same time, reduce the consumption of fuel to a minimum. The factors taken into account include the air temperatures at several positions, the temperatures at the grate and at the kiln-exit, the pressure within the cooler and the back-end draught. Control is also exercised over the flow of pulverised fuel to the kiln-burner pipe and, as an added refinement, the fuel-air ratio is adjusted by reference to the oxygen content of the exit gases thereby ensuring the maximum efficiency of combustion. The kiln-feed slurry is measured by electromagnetic means. The feed of clinker to the cement mills is also closely controlled to maintain the chemical and physical quality of the cement.

The kiln was supplied by Vickers-Armstrong (Engineers) Ltd., and the instrumentation was devised by The Associated Portland Cement Manufacturers Ltd., in collaboration with Honeywell Controls Ltd.

Research in U.K. in 1964.

The following abstracts are from the recently published Report for the Year 1964 of the Cement & Concrete Association and describe the progress and results of the research on the chemistry of cement undertaken by the Association. Copies of the Report are obtainable free of charge from the Association at 52 Grosvenor Gardens, London, S.W.1.

X-ray Diffractometry of Cement Minerals and other Anhydrous Phases.

Investigations have continued on the automation of the analysis of cements by quantitative X-ray diffractometry and, as the procedure has been refined, further potential sources of error have been revealed which will require further investigation if measurement of the content of the four principal components of cement is to be carried out with high accuracy.

The examination by X-ray diffraction of a number of samples of Portland cement, taken from newly opened bags, revealed that in every case both calcium sulphate hemi-hydrate and calcium hydroxide were present. No gypsum was detectable and, if present, the amount cannot have exceeded 0·5 per cent. Trials in a laboratory ball-mill have shown that milling alone under these conditions will not convert gypsum to hemi-hydrate but that milling in the presence of cement clinker will do so. It seems highly probable that, in a cement-mill, gypsum is being converted at least to hemi-hydrate and possibly sometimes to anhydrite. At the same time, free lime in the cement is being converted to calcium hydroxide. This result is inconvenient because the X-ray diffraction patterns of calcium hydroxide and calcium sulphate hemi-hydrate seriously interfere with the diffraction patterns of the four main phases of Portland cement. It now seems that, when great accuracy is being sought from quantitative X-ray diffraction analysis, the work must be done on samples of clinker or on cement which has undergone a preliminary chemical treatment to remove the interfering phases. In the latter case, heating at 550 deg. C. to convert the interfering substances to CaO and anhydrite is practicable but is not entirely desirable.

System CaO-Al_2O_3-SO_3.

The CaO-Al_2O_3-SO_3 system is primarily of interest in connection with the formulation of expanding cements based on the calcium alumino-sulphate hydration reactions. It is also of some relevance to the reactions occurring in Portland cement kilns when sulphur-containing fuels are being used. When the calcium carbonate in the raw feed loses carbon dioxide, it is being exposed to combustion gases with a high SO_2 content which convert part of the calcium oxide to anhydrite. The eutectic between CaO and $CaSO_4$ is thought to have a melting point of 1,365 deg. C. and contain 10 to 15 per cent. by weight of CaO. It seemed possible that lower melting points might occur in the ternary system of CaO and $CaSO_4$ with alumina; some measurements made with the hot-wire microscope confirm this. It is planned to plot an accurate phase diagram of this field if satisfactory arrangements can be made to work at controlled partial pressures of SO_2 and O_2. In

Portland cement clinkers it has been found that not all of the SO_3 present is there as alkali sulphates, and it is of some interest to know how the remainder is distributed between the clinker phases. It has been observed that dicalcium silicate formed in compositions containing both AP_2O_3 and SO_3 is always stabilized as the β-form but, in compositions containing AP_2O_3 but no SO_3, this is not the case; it seems therefore possible that SO_3 is combined in the β-dicalcium silicate phase.

Hydration of Cement.

The investigation of the consecutive reactions occurring in the early stages of the hydration of cement pastes was continued by two methods, based on chemical analysis of the liquid phase and measurement of the rate of heat evolution from freshly made pastes.

