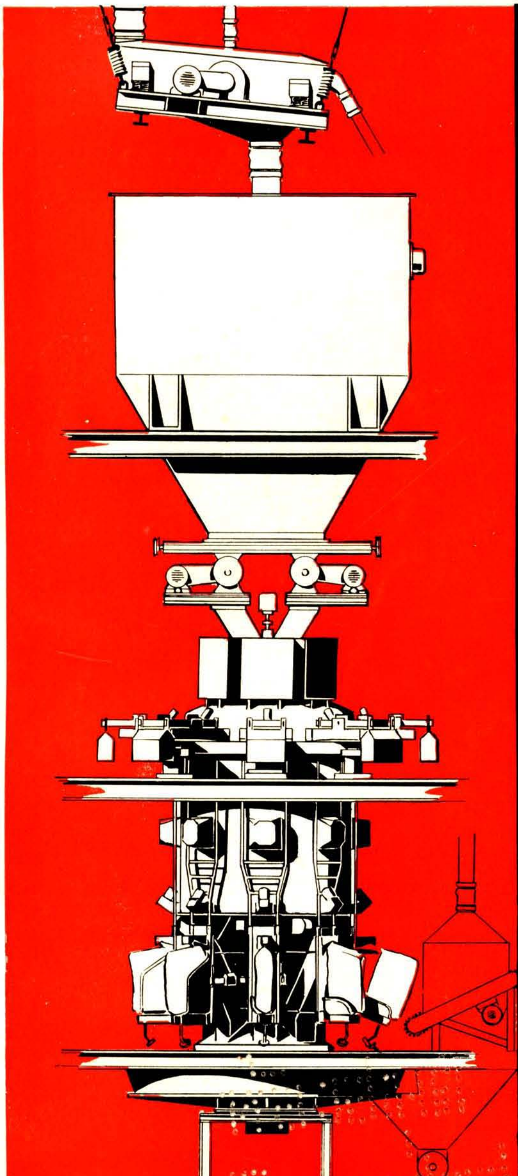
CEMENT
& LIME MANUFACTURE

VOL. XLI. No. 6 NOVEMBER, 1968

Price 1s. 6d. per Copy.
Annual subscriptions: Inland 9s. post free.
Overseas 11s. 6d. including postage.
Canada and U.S.A. 1.80 dollars incl. post.

