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& LIME MANUFACTURE

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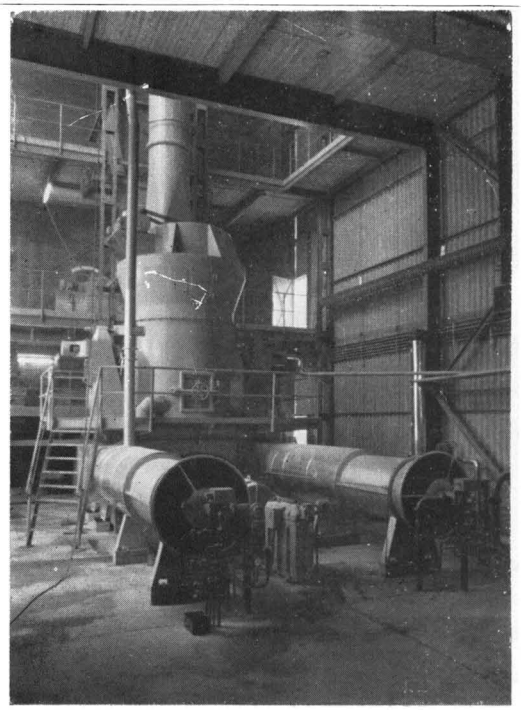