For the first two hours after adding water to cement, there is a quiescent period characterised by low heat production, apart from that due to heat of wetting and heat of hydration of free lime, and in this period the concentration of calcium hydroxide in the aqueous phase rises, eventually reaching supersaturation level. Calcium hydroxide is a product of the hydration of the tricalcium-silicate phase and also of the free lime present in Portland cement; it would be expected that a saturated solution would be formed very rapidly in systems having a water-cement ratio less than 10 : 1. In fact a supersaturated solution is obtained at water-cement ratios up to 50 : 1 but comparatively slowly and the degree of supersaturation appears to be independent of water-cement ratio. It was also found to be the same for all the Portland cements studied.

After the first two hours, further calcium hydroxide is formed by hydration of the alite phase and the total heat production in a paste made with a cement of high alite content was directly proportional to the total calcium hydroxide produced. If the calcium hydroxide is mainly produced at early stages by hydration of alite, the measurement of heat production affords an alternative and simple method of measuring the rate of hydration of alite.

During this period, hydration of tricalcium aluminate is heavily retarded as long as gypsum is available for reaction to form ettringite. When the retardation phase has ended there is an immediate rapid rise in heat production, the residual C_3A hydrates rapidly and there is a simultaneous release of alkali metal ions into the liquid phase. This release of sodium or potassium as the residual C_3A hydrates supports the concept that alkali metal ions are combined in the aluminate phase, especially when it is of the " split peak " variety (mentioned in a previous report). It seems likely that both sodium and potassium can be combined in C_3A and not exclusively one or the other, as has been suggested in some quarters.

Preliminary evidence from X-ray diffraction and electron microscope studies suggests that the late rapid hydration of C_3A may be associated with the formation of the " low " form of calcium sulpho-aluminate hydrate by reaction between C_3A and ettringite.

The kinetics of the reaction of C_3A with calcium hydroxide and calcium sulphate to form ettringite have been examined and the activation energy has been measured as about 9 Kcal. per mole. The most appropriate explanation of the evidence relating to this reaction is perhaps that it proceeds through a surface reaction mechanism.

Chemical Analysis.

Some of the problems concerning chemical analyses which have been dealt with are as follows.

Tests for selecting a method for the determination of aluminium in cements for a proposed British Standard for sulphate-resisting Portland cement have been completed, in collaboration with other laboratories. A modified procedure was developed whereby both iron and aluminium can be determined by an ethylene-diamine-tetra-acetic acid titration method.

In connection with another proposed British Standard, co-operative tests on the heat of hydration of low-heat slag cements have also been completed.

Attention has been given to the method of measuring the heat of hydration of cement and several improvements on the procedure specified as the British Standard method have been made. The wax lining of the dewar flask can be replaced by polythene applied by a hot dipping process giving a more durable protective layer. Immersion of the flask in a constant temperature water-bath and the use of a magnetic stirrer are two other modifications which show promise of improving the precision of the test.

New Cement Works in Sweden.

A new cement works, which cost about £4,000,000, was opened recently by Skånska Cement at Slite on the island of Gotland in the Baltic Sea. The annual productive capacity of works on this island is increased by 300,000 tons, that is about 60 per cent. The older plant, which had an annual capaciy of 550,000 tons, operates on the wet process, but the new works is a dry-process plant. The complete production from the limestone quarry to the despatching point in the harbour is said to be technically advanced and employs a minimum of labour. Ten years ago, most of the cement was loaded into ships in bags, and it then took twenty-two men two days to load one vessel. Today, 70 to 80 per cent. of the cement produced is poured directly into the ships' holds, and one man can load a ship in six hours or unload it in nine hours.

Skånksa Cement is planning further expansion, including a £8,300,000 addition to its works at Limhamn near Malmö. This works will include a comprehensive computer control and centralised monitoring and control system, the equipment for which will be supplied by International Control Systems Ltd., a subsidiary of G.E.C. Ltd., of England. The works is expected to produce over a million tons of cement annually.

Developments in the Polish Cement Industry.

TRIAL running of the new Rudniki cement works near Czestochowa, in the Katowice industrial district, has started. The first kiln and associated equipment has been completed and put into operation several months earlier than planned. The complete works is now about to go into operation. The annual production will be nearly 1,500,000 tons of cement which exceeds by up to 300,000 tons the production at the Dzialoszyn cement works which was previously the largest in Poland. The site of the works at Rudniki was selected because of local rich deposits of the principal raw material, Jurassic stone, and also because of the possibility of using slag from the nearby iron and steel works, and the proximity at the Upper Silesian coalfields. The new works operate on the dry process which has not previously been used in Poland.