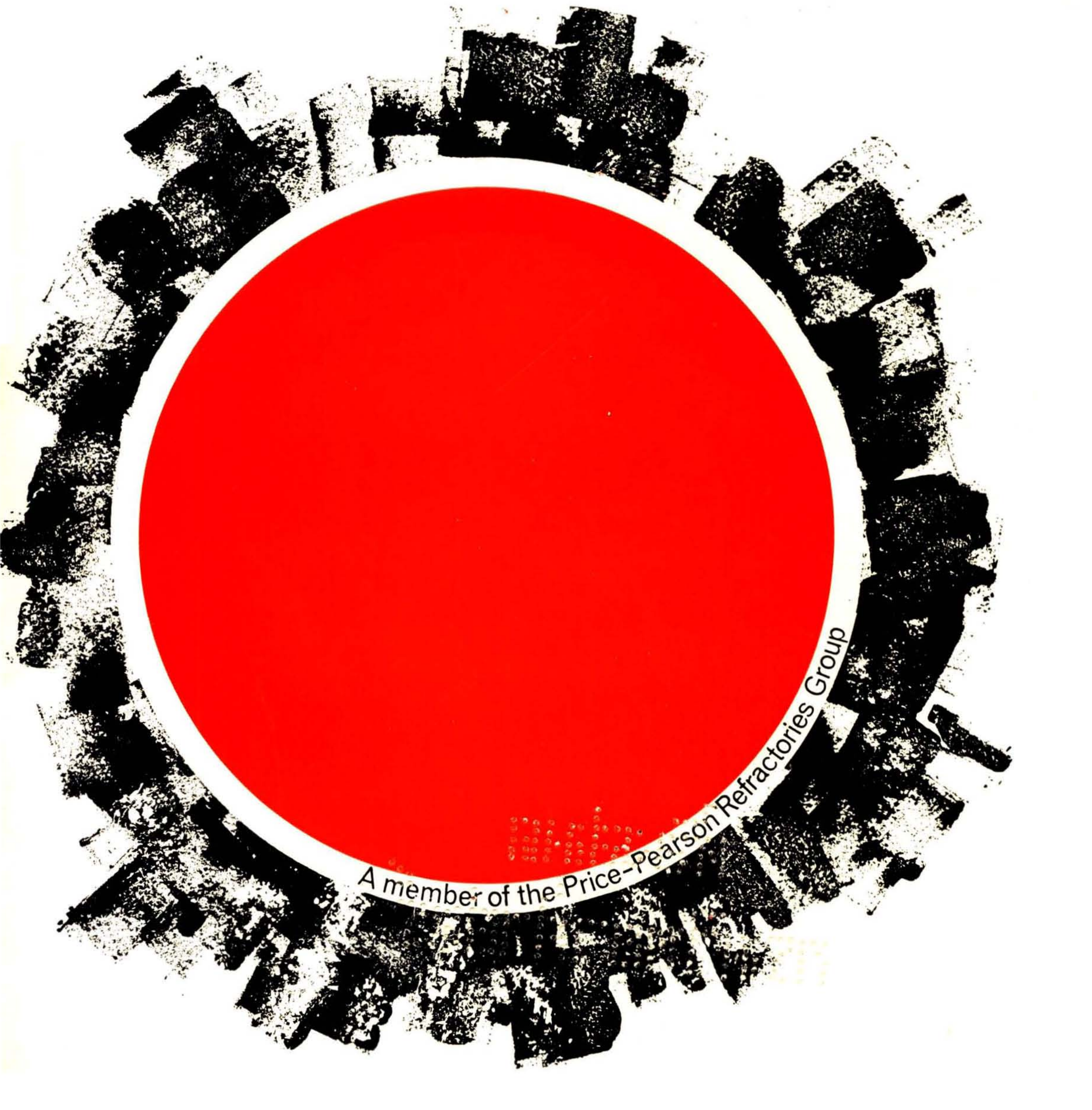


PLANET HUNWICK ALITE

a complete range of lining blocks for cement & lime kilns

send for full details of these grades
HUNWICK magnesite-chrome
ALITE high alumina
PLANET abrasion resistant

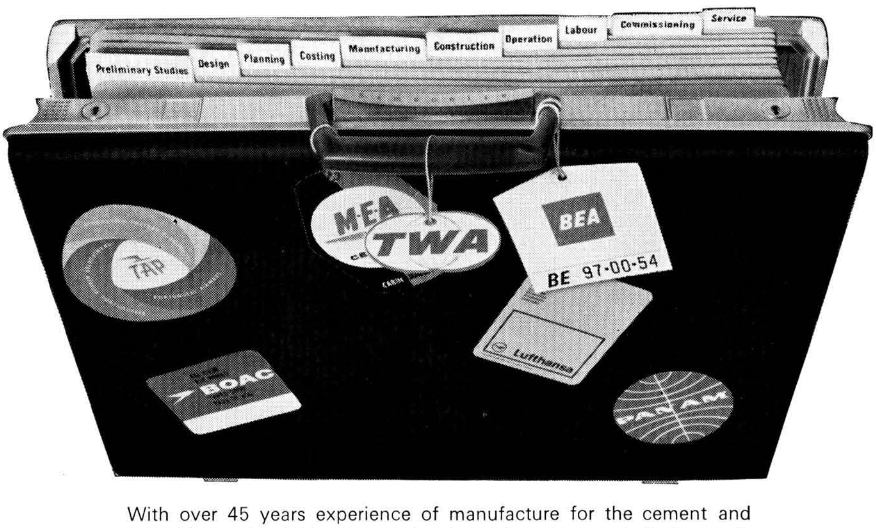
PRICE-PEARSON (SALES) LIMITED STOURBRIDGE WORCS.