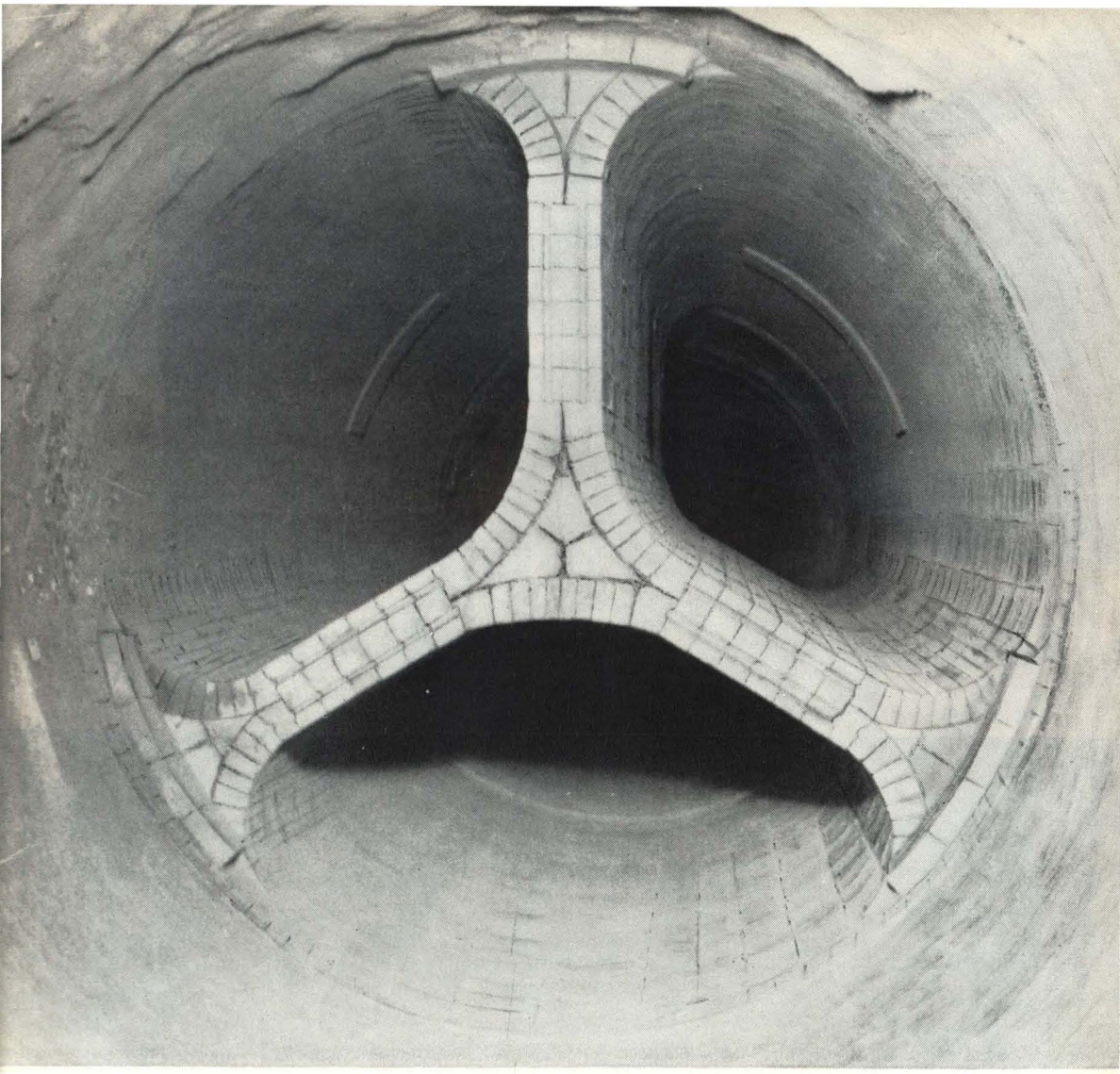

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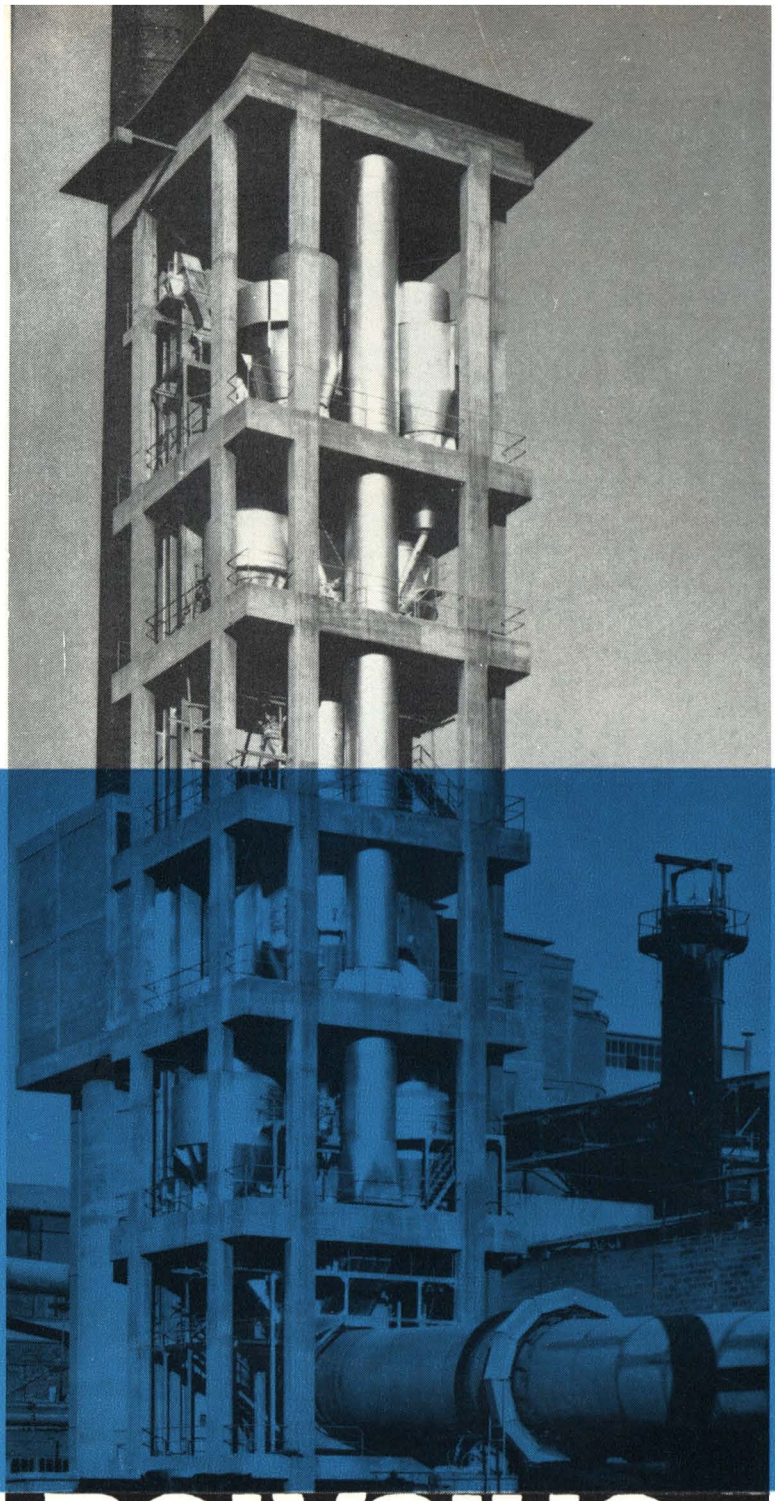

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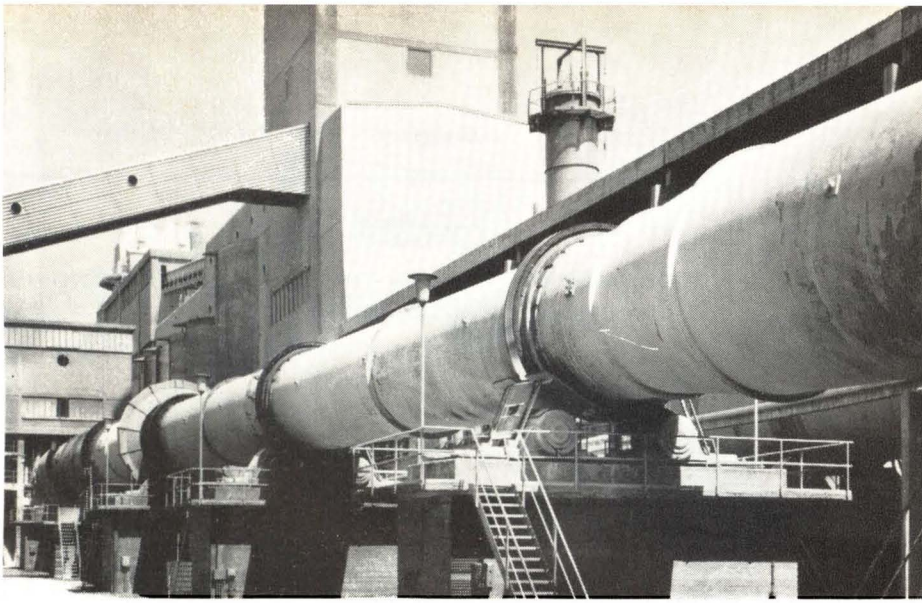

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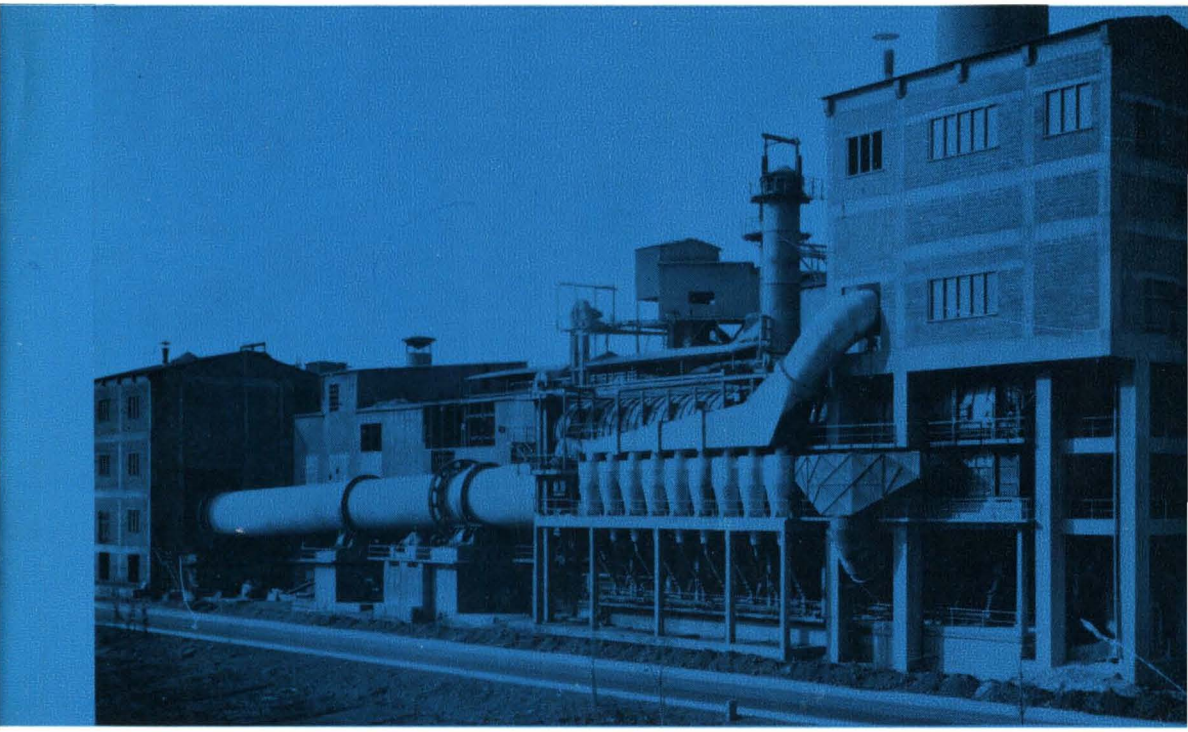

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The Manufacture of High-alumina Cement

THE method of making high-alumina cement at the works of the Lafarge Aluminous Cement Co., Ltd., on the Thames Estuary at West Thurrock, Essex, is described in the following, and a flow diagram of the manufacturing process is given in *Figs.* 1 and 2 on pages 2 and 3.

