CEMENT & LIME MANUFACTURE

VOL. XXXVII. No. 6 — NOVEMBER, 1964

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60 BUCKINGHAM GATE, LONDON, S.W.1
TELEPHONE: VICTORIA 0705/6
TELEGRAPHIC ADDRESS: CONCRETIUS, PARL, LONDON

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VOLUME XXXVII. NUMBER 6. NOVEMBER, 1964

Gas-turbine Power Plant at an Austrian Cement Works.

The Portland Cement Works Hofnjann & Co., Kirchdorf a.d. Krems, in Lower Austria, which is one of the largest cement works in Austria, has ordered a second gas-turbine power plant to supplement a similar unit supplied in 1961 by Simmering-Graz-Pauker A.G. of Vienna in conjunction with Demag A.G. of Duisburg. For the first stage of a modernisation scheme, four free-piston gas generators made by Demag were installed. Three generators supply the gas-turbine with gas for its operation, the fourth serving as a reserve. In the second stage a similar arrangement is to be installed with a few improvements resulting from operational experience. The gas-turbine power house is illustrated in *Fig.* 1.

Increase in demand for cement and increasing use of electrical power induced an investigation of the possibilities of installing a new power plant. Up to 1961, the generation of electrical power was by means of diesel-operated plant. The use of steam turbines was excluded due to the fact that no process steam was required. The use of a gas-turbine was decided upon, in preference to a new diesel plant,

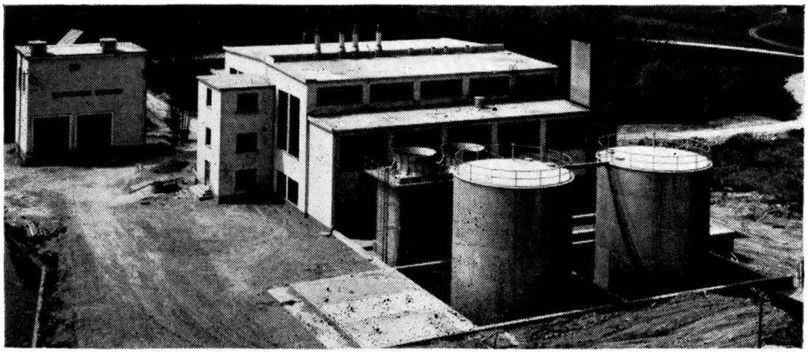


Fig. 1.

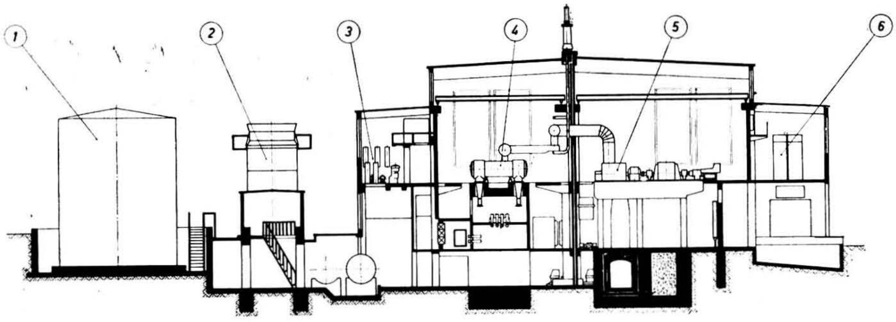


Fig. 2.—Arrangement of Gas-turbine Power Plant.

because calculations based on operational data, from similar plants working under similar conditions in other countries, showed that a combination of Sigma gas generators and a S.G.P. gas-turbine indicated that running costs would be lower than with diesel plant. The slightly lower efficiency of power generation was off-set by more favourable fuel consumption, and by savings in the cost of lubrication and maintenance. A relevant point is that at the end of the second stage, the power required will be generated in only seven reciprocating units, instead of fifty if diesel plants had been installed. Another consideration was that, with a diesel plant, any disturbance of the prime mover or generator eliminates both, making it necessary to install a complete reserve plant, whereas only one gas generator is required as a stand-by unit.

Due to the availability of water power from the hydraulic power plants at the works during the summer months, the thermal plant was only required in winter.

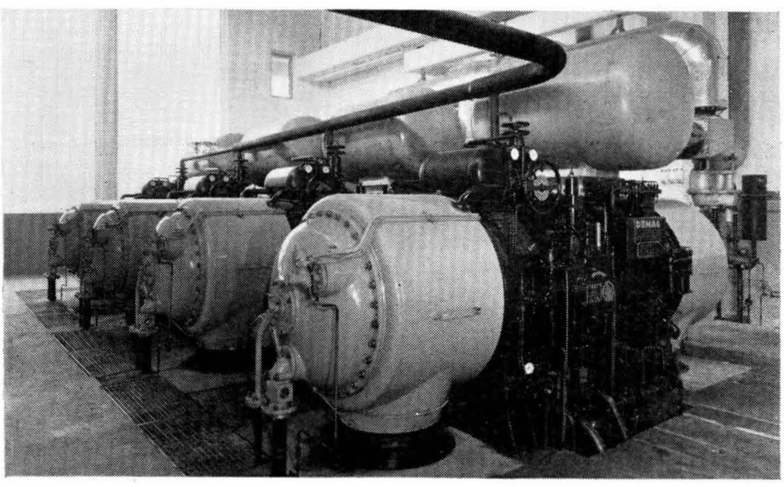


Fig. 3.

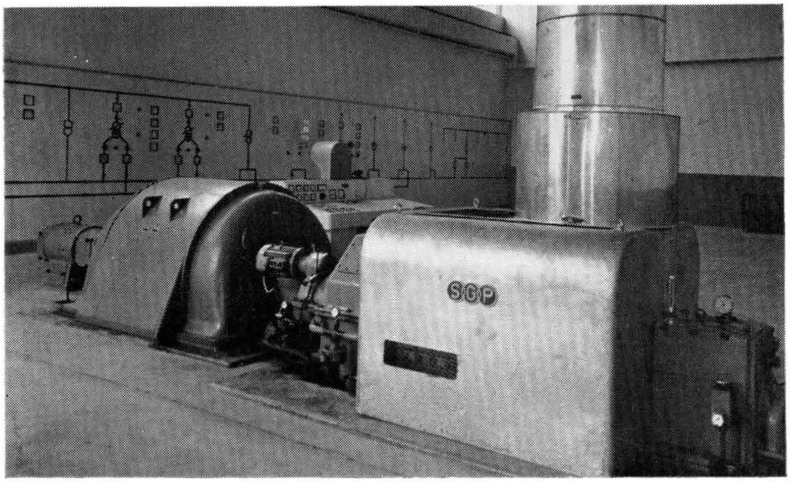


Fig. 4.

Up to March 1963, the gas-turbine plant had run about 5,000 hours and produced over 9,000,000 kW.-hours using heavy fuel oil from Austrian oilfields.

Fig. 2 is a diagrammatic section of the first stage installation which is in operation at present. With three free-piston gas generators feeding the gas-turbine unit, about 2,200 kW. are produced. The second unit will produce about 3,000 kW. with four gas generators in operation. The diagram in *Fig.* 2 shows the gas generators at (4) and the gas turbine and electricity generator at (5), both being on the same floor. The air required is filtered. The fuel oil is stored in tanks at (1) and flows through a steam-heated preheater, filters and separator to the fuel tank, whence the oil is pumped to the nozzles through an oil heater. The viscosity of the oil is kept constant in order to ensure efficient atomisation. The cooling

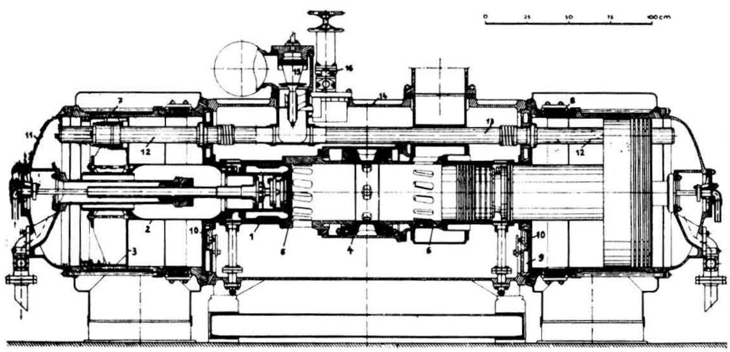


Fig. 5.—Free-piston Gas Generator.