Ask Vickers about cement making plant

You'll get the right answers...

wherever you are



With over 45 years experience of manufacture for the cement and allied industries, Vickers are uniquely equipped to meet all plant and machinery requirements—from a single kiln or mill installation right up to complete production plants. Write or telephone for information about our facilities and our world-wide service.

VICKERS

Complete Wet or Dry Process Plants Grinding Mills Kilns Ancillary Equipment

VICKERS LIMITED ENGINEERING GROUP CEMENT MACHINERY DIVISION (SALES) METROPOLIS HOUSE
39-45 TOTTENHAM COURT ROAD LONDON W1 01-580 5746 Technical enquiries: CEMENT MACHINERY DIVISION
VICKERS LTD ENGINEERING GROUP V-A ENGINEERING WORKS BARROW-IN-FURNESS LANCS BARROW-IN-FURNESS 3366

CEMENT AND LIME MANUFACTURE

PUBLISHED ALTERNATE MONTHS PRICE 1s. 6d. A COPY ANNUAL SUBSCRIPTION 9s. POST FREE
$1.80 IN CANADA AND U.S.A

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

TELEPHONE: 01-834 0705.
TELEGRAPHIC ADDRESS:
CONCRETIUS, PARL, LONDON.

ALSO PUBLISHERS OF
"CONCRETE"
"CONCRETE BUILDING & CONCRETE PRODUCTS"
"THE CONCRETE YEAR BOOK"
"CONCRETE SERIES": BOOKS

VOLUME XLI NUMBER 6 NOVEMBER, 1968

Manufacturing Processes of Portland Cement

FACTORS INFLUENCING SELECTION OF APPROPRIATE PROCESS

CONTRIBUTED BY K. C. BARRELL, M.A., C.ENG., F.I.MECH.E.

FOR many years, the manufacture of Portland cement was confined to two main processes, namely, the "wet process" and the "dry process", but subsequently the "semi-dry process" and what might be called "the semi-wet process" have been developed.

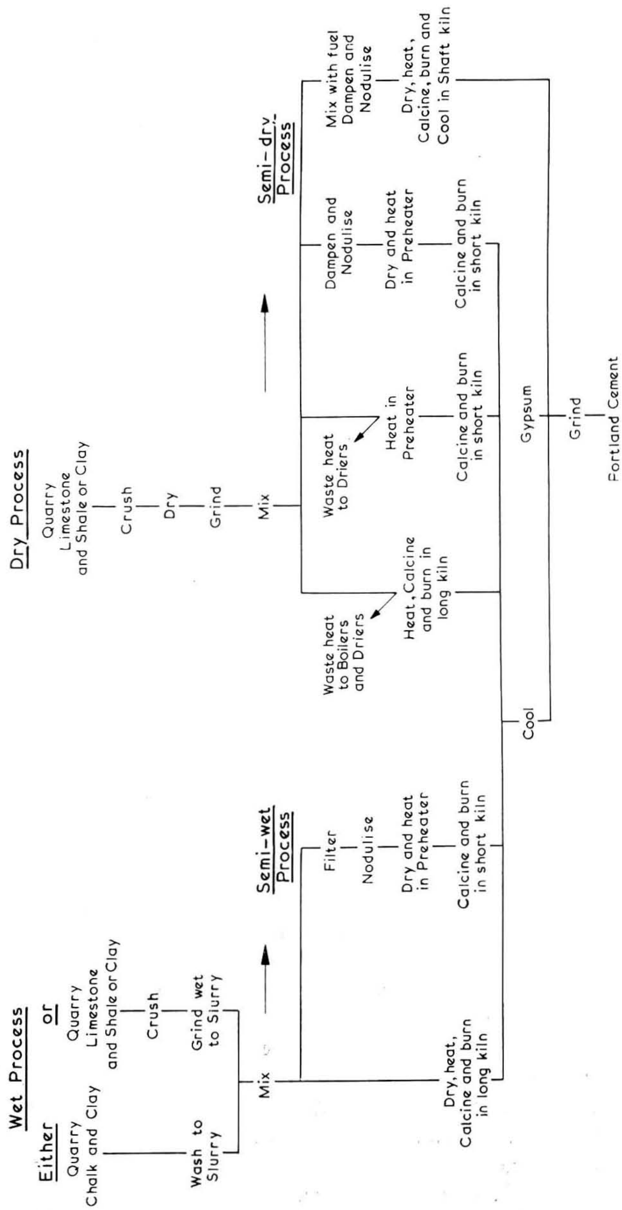
In the semi-dry process, the dry raw-meal is wetted with about 12 to 14 per cent. of moisture so that it can be formed into nodules which are fed on to a travelling grate, up through which the hot gases pass, before they enter the kiln.