Raw Materials

The principal raw materials, bauxite and limestone, are delivered to this riverside works by boat. The limestone is obtained from this country, but the bauxite is imported mainly from France and Greece. The crude bauxite is delivered as a mixture of large pieces and fine material, and is crushed and screened to produce fines and lumps of the required size. The lumps, which range in size from 1 in. to 5 in., are suitable for the direct charging of the furnaces. The fines, $\frac{1}{4}$ in. to dust, are mixed with small quantities of high-alumina cement and water and formed into briquettes, and as such can be fed into the furnaces. The limestone is delivered in lumps ranging in size from 1 in. to 4 in., which is suitable for direct charging of the furnaces without further treatment

Coal for firing the furnaces is delivered, also by boat, in the form of dry clean " smalls " and is pulverised in a central grinding plant before being fed pneumatically to the furnaces.

The bauxite, limestone and coal are stored in a large storage building which is served by two high-speed 12-ton electric overhead travelling grab-cranes. Each crane is capable of handling material at a rate of over 200 tons per hour The store can contain about 12,000 tons of bauxite, 2,500 tons of limestone, and an equal amount of briquettes, together with about 8,000 tons of clinker.

Making the Clinker

By means of the cranes in the store, the limestone and the bauxite in lumps and briquettes are fed into the appropriate hoppers of an automatic weighing

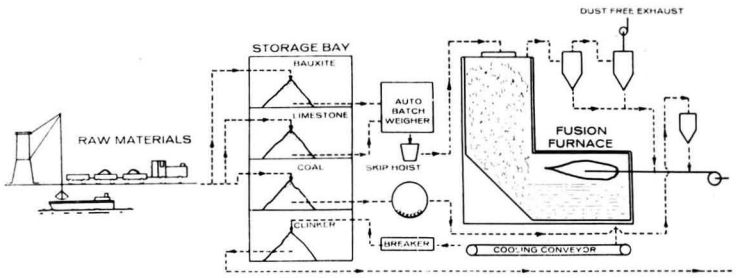

Fig. 1.—Manufacture up to Stage of Clinker Storage. (Continued on Fig. 2.)

plant. After screening and weighing each material accurately to the requirements of the furnace charge, the materials are discharged into the skip of an automatic telpher serving the furnaces. Each charge has a total weight of about 2 tons and each furnace is charged about fifty times in twenty-four hours; continuous working is carried on.

There are several furnaces. Each furnace is L-shaped and is a combination of cupola and open-hearth furnace. The cupola, or vertical part, is filled with the mixed raw materials which are calcined therein, and are then gradually melted by the hot gases from the open-earth, or reverberatory, horizontal part of the furnace. To assist the passage of the combustion gases through the vertical part, an exhaust fan is fitted to produce a continuous suction in the flue of each furnace. The exhaust gases are cleaned of fine dust by being passed through cyclones, the dust then reclaimed being fed back into the furnace via the burner pipe. Screenings from the furnace charges are conveyed by a pneumatic pipeline to the briquetting plant.

The molten cement pours out of the furnace through a spout (*Fig.* 3) and falls into a series of heavy steel pans fitted on a continuously-moving chain conveyor. The " melt " solidifies in the pans, and the resulting cake of hot clinker is carried along the conveyor and, near the end of the travel of the latter, it is broken into small pieces (about an inch or so in the size) by a clinker crusher. This device, the action of which is synchronised with the moving pans, allows a heavy roller with serrated edges to fall onto each cake of clinker. The resulting broken clinker is discharged into a bucket-conveyor, and commences a long and fairly slow journey, during the course of which it cools considerably before being discharged into a pit. The clinker is taken from the pit by the grab on one of the overhead travelling cranes in the storage building, and is deposited in the appropriate compartment of the store. Subsequently, clinkers are blended, according to their chemical and physical properties, to produce a uniform product ready for grinding.

Grinding

The two mills installed for grinding the high-alumina cement clinker are similar to those used for Portland cement clinker. Each is a large combination tube-mill,

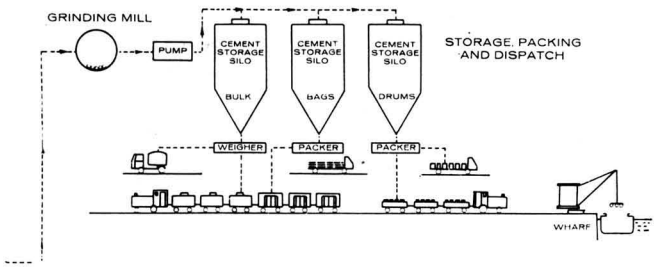

Fig. 2.—Stages subsequent to Preparation of Clinker. (Continued from Fig. 1.)

lined throughout with hard-wearing iron plates, and divided into four compartments by manganese-steel diaphragms. Each compartment is charged with steel balls which, by their tumbling action as the mill rotates, grinds the clinker to a fine powder. Owing to extreme hardness of high-alumina cement clinker, the wear and tear and consumption of grinding media are very much greater than with Portland cement.

Packing and Testing

From the cement mills, the cement is fed pneumatically to storage silos, immediately below which three automatic bagging machines are installed. Each machine is a four-spout machine, and requires only one operator. The filled paper bags are stacked or are passed automatically along belt-conveyors (*Fig.* 4) to the

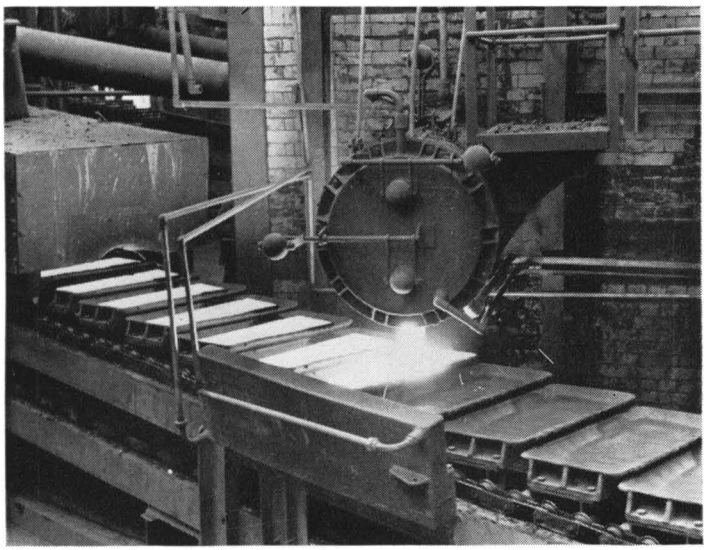

Fig. 3.—Molten Cement discharging from Furnace.