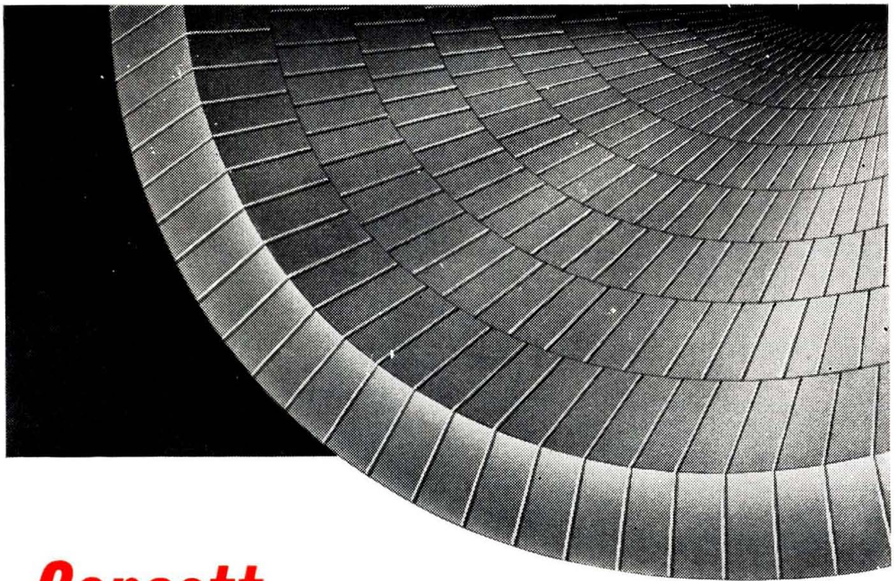
In 1938, the annual production of cement in Poland was 1,700,000 tons compared with an expected production of 8,800,000 tons in 1965. In 1964, 1,000,000 tons of cement were exported.

Polish cement is being improved in the quality. The maximum specified strength of the average grade of cement produced in Poland is at present 300 kg. per sq. cm., but is to be increased to 350 kg. per sq. cm. by the end of the next five-year plan. Some 54 per cent. of the cement produced in 1965 will be 250-grade but, in 1970, it is expected that this grade will amount to only 30 per cent. of the production. Production of the cement of 450-grade will be increased from about 1 per cent. this year to 19 per cent. in 1970.

DE-DUSTING PLANT.—What is claimed to be a new type of de-dusting equipment has been developed at the Szczakowa cement works in Poland. Known as the "water de-duster", the equipment consists of a fan with power transmission, the de-duster, and intake and outlet gas ducts and water pipes. Gases from the rotary kiln are passed through the de-duster, in which the dust is reduced to a sludge in which form it is carried back to the cement-producing plant. Tests conducted by the Institute of the Cement Buildings Material Industry have shown that the equipment removes 97 per cent. of the dust, a performance little inferior to that of electrostatic precipitators which are said to be more expensive to operate. The new water de-duster will be installed at the Szczakowa cement works, where it is expected to save some 10,000 tons of cement annually.

USE OF WASTE HEAT.—Research is being conducted at the Odra cement works in Opole, Poland, on new methods of manufacture. Instead of installing new kilns, waste heat from furnaces is being used for clinker production. This method is claimed to have resulted in a production index of 1,250 tons of cement per worker per year. Coal consumption for the production of clinker has been reduced from 330 k. to 250 k. and power consumption from 100 kWh. to 85 kWh.

AUTOMATION.—For the first time in Poland, a cement mill, at the Odra works, is being equipped with an electrical device and electronic scales to control the grinding process. Work has also started on the installation of a digital computer which will, at first, record technical parameters and will later control the entire production process.



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Mathematics for Engineers.

A BOOK entitled "Engineering Mathematics,"* which was published recently, contains much that is likely to be of interest and use to those in the cement industry who have to deal with complex calculations or with computers. It is stated in the foreword that the intention is to prepare the way for a proper understanding of the many authoritative books and articles on engineering mathematics and related subjects which have been published during the past decade. During that period, the advent of the high-speed computer has increasingly favoured a return to the simple and widely-applicable methods of classical mathematics, since the extensive computations which often result can now be dealt with quickly and reliably by the machine.

The arrangement of the book is based on a simple form of approach in which engineering mathematics is assumed to be concerned with numbers and their orderly combination into useful functions, and with the systematic manipulation of both numbers and functions in the solution of practical engineering problems. It is claimed that this treatment is implicitly in line with the latest approach in terms of sets and sub-sets, and of mapping one domain on to another.