Efforts have been made to improve the thermal efficiency of the wet-process kiln. Because of the rising cost of fuel, the use of mechanical means for removing water from the slurry, such as filter presses, instead of by thermal means, has become commercially viable by bringing the slurry moisture down to 14 to 20 per cent. before feeding the slurry to the kiln. This is the basis of the semi-wet process.

The various processes and the factors influencing the choice of a particular process are summarised in the diagram on page 92.

It is difficult to establish truly comparative data for the various processes, because of the considerable variations in the properties of the raw materials, and in other factors such as the size of the plant, cost of power, fuel and labour, and the effect on capital cost of site conditions, not only between one country and another, but between works in the same country. It is, therefore, practicable to make only a general comparison of the merits of the various processes.

The cost of production of cement, apart from selling costs, depends mainly on



Factors influencing choice of Cement Manufacturing Process

five items; capital charges, labour and supervision, fuel consumption, power consumption, and maintenance costs.

Given comparable conditions, the first two costs and that of maintenance are unlikely to be decisive, except as between the wet and the semi-wet processes, when the cost of installing, operating and maintaining the filter plant could outweigh the savings from improved fuel economy, or with the shaft kiln in which the possible advantage of these factors has to be weighed against severe limitations as to raw material, fuel and quality of the product. The critical factors to be considered can therefore be taken to be the type of raw material, fuel consumption and power consumption.

The fuel consumption will be determined by the process used, and the power consumption principally by the type of raw material. The variations in power consumption are mainly dependent on the power required for the winning, comminution and mixing of the raw materials, which is of the order of 10 k.w.h. per ton of clinker produced for "washed" soft materials, and 30 to 60 k.w.h. per ton for materials that have to be blasted in the quarry and ground, depending upon their hardness. Whereas with older types of equipment, grinding and mixing could consume less power when the material was wet rather than dry, this advantage no longer obtains with modern plant in the case of some materials. The total power consumption for the rest of the process will be of the order of 70 k.w.h. per ton of clinker produced, whatever the process.

The utilisation of the heat supplied to a typical coal-fired kiln using the wet process, the dry process with a cyclonic preheater (suspension preheater), and the semi-dry process is compared in *Table I.* While the percentage of heat carried away in the gases with the suspension preheater is high, much of it can be used in drying the raw materials. In the semi-dry process additional heat must be supplied for this operation and may amount to 20 per cent. of the heat supplied by the coal to the kiln.

The joint effect of the two major factors of fuel and power consumption can best be seen by expressing them in the same units, which can then be added together. The data are tabulated in *Table II* on page 94, the values in which are very approximate and, for the purpose of comparison, are given in kg.-cal. per kg. of clinker.