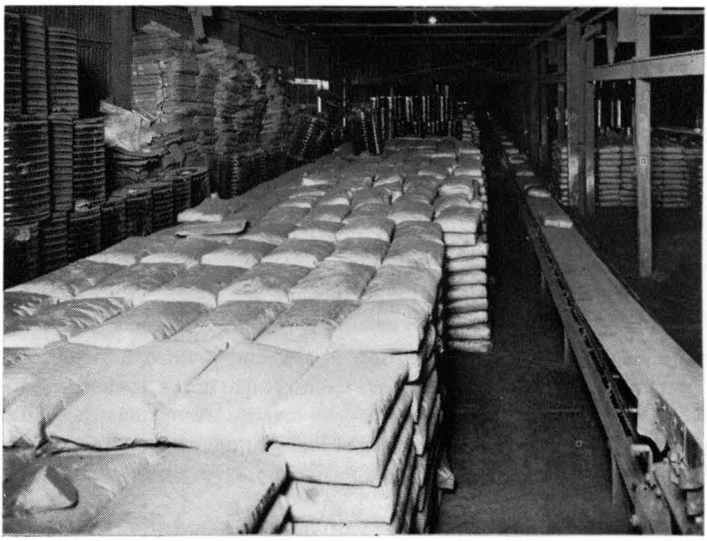

Fig. 4.

vehicles waiting to be loaded. Facilities are also installed for packing the cement in air-tight metal drums (*Fig.* 5) for export, or the cement can be despatched in bulk. Despatch of cement from this works can be effected by road, rail or sea.

Rigorous laboratory control, both chemical and physical, is exercised at all stages of manufacture to ensure that the finished product complies with the

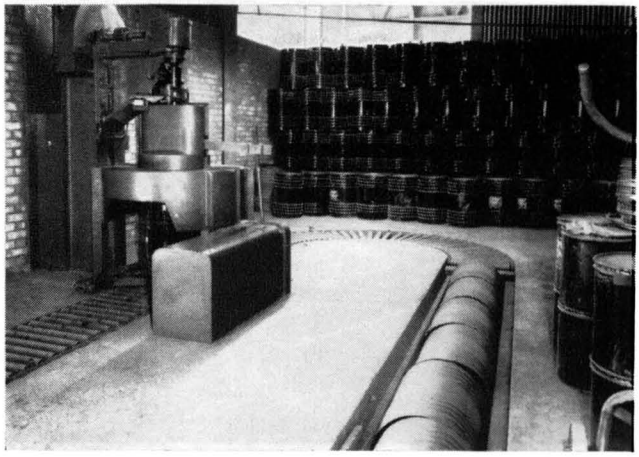

Fig. 5.

Fig. 6.

requirements of the standard specification, that is, B.S. No. 915. The illustration in *Fig.* 6 shows the section of a laboratory where the raw materials are tested. A technical service is provided and research is also carried out in the laboratories established at the West Thurrock works.

Properties of High-alumina Cement

The primary characteristic of high-alumina cement, namely, ultra-rapid hardening and consequently very high early strength, is exemplified by the following.

The roadway at the West Thurrock works illustrated in *Fig.* 7 is of high-alumina cement concrete and the concrete had been laid only eight hours before the 13-ton lorry shown in the illustration travelled over the road. An hour previously, a lorry weighing 21 tons had passed over the road. It is reported that neither of these heavy loads injured the new concrete.

Ultra-rapid hardening is only one of the qualities which make British-made high-alumina cement a versatile product. Others include the ability to harden satisfactorily at low atmospheric temperatures, resistance to an attack by a wide range of materials which attack ordinary cements and, in combination with suitable refractory aggregates, the ability to withstand temperatures up to 1,350 deg. C.

Fig. 7.

The principal brand of high-alumina cement produced by the Lafarge Aluminous Cement Co., Ltd., at the works at West Thurrock, is "Ciment Fondu," the trade name of which signifies the process of complete fusion of the raw materials. The illustration above is of a large sign constructed of high-alumina cement which is erected at the entrance to the works. This sign, which weighs 25 tons, was designed by Messrs. L. G. Mouchel & Partners, and is 30 ft. long and 20 ft. high.

Building Materials Conference

AN INTERNATIONAL Conference on Building Materials is being organised by the Polish Government to be held in Warsaw from June 6 to 8, 1967. All enquiries concerning the Conference should be addressed to the Organisational Committee, International Conference on Building Materials, Warsaw 63, Zurawia 3/5.

The proceedings, which will be conducted in Polish, English, French, German and Russian, will deal with most types of building materials. One session will be concerned entirely with binding materials, and will be under the chairmanship of the Director of either the Institute of the Building Materials Industry, the United Cement Factories, the United Lime & Gypsum Industry, or the Design Office of the Cement and Lime Industry (of Poland). The subjects dealt with will include processes of comminution and homogenisation, firing processes, automation and use of computers, new products and their hydration, and economic problems associated with the production and use of binding materials.

Some Reactions of Tricalcium-aluminate-hexahydrate at Medium Temperatures

By J. H. P. VAN AARDT and S. VISSER*

IT IS known that expansion of a Portland cement in sulphate media is dependent, among other things, on its tricalcium-aluminate content, but the expansion is usually not directly proportional to the C_3A† content and, furthermore, if Portland cement containing C_3A is heated in saturated steam under pressure, the material becomes practically immune to attack by sulphate. The reason for this is not entirely clear although it has been said that C_3A, when autoclaved, is hydrated to 'stable' C_3AH_6 which, with the reaction in the autoclave of free $Ca(OH)_2$ with silica, if present in the aggregate for example, renders a vulnerable Portland cement product stable to attack by sulphate. It has been shown[1] that, even if no free silica is present, for example when a calcareous aggregate is used, autoclaving still renders the Portland cement product resistant to attack by sulphate. This appears to indicate that the reaction between free $Ca(OH)_2$ and silica is not essential for rendering a Portland cement product resistant to attack by sulphate. Therefore it appears that either the conversion of C_3A to C_3AH_6 or some other reaction, or reactions, is responsible for the better sulphate resistance of autoclaved products. In an attempt to investigate the significance of C_3AH_6 as regards sulphate expansion this compound was prepared and it was examined at 5 deg. C. and at 25 deg. C. in the presence of a suspension of $Ca(OH)_2$ in water.