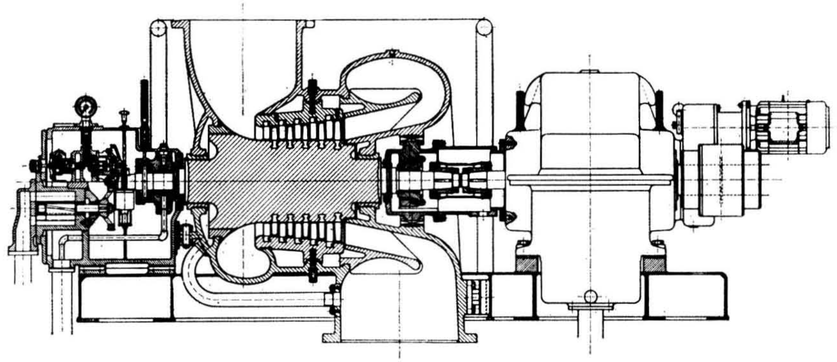


Fig. 6.—2,000 kW. Gas Turbine.

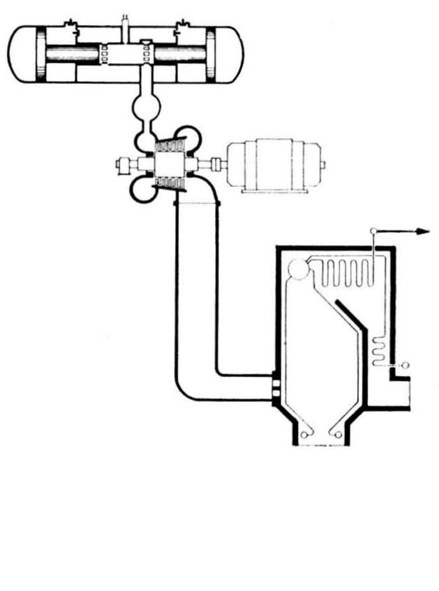
water is circulated and passes to the cooling tower at (2) where cooling is effected by means of two blowers.

The gas-turbine and alternator are shown in *Fig.* 4 and a sectional view of the free-piston gas generator is illustrated in *Fig.* 5. The diameter of the fuel cylinder is 340 mm. and of the compressor cylinder 900 mm. The number of strokes per minute at full load is 560. The temperature of the gas is about 340 deg. C. and the pressure of the gas at the accumulator is 3 atm.

The gas generated in the units is fed into the gas-turbine a sectional view of which is shown in *Fig.* 6. The principal data for this unit are as follows: Speed 8,000 r.p.m; output 2,000 kW.; gas pressure at entry 2·9 atm.; gas temperature at entry about 435 deg. C.; temperature of exhaust gas about 250 deg. C.

The exhaust from the gas-turbine passes through a waste-heat boiler wherein is generated steam for various uses, such as preheating and space heating. The

Fig. 7.—Gas generator with Power-turbine-alternator Unit and Waste-heat Boiler.



waste-heat boiler is of the smoke-tube type and has a capacity of 320 kg. of steam per hour. The operating pressure is 4 atm.

The layout of a complete plant, with waste-heat boiler is shown diagrammatically in *Fig. 7*. The two pistons of the free-piston gas generator operate in opposite directions. The compressed gases flow through an equalising vessel to the power-gas-turbine, the exhaust gases from which proceed as shown to the waste-heat boiler. The advantage of this combination of gas-turbine with steam generation is that the thermal efficiency is nearly the same as with an ordinary steam plant, but the amount of electrical energy produced is much higher.

Gas-turbine power plants are in successful operation in cement works in many parts of the world. The availability of cheap residual fuel oil in this country and recent advances in the use of gas-turbines in other branches of industry might make this form of power plant attractive to the cement industry.

Acknowledgement for the data and illustrations is due to Messrs. Simmering-Graz-Pauker A.G., of Vienna, Austria.

A New Research Association.

A NEW co-operative industrial research organisation called the Welwyn Hall Research Association was established in October last, when two associations, the Whiting & Industrial Powders and the Chalk Lime & Allied Industries were merged. Mr. D. B. Jones, Managing Director of Sevenoaks Brickworks Ltd., is the Chairman of the new Association. Mr. D. C. Soul, who previously was Director of the Whiting & Industrial Powders Research Council, is the Director of Research, Mr. G. E. Bessey, who was the Director of Research of the Chalk Lime & Allied Industries Research Association, is retained as a consultant to the new Association, which occupies the previous joint premises at Church St., Welwyn, Hertfordshire.

It is expected that, during the next five years, over £400,000 will be spent in serving member firms. To assist it in its work, the Association will be grant-aided by the Department of Scientific & Industrial Research to the extent of 70 per cent. of the industrial income up to a maximum of £35,000 per year for the first three years, and 65 per cent. and £40,000 respectively for the remaining two years of the grant period of five years.

The interests of the various groups of members are initially to be covered by five divisions, two of which serve industries producing the basic mineral products, that is whiting and lime. Two other divisions will be concerned with industries which use lime as a primary raw material, for example, calcium-silicate bricks and ready-mixed mortars. The remaining division, will deal with a branch of technology, industrial powders, rather than a particular industry.

Research on Cement in Britain.

THE Reports for 1963 of the Building Research Board and the Cement and Concrete Association contain much of interest to the cement industry and relevant extracts are given in the following. Some of this research work is a continuation of the work carried out in 1962 and previous years; the reports for 1962 were reviewed in this journal for March last.

BUILDING RESEARCH STATION.

The Report for 1963 of the Building Research Board of the Department of Scientific and Industrial Research was published in June last.

Investigation of the quaternary system $CaO-SiO_2-Al_2O_3-MgO$ in relation to the utilisation of blastfurnace slag as aggregate for concrete has continued. The phase diagrams of the join merwinite-gehlenite, and of the partial system dicalcium silicate-forsterite-corundum have been established. Delineation of phase boundaries in the partial system merwinite-spinel-gehlenite is now complete. The results of current studies together with information from earlier work should permit the construction of the primary crystallisation volume of dicalcium silicate in the quaternary system and thus help to define the extent of the formation of this compound.

Studies of the effect of phosphate and other minor components on the manufacture and quality of Portland cement continue. Current work is directed towards understanding the action of fluorspar, which is often used as a flux in the cement industry but may also be of benefit when phosphate is present in the raw materials.

In some high-alumina cements, a fibrous mineral is present, and in an earlier study it was established that this is a complex aluminosilicate. Very similar synthetic preparations are slow-setting but possess some hydraulic properties. Recently two new ternary compounds were discovered in the $CaO-Al_2O_3-MgO$ system which showed marked similarities to the fibrous mineral, but detailed X-ray work now reveals that the crystal structures of all three compounds are slightly different. The fibrous phase cannot be produced by simple ionic substitution in the crystal lattices of either of the ternary compounds. The exact composition of the pleochroic mineral in high-alumina cement therefore remains unknown.

A comparison has been made between the errors involved in X-ray and microscopic methods of determining the quantities of the two calcium silicates in Portland cement. The standard deviation in microscopic point-counting is about one-third of that for X-ray diffractometry.

As part of a study of the hydration products formed during the setting and hardening of Portland cement, investigation is being made of the equilibria in the system $CaO-Al_2O_3-CaSO_4-H_2O$ at 25 deg. C. It has been found that calcium monosulphoaluminate hydrate and tetracalcium aluminate hydrate form a limited series of solid solutions of $CaSO_4-Al_2O_3$ molar ratio from 1·0 to 0·50,

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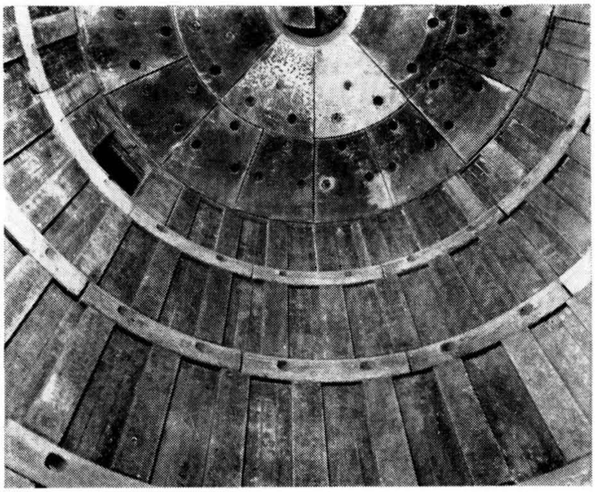