The first five chapters deal in a genuinely elementary manner with numbers, with their combination into functions through the medium of various arithmetical and functional "operators," with the broad field of functions useful to engineers, with some structural and other "combined operations" or type solutions by which numbers and functions are focused on practical objectives, and with the main classes of engineering problems as expressed in the form of "mathematical models." Any attempt at overall balance or completeness is specifically disclaimed; instead, a limited number of subjects of a basic nature and of wide applicability is selected for examination and illustrated by suitable examples. The following extracts from the contents of the first five chapters indicate the scope of the treatment. Numbers: related classes of numbers, numerical aspects of geometry and space, and real and complex numbers. Numbers into functions: equalities and inequalities, algebraical operators and methods including matrix and determinant algebra, differential operators and equations, and finite-difference operators and approximations. Functions: simple algebraical expressions including functions of complex variables, basic power series and their relation to Taylor's theorem, and transforms and associated functions and their relation to the Fourier series. Functions into problems: algebraical methods including elementary plate and shell equations, transforming methods including dimensional analysis, and numerical methods including basic statistical concepts. Engineering problems: including plastic analysis, and initial-value or propagation problems including quality control. A recapitulation and bibliographical references are included at the end of each chapter.

*"Engineering Mathematics: An Introductory Survey of Modern Developments". By A. H. Douglas. (London: Concrete Publications Ltd. 1964. Price 63s. By post 65s 3d.; 15·75 dollars in Canada and U.S.A.)

In the next two chapters, the methods outlined in the preceding pages are applied in some detail to the analysis of frames and shells respectively. The following chapter includes short notes on the practical handling of matrices, on computers and Boolean algebra, and on spherical trigonometry. The book concludes with a twelve-page glossary of mathematical terms.

A feature of this treatise is that the subject matter is arranged so that the text can be read as a continuous narrative, if desired, without the immediate need to consult the detailed mathematics which are contained in the intervening pages. This facilitates a general review of the subject and also permits of more detailed study of selected parts.

Dissolution of the D.S.I.R.

AN Order in Council under the Science and Technology Act 1965 enacted that, from 1 April 1965, the Department of Scientific and Industrial Research was dissolved and its functions and those of the National Institute for Research in Nuclear Science were taken over by other bodies and Government departments, principally the Ministry of Technology, the Science Research Council, and the Department of Education and Science.

The Department of Scientific and Industrial Research was created in 1915 and placed under the control of a committee of the Privy Council for Industrial Research. A small Advisory Council, which included some eminent scientists, was created. In 1956 the Department was reconstituted and placed under an Executive Council appointed by the Lord President of the Council.

The Science Research Council, which formally came into being on 1 April 1965, has taken over the functions of the D.S.I.R. in respect of research grants to universities and postgraduate training awards not within the fields of the other councils. Under the new organisation for civil science, the Science Research Council is responsible to the Secretary of State for Education and Science.

As part of the Ministry of Technology's responsibility for guiding and stimulating a major national effort to bring advanced technology and new processes into British industry, those parts of the D.S.I.R. concerned with research and development in aid of industry are transferred to the Ministry of Technology. The Ministry takes over ten of the fifteen D.S.I.R. research stations, including the Building Research Station, Fire Research Station and the National Physical Laboratory, and the financial support of fifty industrial research associations. The Ministry of Technology will take over the functions of D.S.I.R. concerned with disseminating technical information in industry. The National Lending Library for Science and Technology, the more general scientific information work and the overseas liaison responsibilities of the D.S.I.R., together with control of work of the Scientific Attaches at British Embassies abroad, will come under the Department of Education and Science. The Road Research Laboratory will become the responsibility of the Minister of Transport.

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Safety in Cement Works.

The Report issued by the Accident Prevention Advisory Committee of The Cement Makers' Federation for the year 1964, copies of which are obtainable at the offices of the Federation, 52 Grosvenor Gardens, London, S.W.1, states that it was possible for some years to issue an encouraging report. The frequency-rate of lost-time accidents showed a steady reduction year by year, but in the Report for 1963 there was an increase over the previous year, and this was the first increase since 1956. The 1964 results show a further increase but there has been a similar rise throughout industry generally. The increase occurs in most of the cement companies. Of the 224 accidents, only sixty-one occurred in the twenty-eight works of the Blue Circle Group which had a frequency-rate of 0·35 compared with 0·33 for 1963. The remaining sixteen works contributed 163 accidents, with a frequency rate of 1·62 compared with 1·29 for 1963.