Experiments

C_3A was prepared by repeated burning and crushing of a mixture of pure $CaCO_3$ and Al_2O_3 and at 1370 deg. C. C_3AH_6 was prepared by autoclaving C_3A at 150 lb. per sq. in. for two hours.

Precautions were taken to exclude CO_2. After seven days, some solid was filtered off and X-ray diagrams (*Figs.* 1 and 2) were prepared while the reaction mixture was kept at the required temperature and in a humid nitrogen atmosphere. All X-ray diffraction work was carried out with copper-Kα radiation.

Reaction Mixtures

The reaction mixtures described on page 10 were prepared.

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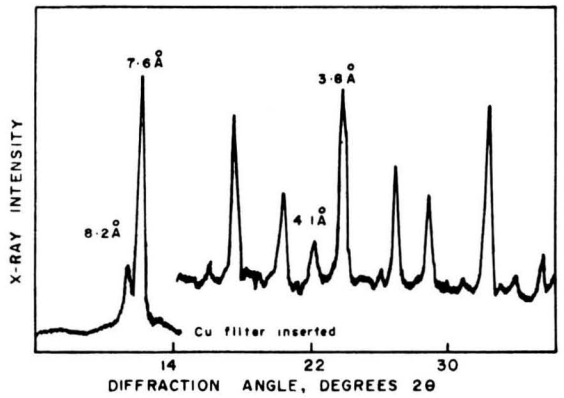
*The authors are associated with the National Building Research Institute, South African Council for Scientific and Industrial Research, Pretoria.

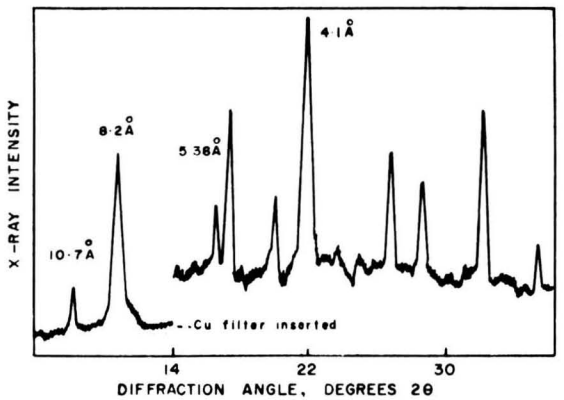
†The symbols used are: C = CaO, A = Al_2O_3, H = H_2O.

1.—VAN AARDT, J. H. P. "Deterioration of cement products in aggressive media." *Chemistry of Cement* (Proceedings of the Fourth International Symposium, Vol. II), National Bureau of Standards, Monograph 43. Washington 25, D.C., U.S. Government Printing Office, 1962, pp. 835-53.

(a)
C_3AH_6(1·89g)+H_2O(50g)
at 25°C



(b)
C_3AH_6(1·89g)+H_2O(50g)
at 5°C.



(c)
C_3A(1·35g)+H_2O(50g)
at 5°C.

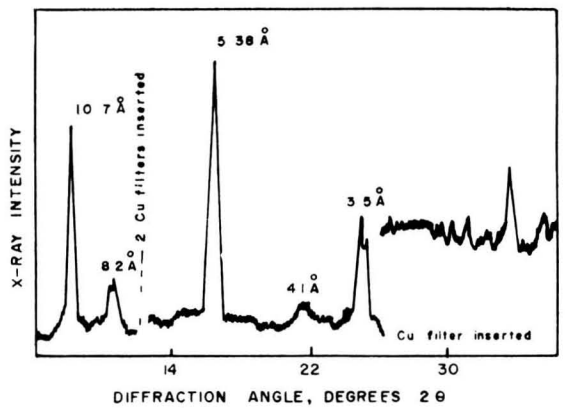
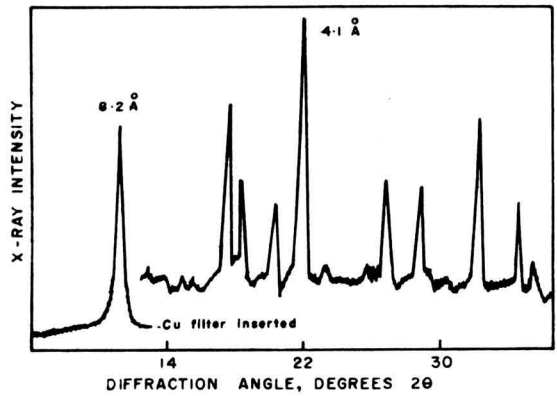
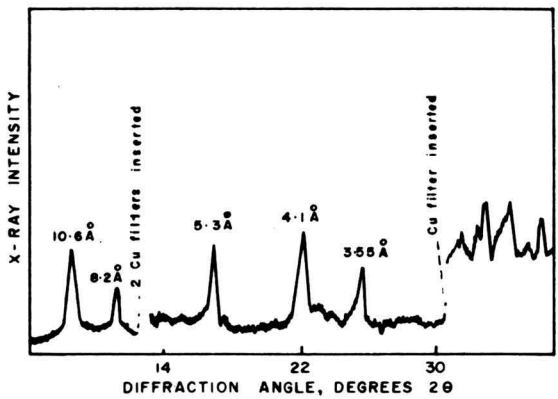


Fig. 1.—X-ray Diffraction Patterns of Calcium-aluminate Hydrates.

(a)
C_3AH_6(1·89g)+H_2O(50g) to which was added $Ca(OH)_2$(0·37g) at 25°C.



(b)
C_3AH_6(1·89g)+$Ca(OH_2)$(0·37g) +H_2O(50g) at 5°C.



(c)
C_3A(1·35g)+$Ca(OH_2)$(0·37g) +H_2O(50g) at 25°C.

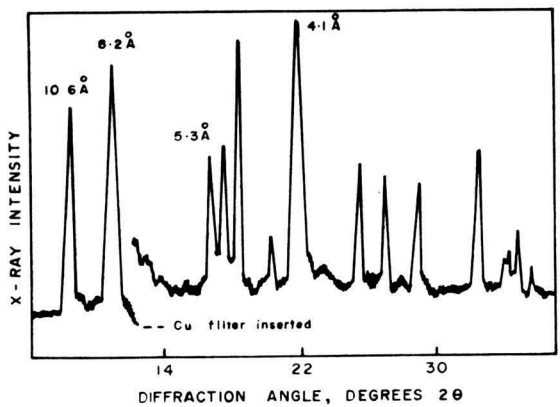


Fig. 2.—X-ray Diffraction Patterns of Calcium-aluminate Hydrates.