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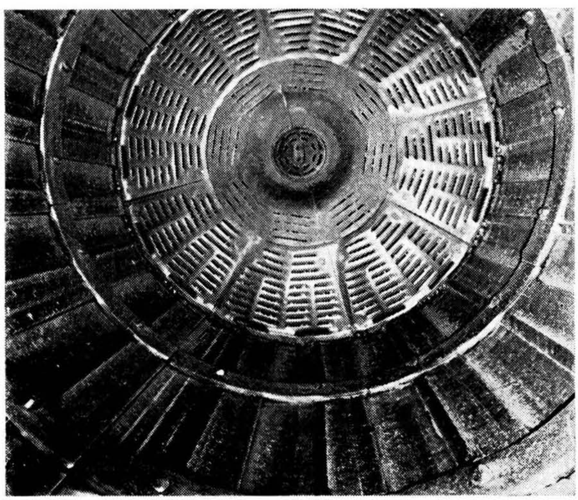

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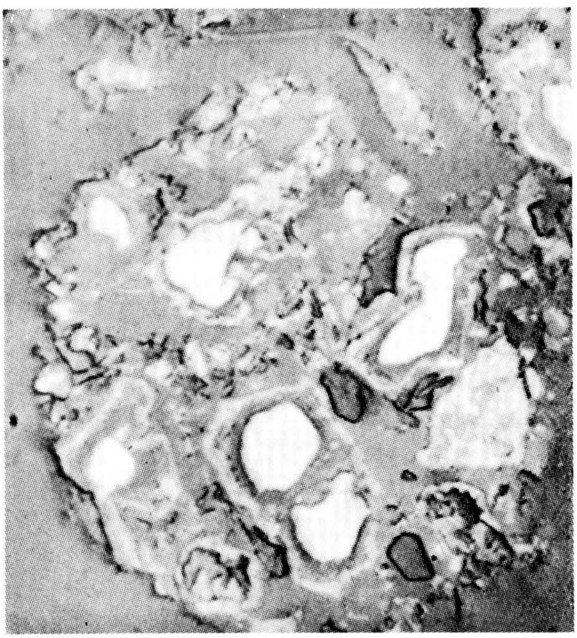
the longest basal spacing in the X-ray pattern changing from 8·96 to 8·77Å. The *a* dimension of the unit cell remains constant at 5·75Å.

SULPHATE ATTACK.—With increasing use of polluted sites for building and the spread of the chemical industry, with consequent effluent problems, the question of sulphate attacks on concrete is of continued interest. Recently there has been some discussion of the usual explanation that the sulphate expansion in concrete is caused by the volume change that occurs when calcium sulphoaluminate is formed from the constituents of set cements. A new theory is that the compounds formed when cement is hydrated as a paste are less hydrated than those formed in a water suspension. Direct X-ray examinations were carried out on thin specimens of cement paste kept in a humid atmosphere, and it was shown that the hydrates were present in their fully hydrated condition.

In the same experiments, results were obtained indicating that small traces of carbon dioxide, such as could be present in the cement as received, can affect the hydration reactions markedly.

The constituent of Portland cement most concerned in sulphate attack is tricalcium aluminate. Recent work at the Cement & Concrete Association



Photomicrograph of polished surface of hydrating $4CaO.Al_2O_3.Fe_2O_3$ showing central core of unhydrated mineral (white), an intermediate rim of $3CaO.Al_2O_3.6H_2O$ (grey) and an outer rim of a hydrated calcium ferrite (white).

Fig. 1.

showed that, in some cements, the normal X-ray pattern of tricalcium aluminate appeared with some of the characteristic lines doubled. It has now been shown, at the B.R.S., that when this occurs a sodium calcium aluminate is present.

There is uncertainty as to whether the compounds formed by hydration of the iron compound in cement are liable to sulphate interaction. X-ray and d.t.a. examination of set pastes of the calcium alumino-ferrite show that a mixture of $3CaO.Al_2O_3.6H_2O$ and a hydrated calcium ferrite are formed (*Fig.* 1). It appears likely therefore that the paste would be slowly attacked by sulphate solutions.

CEMENT TESTING.—The B.R.S. has participated in co-operative investigations to assist in framing a British Standard for low-heat Portland blastfurnace slag cements. The results indicate that the vibrated mortar-cube test and the concrete test are suitable for assessing the strength of such cements.

The B.R.S. is taking part in the activities of the Working Group on Methods of Strength Testing of the International Standardisation Organisation Technical Committee T.C.74 on Hydraulic Binders. A programme of co-operative research has been initiated to examine the suitability of the British Standard concrete test for use as an international test method, in addition to the mortar prism test which has already been adopted as an international test method and which was developed jointly by R.I.L.E.M. and Cembureau. Twenty-two laboratories in eighteen countries are participating.

CEMENT AND CONCRETE ASSOCIATION.

In the following, some of the research work undertaken by the Cement & Concrete Association in 1963 is described. This information is abstracted from the Association's " Report for the Year 1963."*

Constitution of Anhydrous Cements and Cement Minerals.

Work on the constitution of cement has been continued by X-ray diffractometry and powder photography, supplemented by simple chemical separations.

For some time, routine quantitative analyses of cements have been made by X-ray diffractometry and the aim has been to adapt this technique so that analyses could be made automatically. The diffractometer and counting apparatus have been modified to enable the data they provide to be recorded on punched tape in a form suitable for feeding directly to a digital computer. It has been revealed that, through the increased refinement of analysis which this method permits the compounds are even more complex than had been supposed and that modifications of the cement compound phases will need to be considered in the computer programming. This has necessitated further experimental work on these phases. Separation of the phases by selective hydrolysis has been particularly successful; it is now possible to separate the ferrite or (ferrite + C_3A) from the silicates. Results suggest that, by refining the method a separation of the silicate phases

(*Continued on page* 109.)

* Copies of the Report are obtainable free of charge from the Cement & Concrete Association, 52 Grosvenor Gardens, London, S.W.1.

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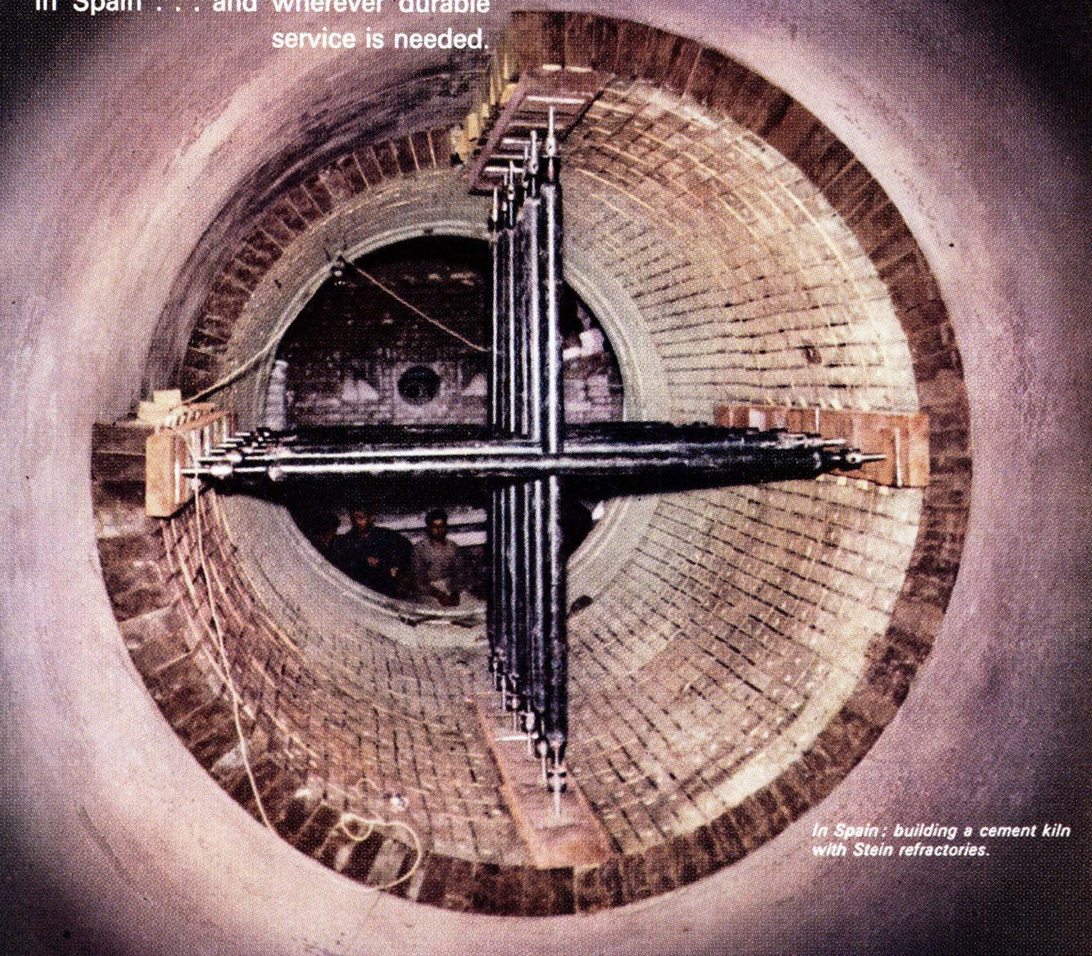