TABLE I—HEAT CONSUMPTION

	Wet process %	Dry process (Suspension preheater) %	Semi-dry process %
Theoretical heat for reactions	25·0	46·2	42·9
Heat in combustion gases	12·5	19·2	11·4
Heat in process gases	2·5	5·4	3·6
Heat for moisture evaporation	44·6	0·7	15·7
Heat lost in clinker	0·8	1·5	1·4
Heat lost from shell	14·6	27·0	25·0
	100·0	100·0	100·0

While costs could be used as the common denominator, it is best to avoid this form of comparison since the unit costs are so liable rapidly to become invalid. Broadly, today in the U.K., in a wet-process plant with soft material, the cost of power is one-third of the cost of fuel, so that the power consumption may be expressed as $\frac{1750}{3}$ kg.-cal. per kg., that is, say, 600 kg.-cals. per kg., corresponding to 80 k.w.h. per ton. For the processes using hard raw material, a mean power consumption of 45 k.w.h. per ton for grinding is assumed, giving a total works consumption of 115 k.w.h. per ton, which corresponds, *pro rata,* to about 850 kg.-cals. per kg. For the semi-wet process the additional cost of power and labour is assessed at an arbitrary value of 100 kg.-cal. per kg.

Wet and Semi-wet Processes

It is not questioned that, for soft raw materials which can be washed to slurry with little power, only the wet process is practicable. Any attempt to dry the material so that it could be ground, and taking into account the power then required to grind it, would be quite uneconomical. There is obviously great inducement to develop the semi-wet process by improving the filtering process.

Dry and Semi-dry Processes

There is not much to choose between the power consumption for the wet process and the simple dry process. In the days when the controversy between the relative merits of the dry and wet processes was active, it would have been fair to add to the data for the dry process the extra power, say 15 per cent., for raw-material preparation that existed at the time. It is true that by installing waste-heat

TABLE II—COMPARATIVE FUEL AND POWER CONSUMPTIONS
Expressed approximately in kg.-cal. per kg. of clinker

Process	Wet		Semi-wet	Dry		Semi-dry	
Kiln	Rotary		Rotary	Rotary		Rotary	Shaft
	Soft material	Hard material	Soft material	Without preheater	With preheater	With preheater	—
Kiln fuel ..	1,750	1,650	1,000	1,300†	875†	950*	1,150*
(Ditto percentage on clinker) ..	(25)	(23·5)	(14·25)	(18·5)	(12·5)	(13·6)	(16·0)
Power	600	850	700	850	850	850	600
Total	2,350	2,500	1,700	2,150	1,725	1,800	1,750

*** In the semi-dry process, there is added to the kiln-fuel consumption 150 kg.-cal. per kg. for separately drying the raw material.**
† In the dry process, the raw material is dried by heat from the kiln which would otherwise be wasted.

boilers and generating plant much, if not all, of the power could be generated without the consumption of fuel in the generating plant. At that time also it was common practice for a works to have its own steam generating station, but the additional cost of such a station to run on waste heat would be considerable and it would of necessity have to contain units to generate sufficient power to keep the works operating when starting up or when any of the kilns were out of commission. This added complication to the process and to the burdens of the manager. With the dust-collecting apparatus then available, the dust emission from the chimney was likely to be very much greater with the dry process, and this rendered the dry process less acceptable in a heavily populated area. With present-day equipment, the dust emission can be coped with, but as power is normally purchased from a supply authority or generated by internal-combustion engines more economically than by steam, waste-heat boilers would be an embarrassment.

However, it is unlikely that the wet process would be selected today for hard materials unless the raw materials were exceptionally wet, or as a replacement in a works in which existing plant for grinding the raw materials wet is too valuable to replace with plant for dry grinding.

Neither would a simple dry-process rotary kiln be selected unless to meet special conditions, such as where lower capital cost and cheap fuel could balance the higher fuel consumption, where water is scarce, where the raw material is high in alkali, or the labour available is not sufficiently sophisticated to operate the more complex plant with preheaters. The more probable selection would be one of the processes with a preheater and short kiln, the choice being largely influenced by the raw materials.