1.—C_3AH_6 in water.

i. C_3AH_6 (1·89g.) plus water (50g.) at 5 deg. C. and 25 deg. C.

ii. $Ca(OH)_2$ (0·37g.) was added to (i) at 25 deg. C. after 7 days.

iii. C_3AH_6 (1·89g.) plus water (0·37g.) paste at 5 deg. C. and 25 deg. C.

2.—C_3AH_6+$Ca(OH)_2$ in water.

i. C_3AH_6 (1·89g.) plus $Ca(OH)_2$ (0·37g.) plus water (50g.) at 5 deg. C. and 25 deg. C.

ii. C_3AH_6 (1·89g.) plus $Ca(OH)_2$ (0·37g.) plus water (1·3g.) paste at 5 deg. C. and 25 deg. C.

3.—C_3A in water.

C_3A (1·35g.) plus water (50g.) at 5 deg. C.

4.—C_3A plus $Ca(OH)_2$ in water.

C_3A (1·35g.) plus $Ca(OH)_2$ (0·37g.) plus water (50g.) at 5 deg. C. and 25 deg. C.

Discussion

This work seems to verify the fact that C_3AH_6 is incongruently soluble in water. When the hydrate is added to water at 25 deg. C., additional X-ray lines at *d*-spacings other than those for C_3AH_6 occur; see (*a*) in *Fig.* 1. However, when $Ca(OH)_2$ is added to the suspension of C_3AH_6 in water, the *d*-spacings at 7·6Å 3·8Å disappear and an X-ray pattern similar to (*a*) in *Fig.* 2 obtained. The indications are that the *d*-spacings at 7·6Å and 3·8Å are not due to a carbonate compound. Furthermore, as special precautions were taken to exclude CO_2, it is unlikely that the lines at d= 8·2Å and 4·1Å are for a carbonate compound. As seen from *Fig.* 2*a*, the reaction between C_3AH_6 and $Ca(OH)_2$ at 25 deg. C. is incomplete, as strong lines for C_3AH_6 and $Ca(OH)_2$ are still present; however, at 5 deg. C. the reaction seems to be complete for C_3A plus $Ca(OH)_2$ also, as for both these reactions a pattern as in *Fig.* 2*b* was obtained. The 10·6Å compound obtained with C_3AH_6 + $Ca(OH)_2$ at 5 deg. C. *Fig.* 2*b* and with C_3A + $Ca(OH)_2$ at 5 deg. C. (*Fig.* 2*b*) and at 25 deg. C. (*Fig.* 2*c*) has *d*-spacings similar to C_4AH_{19} described by Jones and Roberts[2].

The 10·6Å compound is unstable above 30 deg. C. At this temperature, the suspension showed *d*-spacings for C_3AH_6, $Ca(OH)_2$ and the 8·2Å compound. The 8·2Å compound is unstable at higher temperatures, for example at 140 deg. C., the X-ray diagram showing only *d*-spacings for C_3AH_6 and $Ca(OH)_2$. Cooling and standing the suspension at room temperature (25 deg. C.) causes the 8·2Å, 4·1Å lines to reappear. Furthermore if the material is again cooled to 5 deg. C., an X-ray pattern similar to (*b*) in *Fig.* 2 is obtained.

For pastes of C_3AH_6 in water, no lines at d = 7·6Å, 3·8Å were observed; only the lines for C_3AH_6 and extra *d*-spacings at d = 8·2Å, 4·1Å are present at 5 deg. C. and 25 deg. C. It is noteworthy that when C_3AH_6 or C_3A was added to

2.—JONES, F. E. and ROBERTS, M. H. " The system CaO-Al_2O_3-H_2O at 25 deg. C. Research Series 1, Building Research Station, Garston, 1962.

Concluded on page 11.

water at 5 deg. C., there were *d*-spacings at 10·7Å (see (*b*) and (*c*) in *Fig.* 1. It is not unlikely that this is a hydrous calcium aluminate with a lower $Ca(OH)_2$ content, that is C_2AH_8.

Conclusion

C_3AH_6 is unstable at low temperatures and, in the presence of $Ca(OH)_2$ at 5 deg. C, a metastable compound, presumably C_4AH_{19}, is formed.

Effect of Carbon Dioxide on Portland Cement Paste

A PAPER entitled " Effect of carbon dioxide on silicate structures in Portland cement paste " was presented by C. W. Lentz at the thirty-sixth International Congress on Industrial Chemistry which was held in Brussels in September 1966. The following is a summary of the paper.

A novel method of silicate analysis, which was developed only three years ago, was recently used to explain certain changes of chemical structure that occur when Portland cement is mixed with water. This method of analysis has now been applied to a study of the changes of chemical structure which are induced by exposure of a cement-water mixture to the atmosphere. Normal atmosphere contains small amounts of carbon dioxide. It was learned that atmospheric carbon dioxide hastens certain changes of chemical structure and promotes a greater change than the action of water only. This effect of carbon dioxide is described as a CO_2-induced polymerisation.

Aluminium in Cement.

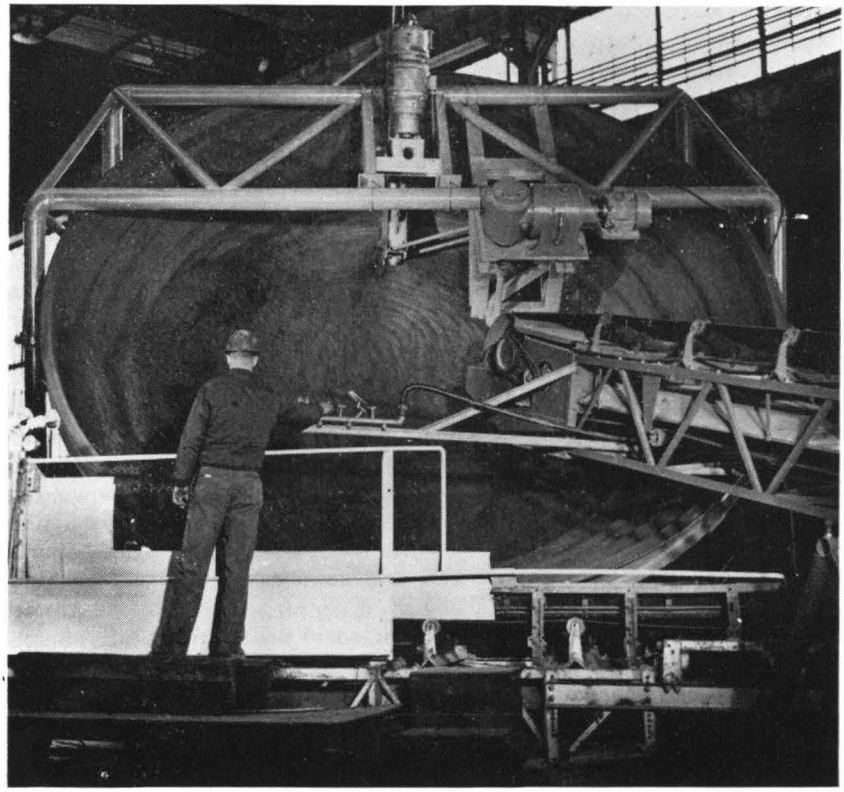
A PAPER recently issued is entitled " Estimation of Aluminium in Cements: Edta Method ". (By S. R. Nowden. Building Research Miscellaneous Papers No. 7; issued by Building Research Station, Ministry of Technology. No charge for single copies.) The summary of the paper is as follows.