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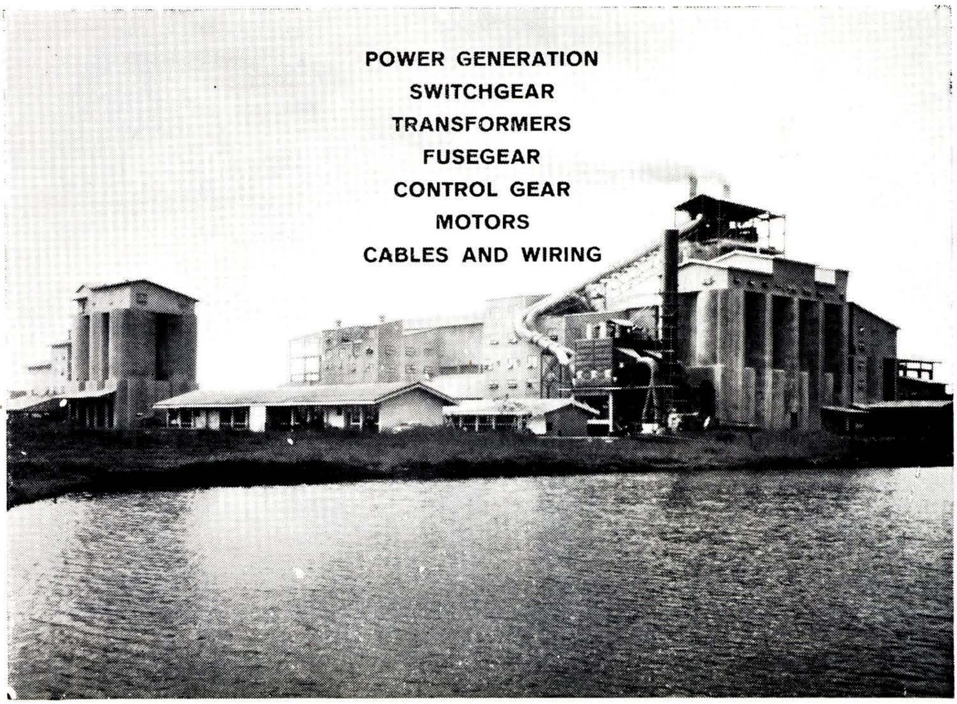
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may be practicable. The use of this method of separation has led to the identification of a new alumina-rich phase in commercial cements, this compound being essentially a modified tricalcium aluminate. The ' alite ' modification of tricalcium silicate is well known and a study of the CaO-SiO_2-Al_2O_3-Fe_2O_3 system in the region of composition close to C_2S is being made to discover whether ' belite ' has a variable constitution in commercial cements.

Some work has also been done on the system CaO-Al_2O_3-SO_3 with a view to increasing the present scanty knowledge of this system.

Reactions in the System CaO-SiO_2-H_2O.

Investigations are continuing into the nature of the calcium-silicate hydrate formed during the hydration of cement. This hydrate is less well crystallized than that formed by reaction of lime solution with colloidal silica at room temperature and, in particular, the lattice spacing of about 12·5Å, normally characteristic of products of the lime water-silica reaction, is absent in the cement hydrates even when these are prepared at very high water-cement ratios, for example 500 : 1, when the solution phase is not saturated with lime. By reacting super-saturated lime solution with colloidal silica at room temperature, a calcium silicate hydrate having an X-ray pattern apparently identical with that given by the product of cement hydration has been synthesised. This suggests that the poor crystallinity of the calcium silicate hydrate formed by cement hydration may be associated with the presence of an environment of highly super-saturated lime solution. If this is true, the fact that the same cement hydrate forms in systems of very high water-cement ratios when the average composition of the liquid phase is equivalent to something more dilute than a saturated lime solution, suggests that the hydrate is being formed near the surface of cement grains where local high lime concentrations are likely to occur.

Cement Hydration.

The processes which take place in the early stages of the hydration of cements give indications that they may have a marked influence on the long-term properties of cement products, and an investigation of the early reactions in the hydration process is being made in two ways. In one, the changing composition of the liquid phase in the cement paste is being studied; in the other, the reactions taking place are being followed by microcalorimetry. To a certain extent the results obtained have been complementary but the correlation between them is not particularly close.

In order to gain a clearer understanding of the crystallisation processes occurring in the hydration of cement, the composition of the liquid phase in contact with hydrating cement is being examined. The liquid is extracted by means of a pressure filter but it is impracticable to do this at water-cement ratios below 0·5 : 1. Initially, extracts were made at water-cement ratios in the range of 50 : 1 to 0·5 : 1 in the hope that extrapolation to lower ratios might be justifiable. Results so far obtained with pastes held at 15, 25 and 35 deg. C., show clearly that the Na^+ and K^+ concentration increases directly with the proportion of

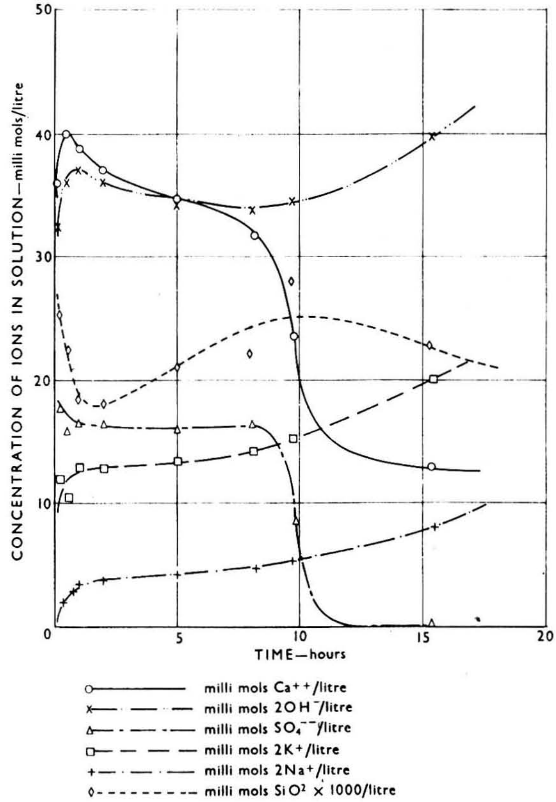


Fig. 2.

cement in the cement-water mixture and indicate that a nearly constant proportion of the alkali in the cements is quickly dissolved irrespective of water-cement ratio (*Fig.* 1). After about ten hours hydration, the Na^+ and K^+ concentration start to rise quickly. This is thought to be due to a retardation of the hydration

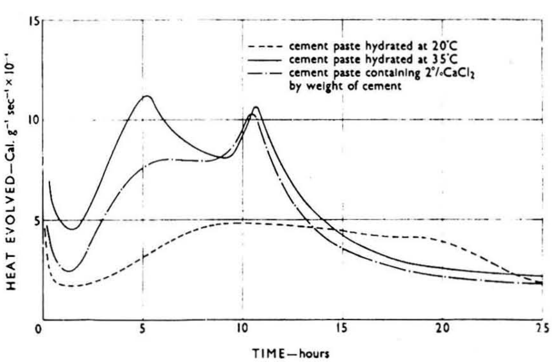


Fig. 3.

of K or Na-containing C_3A by sulphate ions until the sulphate is exhausted, whereafter the C_3A hydrates more rapidly.

In pastes of moderate water-cement ratios, the silica concentration in the liquid phase changes very little although a slight fall is detectable in the first few hours. In pastes of high water-cement ratios or suspensions, the silica concentration in the liquid phase in the first minutes of hydration is more than ten times that to which it later declines, showing that silica is readily available for solution reactions but that other factors, probably the high calcium hydroxide concentration, keep the silica concentration very low in pastes of low water-cement ratios. On a much smaller scale it is noticeable that the relatively stable silica concentration in the liquid phase in pastes of low water-cement ratios increases as the water-cement ratio decreases, presumably because the rising alkali concentration causes a fall in the lime concentration. A curious observation is that the liquid phase in pastes of low water-cement ratio contains significant amounts of chromate ions.