The Blue Circle group have also issued a report for 1964 entitled " Accident Prevention ", copies of which are obtainable from the Chief Welfare Officer of the Group, Portland House, Stag Place, London, S.W.1.

In both reports it is emphasised that the four main causes of accidents in 1964 were still as in previous years, namely, falls of persons, handling objects, objects falling, and stepping on, striking against or caught between objects. These were the causes of three out of four of all the accidents. In consequence, the safety campaign in 1965 is being directed towards reducing accidents in these categories in particular.

It has been announced recently by The Royal Society for the Prevention of Accidents (R.O.S.P.A.) that, for 1965, the Sir George Earle Trophy has been awarded to The Reed Paper Group Ltd. The Trophy was first awarded in 1956 when H.M. Factory Inspectorate of the Ministry of Labour were the winners. It has since been won successively by The Birmingham Industrial Safety Group, Imperial Chemical Industries Ltd., Vauxhall Motors Ltd., Associated Electrical Industries (Manchester) Ltd., John Laing Construction Ltd., The Blue Circle Group of Cement Companies, British Titan Products Co., Ltd., and the British Iron & Steel Federation.

Technical Publications.

The following books and papers have been received recently.

" Chemistry and Biology Laboratories: Design; Construction; Equipment." By W. Schramm. First English edition translated from the second revised German edition. (London: Pergamon Press Ltd. 1965. Price £5 5s.).

" The Microstructures of Cement Gel Phases." By Ake Grudems. Translations of the Royal Institute of Technology, Stockholm, No. 242: Civil Engineering No. 13. (Published 1965. Obtainable from the Institute. Price 45Kr.).

" Particle Size Measurement." Report of a meeting of the European Ceramic Association held at the British Ceramic Research Association, November 1963. (Stoke-on-Trent: The British Ceramic Association. 1965. Price 5s).

Lime Kilns of 100-tons Capacity.

WEST'S (MANCHESTER) LTD., a member of West's Group of Industries, report that they are supplying three large oil-fired lime kilns to the Beswicks Lime Works, near Buxton. The kilns will have a daily productive capacity of 100 to 120 tons. A battery of three 50-ton kilns has been operating at Beswicks' works since 1961, and this was the first commercial installation of the new type of kiln which is oil-fired by the Catagas system; this installation was described and illustrated in the number of this journal for November 1962.

The first 100-ton kiln of the new type is in production at the works of Messrs. S. Taylor Frith & Co., Ltd., Dove Holes, near Buxton. Other similar lime kilns are operating in Great Britain, two kilns have been installed in Australia, and others have been or are to be installed in Europe and elsewhere.

A Lime Company Take-over.

IT is announced that the Pointer Group has acquired the entire share capital of Messrs. F. J. Mount & Son Ltd., which firm have been lime and whiting manufacturers at Brandon, Suffolk, since 1868.

A New Cement Company.

IT was announced in June last, that a new firm of cement makers called Pozament Cement Ltd., has been formed by the Hargreaves Group and Stephenson Clark Ltd., a member of the Powell Duffryn Group, to manufacture a pozzolanic cement called " Pozament ", an ingredient being pulverised-fuel ash, which has properties akin to pozzolana. The cement will have a low heat of hydration and high sulphate resistance. The works of the Company are at Ferrybridge, Yorkshire, and the registered office is at Bowcliffe Hall, Bramham, Boston Spa, Yorkshire (Telephone: Boston Spa 2081; the telephone number of the works is Knottingley 2347.).

High-alumina Cement.

A REVISED data sheet dealing with the properties and use of high-alumina cement was issued recently and incorporates the recommendations made in the Report of the Institution of Structural Engineers, " The Use of High Alumina Cement in Structural Engineering."

If the technical advice given in the data sheet and the Report is properly observed, satisfactory structural concrete can be made with high-alumina cement, where high strength at an early age or chemical resistance is required. Variations in the conditions and situations where the use of high-alumina cement concrete is described in the data sheet are permissible, but such variations should only be made after consultation with the manufacturers.

Copies of the data sheet are obtainable from The Cement Marketing Company Ltd., Portland House, Stag Place, London, S.W.1., or from Messrs. G. & T. Earle Ltd., Wilmington, Hull.

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