A preferred method for the accurate determination of aluminium in calcareous cements is described. Silica (plus insoluble residue) is removed by the ammonium chloride method, and aliquots of the filtrate are taken. Ammonia (but not bromine) is added and the resulting precipitate centrifuged out; the liquid, containing nearly all the calcium and manganese, is poured away. The residue is re-dissolved and transferred to a separating funnel, where treatment with cupferron and chloroform removes iron, titanium, etc. To the aqueous layer a known volume of standard EDTA solution is added, and the excess is titrated back in 50 per cent. alcoholic solution with standard zinc solution, using dithizone as indicator.

An American Pelletiser

THE equipment shown in the accompanying illustration comprises a rotating cylindrical pan mounted on an inclined axis. The pan, which has a patented multi-stepped wall can be used not only to pelletise material, but to ball or mix various fine raw materials. The slope of the pan and rotational speed are controlled for any specific application and to suit the agglomeration characteristics of the material. Balling is performed by feeding moistened fines into the rotating pan and allowing the material to tumble and cascade, which action causes the particles to adhere to each other and grow much like a snowball. At times, admixtures, such as bentonite, clay, lime or comparable materials are blended with the fines to aid balling and to increase the strength of the wet or dry pellets so formed. Other admixtures may be added to strengthen sintered pellets. The process of mixing is similar to balling, except that certain conditions are controlled to form nodules of various sizes rather than pellets of uniform size. In either case, all tumbling action takes place on a surface lined with the material being processed rather than on the bare metal, thus minimising wear.

The pelletiser is obtainable with pans ranging from 3 ft. 3 in. to 18 ft. in



diameter. The pan is mounted directly on the output shaft of the reduction gear and is equipped with heavy-duty bearings to resist the effects of the overhang and thrust loads. The totally-enclosed driving unit is fixed under and to the rear of the pan where it is substantially free from wear caused by dust and, since it is well above the level of the floor, it is likewise protected from spillage and sprays. A variable-speed motor is provided as standard, but a constant-speed motor can be fitted, since the latter type is preferred for mixing, the rotational speeds being altered as necessary by changes of belt and sheaves.

The multi-stepped wall of the pan is claimed to play an essential part in the formation of basic pellets, in the separation of basic pellets from larger pellets, and in pellet growth, and to produce stronger and more uniform green pellets. In addition, the stepped wall increases the effective balling surface of the pan.

Rotating side and bottom scrapers loosen and scrape excess material from the balling surface. The scraping action keeps the material on the balling surface at a uniform thickness and roughness for better pelletising, and the rotating scrapers reduce substantially the vibration inherent in stationary scrapers and minimises the build-up of unagglomerated material which tends to form on the blades of stationary scrapers. The patented rotating side scraper, which is driven by a constant-speed gear motor, has blades spaced symmetrically and these scrape the steps in the wall of the pan. These blades are provided with tungsten-carbide cutting edges, and are clamped to the support in such a manner that the clearance between the cutting edge and the pan can be varied thus allowing worn blades to be reset easily to obtain the proper thickness of lining. The cutting edges of the rotating bottom scraper are also equipped with wear-resistant material, normally tungsten carbide, and in this case also, there are provisions for varying the clearance between the cutting edge and the pan.

The pelletiser is used not only in the production of Portland cement, but also in the production of other building materials such as lime and lightweight aggregate. Specifically, it also can be used in other branches of the ferrous and non-ferrous metallurgical, mineral and chemical industries, since it is suitable for balling and blending raw materials prior to drying, calcining, indurating or sintering. The physical characteristics of the materials to be balled may range from dry powdery substances to moist pasty sludges, and particle sizes may vary from fines of about $\frac{1}{4}$ in. down to ultra-fine materials all predominantly of 1 micron in size. The bulk density may vary from 50 lb. per cu. ft. to about 200 lb. per cu. ft. The physical characteristics of the raw material that should be considered when pelletising include fineness, wetability, particle shape and particle-size distribution. Since all materials possess unique balling characteristics, those for which reliable data are not available should be studied first in a laboratory before proceeding with a commercial installation. The most favourable conditions of operation should also be considered, for example, the location of the feed may be critical for some materials.

The manufacturer of this equipment is McDowell Wellman Engineering of Cleveland, Ohio, U.S.A.

Research on Cement in Britain

THE report entitled " Building Research 1965*," which was issued recently by the Building Research Station of the Ministry of Technology, contains the following regarding research on cement. Much of the work is in continuation of investigations reported in previous years, as recorded in past numbers of this journal.

High-temperature Studies

A reinvestigation of the system $CaO–Al_2O_3$, one of the earliest to be studied, has been completed and several puzzling features have now been resolved. It has shown that the compound $12CaO.7Al_2O_3$ contains a small amount of water in its crystal lattice at high temperatures and probably at its melting point. Infra-red spectroscopic examination proved that this water is present as ionic OH^- groups. Phase relations and melting behaviour of the compounds $3CaO.Al_2O_3$ and $CaO.Al_2O_3$ within this system have been elucidated. The former compound is a major factor in the setting of Portland cement and the latter is the principal compound in high-alumina cement.

With the financial support of Uganda Cement Industries Ltd., further studies have been made on the influence of minor constituents on the reactivity of tricalcium silicate with water. Preparations of individual polymorphic forms of $3CaO.SiO_2$ stabilized with Mg-ions, or Mg-ions and fluorine, and carefully scrutinized for structural purity were tested for compressive strength. The results showed that structural changes do not have a strong influence on the strength of $3CaO.SiO_2$, although the retention of the high-temperature trigonal form might lead to low strength and be an exception in this respect. Further evidence was obtained that fluorine has a specific effect on the strength of $3CaO.SiO_2$.