Studies of the rate of heat evolution during the reaction of cement and water have continued with the aid of a sensitive isothermal calorimeter. The versatility of this apparatus has permitted the effect of temperature changes and addition of accelerators and retarders on the rate of the reaction of cement and water pastes to be examined in detail. The addition of calcium chloride to a cement paste accelerates the hydration reactions and also increases the rate of gain of strength. Similar effects are observed when the hydration reactions take place at a higher temperature than normal. In *Fig. 2*, the heat-evolution curves for both heat and chemically accelerated cement-water reactions are shown and it is interesting to see that they follow a closely similar pattern. The appearance of a sharpened third peak in the heat evolution rate seems to coincide with a drop in the sulphate ion concentration in the liquid phase. This peak is thought to be due to rapid hydration of C_3A in excess of that required for reaction with sulphate ions and may indicate that this hydration reaction contributes to the early strength of accelerated cement paste or concrete.

Other Problems in Chemical Analysis

An assessment of the precision of the Bogue calculation for cement compound composition, taking into account typical analytical errors, has been made. The principal errors in the calculations have been found to arise from uncertainties in the determination of the alumina in cements.

Development work has been carried out on the determination of calcium and magnesium and co-operative tests are in progress with other laboratories to produce an agreed method of determination of alumina for sulphate-resisting Portland cement. Work is also in progress on the determination of the heat of hydration of low-heat cement for the purpose of specification.

The Chemistry of Cements.

IN this journal for September last, a descriptive review of the contents of Volume I of "The Chemistry of Cements"* was given. Volume II, which deals with non-Portland cements and experimental methods, has now been published. The principal contents of the part dealing with non-Portland cements includes chapters on high alumina cement and refractory castables (by T. D. Robson of Lafarge Aluminous Cement Co., Ltd.), slag cements (by R. W. Nurse of the Building Research Station), the chemistry of pozzolanas (by R. Turriziani of Cagliate University, Italy), expanding and stressing cements (by P. E. Halstead of the Cement & Concrete Association), and hydrated-calcium-silicate products other than hydraulic cements (by G. E. Bessey of the CLAIRA Research Laboratories).

The subjects dealt with in the part concerned with experimental methods include the high-temperature phase equilibria (by F. P. Glasser), the chemical analysis of silicates (by R. A. Chambers), X-ray diffraction (by L. S. Dent Glasser), optical microscopy (by H. G. Midgley of the Building Research Station, and H. F. W. Taylor), electron microscopy and diffraction (by J. A. Gard), differential thermal analysis (by V. C. Farmer of the Macaulay Institute for Soil Research), infra-red spectroscopy of silicates and related compounds (by R. C. Mackenzie of the Macaulay Institute for Soil Research), the determination of surface area and particle size distribution (by D. L. Kantro and S. Brunauer, both of the Portland Cement Association), and aqueous and hydrothermal chemistry, weight-change curves and density determinations (by F. P. Glasser and H. F. W. Taylor). Unless stated otherwise, all the authors of these chapters are of Aberdeen University.

Tabulated crystallographic and other useful data are given in Appendices occupying some sixty pages out of a total of upwards of four hundred.

*Edited by H. F. W. Taylor of the Department of Chemistry, University of Aberdeen. Published by Academic Press Inc. (London) Ltd. 1964. (Price 95s. each of two volumes.)

The Cement Industry in North America.

Mexico.—The Export-Import Bank of Washington announced recently the authorisation of a credit amounting to about £500,000 to Cementos Hidalgo, S.C.L., of Hidalgo, Mexico, which is to be used to expand and modernise the Company's cement plant. Cementos Hidalgo is one of the oldest cement producers in Mexico, having been established in 1905. In 1930, competition forced the works to close but since the cement industry was the principal means of livelihood for the people of Hidalgo, a co-operative society was formed which re-opened the plant and still owns and operates it. New equipment is to be purchased in the U.S.A. and this should enable production to increase by about 115,000 tons per annum and, at the same time, reduce production costs. Current production is about 137,000 tons a year. The supplier of the equipment is Messrs. F. L. Smidth & Co., of New York City, and the plant to be purchased includes a large kiln with auxiliary equipment, a cement mill, cement storage silos and packing plant, a limestone feeder, and clinker transport and storage facilities.

Pioneer Cement Manufacturers.

MESSRS. PARKER & WYATT.

CONTRIBUTED BY MAJOR A. J. FRANCIS

NEARLY 120 years have elapsed since the business founded by James Parker & Samuel Wyatt came to an end. It occupies a key position in the history of the cement industry and yet historians have recorded almost nothing of its activities. The interest and importance of business history and "industrial archaeology" are today becoming increasingly recognised. It is surely long overdue that an industry, which is not only one of this country's greatest undertakings but is also the world's pioneer in this particular field, should take steps to ascertain and place on record the full facts about those who brought it into existence. The writer hopes that the following notes together with his article published in the March number[1] of this journal may provide some encouragement in this respect.

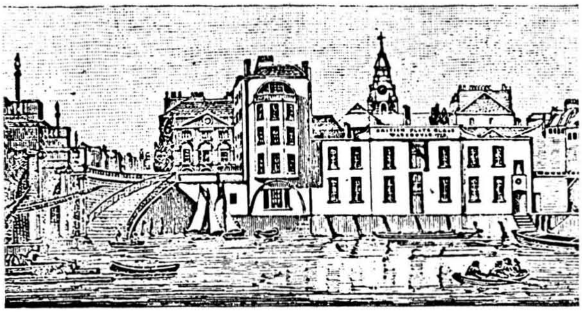
THE cement industry virtually originated with the firm of Parker & Wyatt. The material which they produced was used for most of the major engineering and architectural works constructed in this country during the first fifty years of the last century. Details of the two patents of James Parker of Northfleet are already well known. The first, dated May 17, 1791, is 'for burning bricks and tiles and calcining chalk and limestone with a material not previously used for the purpose.' By this date Parker had no doubt set up in business as a "stone-lime burner." By 1794, trade directories were announcing the existence of Parker & Co., at Kings Arms Stairs, Lambeth. The second patent is dated June 28th, 1796, and introduced Parker's cement to the world; as is well known, he named the material "Roman" cement.

Writing about 1840, Thomas Leverton Donaldson, Professor of Architecture at University College, London, and later President of the Institute of British Architects, gives the following description of Parker's discovery:

> 'The Rev. Dr. Parker was on a visit in the Isle of Sheppey and strolling under its high cliffs on the northern side, he was struck with the singular uniformity of character of the stones upon the beach and which are also observable sticking in the cliffs here and there. On the beach however, the accumulation of ages, they lay very thick. He took home with him two or three in his pocket, and, without any precise object in view he threw one onto the parlour fire from which in the course of the day it rolled out thoroughly calcined. In the evening he was pleased to recognise his old friend with a new face upon the hearth, and the result of some unpremeditated experiments with it has been the introduction into England of a strong durable and valuable cement.'

Donaldson's description of Parker himself is interesting, but the writer has been unable to confirm it from any other source. It was not unusual at this period to find professional men with commercial interests.

In late 1795 or early 1796, Parker approached the Directors of the "British Society for Extending the Fisheries and Improving the Sea Coasts of this Kingdom" with details of his cement, and on March 17, 1796, they instructed their engineer, Thomas Telford, to investigate the material and make a report. Telford complied promptly and within four weeks he had twice visited Parker's house at



BRITISH PLATE GLASS WAREHOUSE, 1773, AT BLACKFRIARS.

(a)

ROMAN CEMENT, ARTIFICIAL TERRAS, AND STUCCO.

Meſſrs. PARKER and CO. Bankſide, Southwark, London, (removed from Pedlars Acre, Lambeth,) beg leave to lay before the publick the copy of an official letter from an eminent Engineer, containing an account of the properties of the Compoſition which they manufacture, and of its uſes in building.

They publiſh this letter, on the preſumption that an impartial and diſintereſted report, on a ſeries of experiments, expreſsly undertaken by the direction of a public body of Gentlemen, to aſcertain the merits of their manufacture, will be conſidered as a ſafe and competent guide for the judgement of the publick.

Independent of the facts contained in this report, many other proofs, from works of conſequence, may now be brought to ſhew the excellence of theſe materials for their reſpective purpoſes. The Cement is uſed in the conſtruction of Locks, Aqueducts, Bridges, Arches, Pavements, Reſervoirs, Floors, Wells, and other works, intended to contain or reſiſt water, and the Stucco for the uſual purpoſe of ſtuccoing buildings. The Dutch Terras which they prepare has all the properties of the natural terras, but with the advantage of requiring not half the labour in beating-up.

Meſſrs. PARKER and CO. alſo manufacture Coping-Stones, Window-Sills, Blocking and String Courſes, Baluſtres, Gothick Ornaments, and other works of this nature, cheaper than they can be executed in natural ſtone.

SIR, *London, April* 12, 1796.

IN conſequence of the inſtructions which I received from the Directors of the Britiſh Society, at their Meeting on the 17th of *March*, I went to Mr. Parker's houſe in *Bridge Road, Lambeth*, on the 23d, and made the following experiments upon his Compoſition for a Water Cement, in order to prove whether it anſwered to the deſcription which he gave of it to the Directors.

Mr. Parker having produced a ſmall quantity of the Compoſition in a paper bag, I examined it, and found it in the ſtate of a dry Powder; this was taken into Mr. Parker's yard, which is paved with ſmooth ſquared flags; we had a part of the pavement waſhed clean, and upon the clean part was put down a

5 portion

(b)

KEENE'S PATENT MARBLE CEMENT.—Scagliola manufactured from this Cement excels other imitations of Marble and Granite, as well in the richness of its colour as in its extreme hardness, which latter quality especially adapts it for Ornamental and Inlaid Pavements. When rightly treated in a humid state, it has the property of fixing water-colours or tempera, and when dry and polished may be painted on in encaustic. Patentees and sole Manufacturers, John Bazely White and Sons, Millbank-street, Westminster.

POLONCEAU'S BITUMEN PAVEMENT for paving Foot walks, Terraces, Garden walks, Stables, Coach Houses, Granaries, Corn Stores, and Salt Warehouses. For the exclusion of Damp and Vermin in Basements it is particularly adapted, and for Roofing Dwelling Houses, Porticos, Balconies, and Sheds.

Price 3s. 6d. per square yard.

BITUMEN for covering the Arches of Bridges, Culverts, &c. &c. on Railways and other places (with instructions for laying it down), may be had at the rate of 45s. per ton, by applying to JOHN PILKINGTON, 15, Wharf-road, City-road.

TO ARCHITECTS, BUILDERS, AND PAINTERS IN FRESCO.

MARTIN'S PATENT CEMENT.

STEVENS and SON beg respectfully to announce that this beautiful cement has now arrived at a degree of excellence far surpassing their most sanguine expectations. For all internal work it possesses a great superiority over every article hitherto in use; it is now being used extensively by Government in the British Museum and other public buildings. It does not throw out any salt, but presents a beautifully plain and perfect surface, which may be painted upon within four days without peeling. It is equally applicable for walls or lath, for mouldings, architraves skirting, or flooring; and is admitted to form the best ground for fresco painting, having been used for many of the prize frescos lately exhibiting in Westminster Hall. It will bear an intense heat without cracking, and for hardness, durability, and economy, cannot be equalled.

186, Drury-lane, London.

ATKINSON'S CEMENT.—WYATT, PARKER, and Co., Albion Wharf, Holland-street, Surrey foot of Blackfriars-bridge, beg to inform ARCHITECTS and BUILDERS, that the price of this Cement is now reduced 25 per cent., and that they now receive it direct from the Mulgrave works, and its quality is of the best and freshest description. They are also manufacturing a new cement, called ENGLISH TARRAS, which is an excellent hydraulic mortar. It does not harden quickly like Roman cement, but gradually, and more like the mortar made of Italian Pozzolano and Abertnaw lime. It may be used for stucco, and will bear three parts of sand to one of cement: it is of a bright stone colour and does not vegetate. The English tarras and Atkinson's cement, when used together, in the proportion of one-third of the former to two-thirds of the latter, is an excellent material for casting or stucco.

WYATT, PARKER, and Co. beg to call the attention of ARCHITECTS, CIVIL ENGINEERS, and BUILDERS, to a NEW CEMENT they are now manufacturing for the construction of Arches and bedding Masonry, either under or out of water, where it is important the work should set or consolidate slowly. It is sold under the name of TARRAS, and applied in the same manner as Parker's Cement, and does not injure so quickly as that Cement by exposure to the air. It is of a fine light stone colour, and may therefore be advantageously used as a Stucco, and for such purpose will bear three times its own quantity of sand. It may be beat up a second time, and used after it has become partially set from the first mixing, without at all injuring its tenacity, and partakes in hardening more of the character of the Roman Mortar, made from Pozzolano and Lime. It has been severely tested at the Westminster Bridge works, under the direction of Messrs. Walker and Burgess, and is an Hydraulic Cement of the greatest value and importance in Engineering works.

Albion Wharf, Holland-street,
June, 1844. Surrey foot of Blackfriars Bridge.

TO ARCHITECTS, ENGINEERS, CONTRACTORS, BUILDERS, MASONS, AND PLASTERERS, MERCHANTS, SHIPPERS, AND THE PUBLIC IN GENERAL.

JOHNS and CO.'S PATENT STUCCO CEMENT.—The following are the positive advantages possessed by this Invention over every Cement hitherto introduced:—It will effectually resist Damp. It will never vegetate nor turn green, nor otherwise discolour. It will never crack, blister, nor peel off. It will form a complete Stone casing to any Building covered with it. It so closely resembles Stone that it is impossible to detect it. It never requires either to be painted or coloured. It will keep fresh and good in the cask in any Climate for any number of years. It is the only Cement that can be depended upon for export. It is the only Cement that can be used with confidence by the Sea-side. It may be used in the hottest or coldest Climates at any season. It will adhere to any substance, even to Wood, Iron, or Glass. It will carry a larger Proportion of Sand than any other Cement. It matures by age, and becomes perfect when other Cements begin to perish. It may be worked through the Winter, as frost has no effect upon it. It may be used on the Inner Walls of new Houses, which may be papered over or painted directly. Roofs laid or pointed with this Cement will remain undamaged by the severest Storms. Any Plasterer may apply it, the Instructions for use being very clear and distinct. The first cost of this material does not exceed that of the cheapest Cement now in use; but with all the above-named extraordinary and valuable advantages, nothing can approach it in point of economy.

Architects and Builders who have used this Cement have declared that it requires only to be known, to be universally preferred.

Specimens may be seen, and a Prospectus fully describing the Cement and its mode of application together with a volume of Testionials, from every part of the Kingdom, may be obtained on application to MANN and CO., SOLE AGENTS for the Patentees, 5, Maiden-lane, Queen-street, Cheapsid, London: of whom also may be had,

JOHNS and CO.'S PATENT STONE-COLOUR STUCCO PAINT, expressly intended for Painting over exterior Walls of Houses that have been covered with Roman or other Cements, and which have become dirty and discoloured. It is in every way better suited for this purpose than White Lead Paint, which will frequently come off in flakes, being in direct chemical opposition with Cement; whereas MESSRS. JOHNS and CO.'S PATENT PAINT having an affinity for Stucco, binds itself with it, stopping the suction, thereby rendering the wall proof against weather, and in the finish producing a pure stone-like effect, produceable by no other Paint whatever. It is cheap in its application,—and may be used by any Painter, in any climate, even in the most exposed Marine situations.

(b) Fig. 1. (c)

Bridge St., Lambeth, made various experiments, and drawn up a report which was entirely favourable. There are two or three printed copies in existence. Parker also arranged for advertising purposes and the first page of his leaflet is illustrated in *Fig. 1b*, which is reproduced here by permission of the Librarian of the Patent Office Library.

At this time Parker & Co., had their wharf on the River Thames at Pedlar's Acre, Lambeth. The cement was brought up by barge from the firm's works at Northfleet, Kent. After publication of the report, Parker felt the need for improved accommodation and moved to 40 Bankside, Southwark.

In his report Telford mentions being taken by Parker to see ' the plate glass manufactory on the upper side of the Surry end of Blackfriars bridge' for which his cement had been used. This building was the London warehouse of the British Plate Glass Co., of Ravenhead, Lancs.; *Fig. 1a* shows this building which can probably be regarded as the earliest known example of the use of Parker's cement. The British Plate Glass Co., was established in 1773 and continued in existence until 1901 when it was acquired by Messrs. Pilkington Brothers Ltd.