In the studies of phase equilibria relevant to the chemistry of blastfurnace slag, a new compound of molar composition $(2CaO.SiO_2)_{5·6}$ $(3CaO.MgO.2SiO_2)_{4·4}$ or $(CaO1·7)$ $(MgO)_{3·3}$ SiO_2 had been reported earlier. The phase diagram of the system $2CaO.SiO_2–3CaO.MgO.2SiO_2$ in which this compound occurs has now been established by means of high-temperature microscopy and X-ray analysis. Dicalcium silicate is the primary phase throughout the system.

The new calcium magnesiosilicate decomposes into α-$2CaO.SiO_2$ and merwinite, $3CaO.Mg.2SiO_2$, at 1460°C. Magnesium ions enter into solid solution in the structures of the γ and α polymorphs of $2CaO.SiO_2$ and alter polymorphic inversion temperatures. Conditions of formation of the compounds in this system and their phase relations affect the stability of slag aggregates and the soundness of slag cements.

Studies of Portland Cement

The Warren Spring Laboratory has developed a process for the production of potassium nitrate from adularia shale deposits in Scotland. Profitable exploitation is dependent on the production of Portland cement as a by-product, from the residue left after potassium is removed from the shale. The Station was asked

*Published in London by Her Majesty's Stationery Office, 1966. Price 14s. 6d.

to investigate this aspect of the process, and cements passing B.S. No. 12 (1958) were made on a small scale from this residue, with added limestone. The mineralogy of these clinkers and their elemental composition was examined.

A new electron-probe X-ray micro-analyser, with which it is possible to detect quantitatively elements present in a volume of material about 1 micron cube, has been used on Portland cement clinker. Attention has been given particularly to the tri- and di-calcium silicate phases, the cementing properties of which are considerably modified by minor components. Magnesium, potassium, manganese, sodium, iron, aluminium and titanium occur in both materials, with aluminium, titanium, manganese and sodium in greater amount in dicalcium silicate. Sodium, titanium, manganese and magnesium are more abundant in the interstitial aluminate phase.

The probe has also been used in an investigation of tricalcium aluminate, an important phase in Portland cement.

In 1963 a new compound, very similar to tricalcium aluminate, was detected at the Cement & Concrete Association's laboratory and has subsequently been investigated co-operatively by that laboratory and the Station. X-ray diffractometry has been used to investigate the binary system of tricalcium aluminate and a phase containing sodium calcium aluminate ($Na_2O.8CaO.3Al_2O_3$). Two separate compounds with very similar unit cells have been found. The microprobe has shown that the new compound has very nearly the composition $Na_2O.8CaO.3Al_2O_3$ and is formed by the replacement in the lattice of tricalcium aluminate of one calcium by two sodium atoms.

Hydration of Portland Cement

In a study of the system $CaO\text{-}Al_2O_3\text{-}CaSO_4\text{-}H_2O$, concerned in the setting reactions of Portland cement and in the action of sulphate solution on concrete, examination of the calcium monosulphoaluminate hydrate equilibria has shown that three different forms of this hydrate exist within the aqueous system. One form is indicated to be a $15H_2O$ hydrate which is more stable in contact with solution at temperatures below 25°C. The second form is obtained alone in saturated lime solution at 25°C, but the third form is precipitated to an increasing extent as the lime concentration decreases. These two latter forms may also occur together in solids dried at room temperature at relative humidities in the range 81 to 83 per cent. They appear to be polymorphs of a $12H_2O$ hydrate. All three modifications transform into a lower hydrate, possibly 10 H_2O when dried over anhydrous calcium chloride.

A co-operative investigation with laboratories in the U.S.A., U.S.S.R., Japan and the U.K., organised by Task Group B6a of the U.S. Highways Research Board, has involved a study of the mineralogy of set cements and cement minerals by X-ray diffraction, differential thermal analysis and electron microscopy. For identifying minerals, a photographic method of X-ray diffraction using a high-resolution camera was superior to counter diffractometry with existing equipment.

Slag Cements.

New British Standards for supersulphated and low-heat blastfurnace Portland cements are in preparation. The Station has supplied data to the B.S.I. which have assisted in the selection of magnesia and sulphide limits. The data on magnesia originated from observations by high-temperature microscopy on periclase (MgO) formation in slags. The proposed sulphide limit is based on results of an investigation of the dimensional stability of Portland blastfurnace cement concretes made with granulated slag containing 2·6 per cent. sulphide. The dimensional stability of these concretes remained satisfactory for two years, while already after one year the sulphide level of 1 : 2 : 4 concrete had fallen from 0·23 per cent. to only 0·08 per cent. so that further instability from sulphide oxidation need not be expected.

The method developed for the determination of the heat of hydration of slag cement has been investigated on behalf of B.S.I. by several co-operating laboratories. Following this it has been proposed for inclusion in the British Standard for low-heat blastfurnace cement.

A bibliography is given in the Report.

The Cement Industry Abroad

Rumania.—The following information regarding cement works in Rumania is abstracted from a booklet entitled "Rumanian Industry: Part 8—Building Materials," issued recently by Messrs. Joseph Crosfield & Sons, Ltd., of Warrington.

The cement works, and the district (in brackets) in which each works is situated, are as follows:

Albesti and Malureni (Pitesti); Turda and Sandulesti (Cluj); Brasov (Brasov); Bicaz and Cheile Bicazului (Bacau); Fieni and Comarnic (Ploiesti); Cura Vaii and Virciorova (Craiova); Cernavoda and Medgidia (Constantsa); Braila (Galatsi); Medgidia (Dobrogea); Dej; and Bucharest.

The works at Brasov, Cernavoda, Medgidia (Constantsa) and Bucharest were established before World War II but have since been extended. The works at Bicaz and Medgidia (Dobrogea) are entirely new works, the former having been designed by Rumanian engineers as have also the extensions to the works at Medgidia (Constantsa). The works at Turda and Fieni were designed and equipped by Rumanian engineers. The works at Cura Vaii is only a small concern.

The production of cement per head of population was 32·7 kg. in 1938 and 142·4 kg. in 1958.

Poland.—It is expected that in 1966 the production of cement from works operated by the Ministry of Building will amount to 11,000,000 tons, an increase of 10 per cent. on 1965. The increase is made possible by the establishment of the new works at Nowiny, and to the better use of the productive capacity of other works. The proportion of high-grade cement will also be increased.

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