Being in close touch with the trade, Parker would no doubt have heard of Higgins' cement, which was patented in 1778 by Brindley Higgins, M.D. Higgins, who ran a school of practical chemistry in Greek St., Soho, describes his experiments on cement in a book published in 1780 and tells us that he authorised ' James Wyatt, the celebrated architect of the Pantheon, and his brother Samuel Wyatt of Berwick St., who is a very eminent builder ' to use it. The book lists a number of houses on which it was used as a stucco but it would clearly have been costly and elaborate to produce and of comparatively short life. Perhaps as a result of this knowledge, Parker approached Samuel Wyatt during 1797, and the latter with his long experience as a builder and architect (he was then over sixty) would have immediately appreciated the advantages of this new cement and its probable superiority over similar materials then available. Accordingly there is the appearance, from 1798 onwards, of the firm of Parker & Wyatt described as " Cement and Stucco Manufacturers, Bankside ".

This is almost the extent of our knowledge about James Parker himself and his activities. Although some writers state that Parker traded in partnership with Samuel Wyatt, this is controverted by John Rickman, who edited Telford's autobiography (published in 1838), and who states in a footnote that the business did not flourish to begin with and that Parker sold his patent to Samuel Wyatt, emigrated to America, and soon after died there. Further research will be needed before the full story of James Parker can be written.

Much more information is available concerning Samuel Wyatt. The third son of Benjamin Wyatt of Blackbrook, Staffs, a farmer and timber merchant, he was born in 1737. Like his father he practised initially as a timber merchant but subsequently became a builder and architect. One of his six brothers was James Wyatt, R.A., the noted architect. Samuel Wyatt had premises at Berwick St., Soho, which appear to have been previously in the occupation of his youngest brother George, also a builder. In 1784, he joined with his brothers James and George in building Albion Place, Blackfriars, where he afterwards lived. He also built the adjoining Albion Mills, the machinery for which was designed by Boulton & Watt, assisted by George Rennie; this machinery incorporated one of Boulton & Watt's earliest rotative engines. In 1792, Samuel Wyatt succeeded Robert Adam as Clerk of Works to Chelsea Hospital. In 1801 he took out a patent for building cast-iron buildings and warehouses and, shortly before his death, he had been asked to prepare plans for Rugby School. He died on February 8, 1807, and was succeeded in the business by his cousin Charles, son of John Wyatt of Birmingham, the inventor.

Charles Wyatt was trading at Bridge St., in the City of London, and about 1805 he moved to 41 Bankside, next door to the offices of Parker & Wyatt. His association with Parker and Wyatt probably dates from this period. He died in 1819 and James, one of his two sons, took over the business. James Wyatt was himself succeeded by Walter Henry Wyatt, a distant relative.

Reverting to the firm's trading activities, the use of Parker & Wyatt's cement for engineering purposes, appears to have been largely confined to Telford's works; the use of Roman cement for the Chirk aqueduct is well-known and it is probable that the material was used for most of Telford's subsequent bridges. Telford's autobiography includes many of his specifications for these bridges, particularly for those in Scotland and most of these mention the use of Parker's cement. One cannot be sure, however, that this material was in all cases supplied by Parker & Wyatt. Telford's personal memoranda book contains only one entry relating to cement and this is an analysis of the stone used by Francis & White[1] of Vauxhall.

In contrast, Parker's cement was, understandably, taken up by many architects for stucco which was fashionable for hiding brickwork, the stucco being intended to suggest stone. John Nash used Roman cement extensively from 1796 onwards and it has been said that it was this material which made his architecture possible. The Wyatts did much to popularise the material, in particular James Wyatt whose works could be found throughout the country. Sir Jeffrey Wyatville (Jeffrey Wyatt) worked in the office of his uncle, Samuel, at an early age and would thus have become well acquainted with the material. He is known to have used it extensively.

A study of the progress of the firm through its entries in trade directories is less revealing than might normally be expected. The name Parker & Wyatt is used from 1798 until 1803 when it reverts to its original Parker & Co., until about 1814 when it is again Parker & Wyatt. Possibly the 1803 period marks the end of Samuel Wyatt's association with the firm. The name Parker & Wyatt continues from 1814 to 1822 when there are several variations including Wyatt & Parker, Wyatt & Son, and Wyatt, Parker & Co. Some of these changes presumably mark James Wyatt's assumption of control. From 1830 onwards the name remains as Wyatt, Parker & Co., with offices still at Bankside where they had been since 1796. About 1840 the offices moved to Albion Wharf, Holland

St., Blackfriars. By 1840, or perhaps earlier, it became necessary for the firm to extend its interests and they then dealt in marble and other stone and several varieties of cement. In 1841 Wyatt, Parker & Co., issued a catalogue of statues and ornaments. At this time the firm described itself as Roman cement, plaster, mastic, scagliola and tesselated pavement manufacturers, and marble importers and merchants.

Many of the early technical publications came into being in the late 1830s and early 1840s and some contain advertisements of Wyatt, Parker & Co.; examples appearing in " The Builder " about 1844 are shown in *Fig.* 1c [2]. Such advertisements continued regularly until April 1846 but none is found after that date. By November 1846, the firm's premises at Albion Wharf appear to be in the possession of Messrs. E. Rosher, lime merchants, who at this period were also in possession of premises at Northfleet. It can therefore be concluded that the year 1846 brings the existence of the firm to a close. The pressure of competition and the increasing use of Portland cement undoubtedly played their part. So ended, after a span of nearly half a century, the business originated by James Parker and Samuel Wyatt. They surely have a strong claim to be regarded as the ancestors of the modern cement industry.

[1] A short history of the firm of Francis & White was contributed by the author to this journal for March 1964.

[2] The other advertisements in this column are interesting since they announce Keene's, Martins's, Atkinson's and John's cements as well as Wyatt, Parker & Co's., product.

Cement Industry in Central America.

Dominica.—Allis-Chalmers International announced recently that they are supplying the principal cement-making plant for the expansion of the works of the Fabrica Dominicana de Cemento, Santo Domingo. The new plant, which includes complete equipment for a wet-process rotary kiln, will increase the daily productive capacity by 800 metric tons. The major plant to be supplied is a 450-ft. kiln of 12 ft. 6 in. diameter. Additional equipment includes two 150-b.h.p. motors to drive the kiln, a master control board, a 300-h.p. motor for the induced-draught fan, a slurry chain system, and all other motors and starters.

Developments in the Cement Industry in the North of England.

MUCH activity continues in the development of cement works and distribution depots in the northern counties of England; some of these developments are recorded in the following.

The New Weardale Cement Works.

Construction and installation of plant has commenced at the new works of The Associated Portland Cement Manufacturers Ltd., at Weardale in County Durham. The works will operate on the dry process and cement production, which will be 300,000 tons annually, is expected to commence in mid-1965.

Site preparation work has been completed for some months. More than 7,500 cu. yd. of top soil have been moved to form a flood bank alongside the River Wear which runs near the site; 102 foundation piles have been installed to depths of up to 32 ft.; and 28,000 tons of filling has been brought in to make the access road, the surface of which has been concreted. Some 430 ft. above the site, near the summit of Ludwell Burn Head, work has started on building the road which will link the shale and limestone quarry with an existing road 300 ft. farther down the hillside; this new road will be 1 mile long and will be on a gradient of 1 in 10 in places. The limestone will pass through the crushing and milling plant on the hill-top before being carried down by conveyor belt to the works in the valley below. A private railway line nearly 1 mile long is to be laid to connect with the nearby Bishop-Auckland line. Gypsum will be brought from Cumberland. The fuel will be coal which will be brought from the Newcastle area.

Building and civil engineering work is proceeding in connection with the granulator building, the Lepol-grate house, the foundations of the kiln buildings, the cooler pit and foundations, and the blending and storage bunkers for the raw

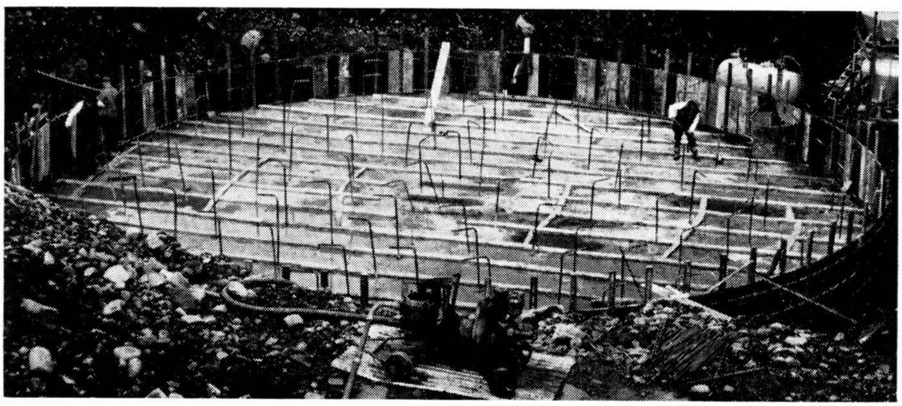


Fig. 1.—Weardale Cement Works: Chimney Foundation

meal. The foregoing works, together with the clearing of the site, laying drains and constructing roads, are being carried out by Tarmac Civil Engineering Ltd., which firm is also carrying out the bulk excavation required in connection with the crusher house, raw-materials store, and Aerofall mill building in the quarry.

The Scottish Land Development Corporation are the sub-contractors for earth moving and Messrs. A. Waddington & Son Ltd., carried out the piling.

The reinforced concrete chimney, the foundations (*Fig.* 1) for which are completed, will be 400 ft. high and will have a diameter of 30 ft. at the base. The construction of the chimney and its foundations (which is expected to be completed

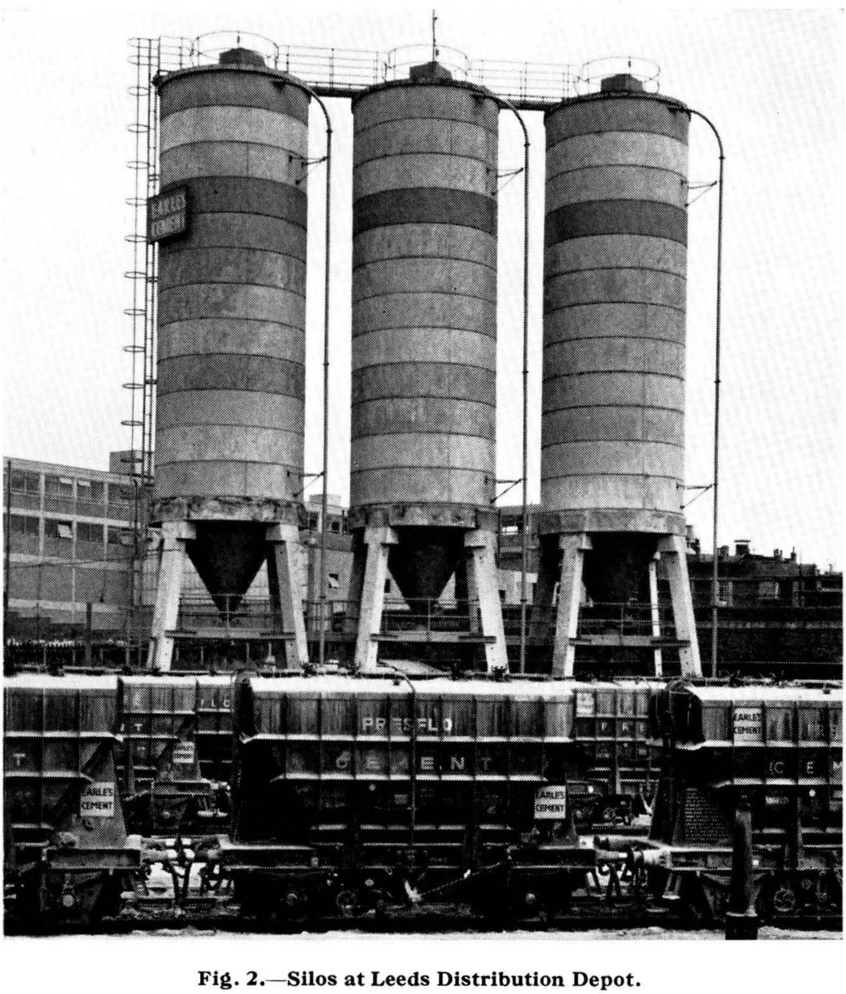


Fig. 2.—Silos at Leeds Distribution Depot.

in March 1965), are being carried out by Mitchell Construction Co. Ltd., a member of the Mitchell Construction-Kinnear Moodie Group.

What are probably the largest single precast concrete frames so far manufactured are being provided for the kiln building. These frames are 80 ft. high and each comprise two posts, each of 12½ tons weight, and a rafter piece weighing 6 tons. The frames were designed, made and erected by Conspan Ltd.

Planning permission is being sought for the extension of the Weardale works to a capacity of 600,000 tons per annum.

Bulk Cement Depot in Yorkshire.

Three cement storage silos (*Fig.* 2) 70 ft. high, having a total capacity of 540 tons, have been erected at the new bulk-cement depot of Messrs. G. & T. Earle Ltd. (a member of the Blue Circle Group) at Marsh Lane Goods Yard, Leeds. The cement is brought from the firm's works in Melton, or from other of the Group's works in the Thames area, in " Presflo " railway wagons, three or four trains of which arrive at the depot each week. The all-steel wagons, which are shunted by the cement company's own staff using a diesel locomotive, are gravity-loaded through inlets in the roofs and can discharge the cement by compressed air up to a height of 60 ft. A mobile compressor discharges the cement into the silos at the rate of ½ ton a minute, and a complete train load can be cleared on the day of arrival thus giving a 24-hour turn-round of the wagons, thereby making it possible to decrease the number of wagons required. Each silo is constructed of twelve precast concrete rings, each 3 ft. high and 13 ft. in diameter.

The depot also contains a 30-ton weighbridge capable of taking 15-ton road tankers. Distribution of cement from the depot is made in these tankers, each of which is fitted with a compressor for filling the customer's silos.

The design, manufacture and erection of the silos were carried out by Conspan Ltd., in conjunction with Portasilo Ltd., both of which firms are members of the Shepherd Building Group. A battery of four similar silos, but each of 250-tons capacity, is to be erected by Messrs. G. & T. Earle Ltd., at their distribution depot at Manchester.

Extension of Westbury Cement Works.

ANOTHER kiln, which is expected to be in operation by June 1965, is being installed at the works of The Associated Portland Cement Manufacturers Ltd., at Westbury, Wiltshire. (The present new works was described in this journal for May and July 1963). The contracts for the clinker cooler pit and tunnel, the kiln piers, the foundations for the precipitators, cement-mill building, cement mills, and the clinker and gypsum silos have been awarded to Messrs. A. E. Farr Ltd. Another contract is for a reinforced concrete chimney, 400 ft. high, and this has been placed with the Mitchell Construction Co. Ltd.

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DOWN PIPES
CORRUGATED
AND FLAT
SHEETS

. . . Production, delivery, service and (if required) finance for complete installations, large or small.

Installations complètes pour la fabrication des tuyaux haute et basse pression et des plâques planes et ondulées en amiante-ciment.
Production, livraison, service et (si desiré) financement des installations complètes grandes ou petites.

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HAUPTSTRASSE 26, VADUZ-LIECHTENSTEIN (Switzerland)
P.O. Box 34.649

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34s. per single column inch.

Advertisements must reach this journal at 60 Buckingham Gate, London, S.W.1. by the 1st of the month of publication.

FOR SALE

MULTIWALL BAG MACHINE, printer and bottomer for sale. Makes cement, lime, chemical bags. Complete unit for making stepped end and flush cut pasted valve style bags. This is a combination machine. Reply BOX 2016, CEMENT AND LIME MANUFACTURE, 60 Buckingham Gate, London, S.W.1.

SITUATIONS VACANT

THE UNITED STEEL COMPANIES LIMITED

Cement Research

THE UNITED STEEL COMPANIES LIMITED require a young graduate or equivalent for research and development work on slag based cements. Applications are invited from experimental CHEMISTS and PHYSICISTS who are interested in carrying out work into problems associated with the manufacture and properties of cements. Previous research experience, particularly in this field, will be a distinct advantage. Excellent working conditions in a new and fully equipped laboratory in a pleasant residential district of Rotherham. Canteen, sports and social facilities.

Applications should be addressed to :
The Secretary,
THE UNITED STEEL COMPANIES LIMITED,
Swinden Laboratories,
Moorgate, Rotherham.

TECHNICAL SUPERVISER

required for concentration plant at phosphate works in Curacao, N.A. Practical experience in operation of oil-fired rotary kilns essential. Must be capable of supervising local labour operating on shift system. Housing provided on attractive part of Island. Conditions of employment above local average for expatriate staff.

Apply

N. V. Mijnmaatschappij Curacao,

Newport, Curacao, N.A.

CEMENT
AND
LIME MANUFACTURE

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INDEX TO VOL. XXXVII, 1964

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.

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