A New Early-strength Cement

THE BLUE CIRCLE Group have introduced a new cement, called "Swiftcrete," which should aid producers of precast, site and ready-mixed concrete to achieve more rapid results with greater economy than previously. The new cement is a very finely-ground ultra-high-early-strength Portland cement, and contains no admixture, other than the gypsum normally added to Portland cement. It is claimed to develop early strength much more quickly than any other known Portland cement, either with or without accelerating admixtures. The setting times are comparable with those of rapid-hardening Portland cement, and shrinkage and creep properties do not cause difficulty in use. It is especially valuable when heat curing is used. The cement is used in the same way as ordinary Portland cement but gives higher strengths than commercially available cements with calcium chloride mixed in. It has been subjected to site tests for five years and will be the subject of a technical paper to be submitted shortly by members of Leeds University. A summary of the properties of "Swiftcrete" is given on a data sheet available on request from The Associated Portland Cement Manufacturers Ltd., Portland House, Stag Place, London, S.W.1.

Cement Standards of the World

THE REVISED 1968 edition of "Cement Standards of the World: Portland Cement and its Derivatives," was published recently. The Standards organisations of forty-four countries, that is all those countries which have published standard specifications for cements, have assisted in providing the information necessary to compile the statistics given in this book of 250 pages which is published by CEMBUREAU.

In addition to the standards for Portland cement, the requirements for the various types of blastfurnace and pozzolanic cements are now included, and thus there is contained in the one publication summaries of all national specifications concerning Portland and similar cements used in the construction industry. High-alumina cements are excluded. Most of the data is up-to-date to 1967 and therefore, as regards the United Kingdom, the 1968 Standards for supersulphated cement (B.S. 4248) and low-heat Portland blast furnace cement (B.S. 4246) are omitted, particulars of these two Standards are given below. For West Germany, however, the revisions likely to be in force in 1969 are included in the CEMBUREAU. publication.

The data are given under the names of the countries, listed alphabetically, and a comprehensive introduction explains the abbreviations and gives some details about the chemical formulae for the various tests. The names and addresses of national standards organisations throughout the world are also given.

This publication is obtainable from: CEMBUREAU, The European Cement Association, 2 rue Saint-Charles, 75-Paris (15e) France. (Price: French francs 30 including postage.)

Requirements of British Standards for Cements

THE CURRENT requirements for all types of cement covered by British Standards are summarised in Table I on page 98 and 99.

Two new British Standards were issued recently, one being for supersulphated cement and the other for low-heat Portland-blastfurnace cement. The requirements of these Standards are given in the following and are included in the summary on pages 98 and 99.

New Standard for Supersulphated Cement

Supersulphated cement is dealt with in B.S. 4248 (1968), "Supersulphated Cement". This cement is resistant to most of chemically-aggressive conditions commonly encountered in the construction industry. In particular, concretes and mortars made with this cement have considerable resistance to deterioration due to sulphates. It has been found in practice also that dense concretes having a water-cement ratio of 0·45 or less and made with this cement have a useful life when in contact with weak solutions of mineral acids having pH-values of upwards of 3·5. There are important differences in the chemical and physical properties of this cement compared with other cements, and therefore the test requirements are different. Some of these differences are as follows.

The water-cement ratio (by weight) for the concrete-cube test for compressive strength is 0·55 instead of 0·60, the lower value being considered to be more appropriate to a finely ground slag-based cement and giving better test reproducibility. The soundness test is a cold-water modification of the Le Chatelier test described in B.S. 12 for Portland cement since the boiling procedure described in the latter standard is intended to detect expansion due to an excessive content of free lime. As there is no measurable quantity of free lime in supersulphated cement, if complying with the new Standard, the test has been modified to act as a general safeguard against potential unsoundness

There is no requirement relating to loss-on-ignition as the test for this property is not appropriate to cements containing a high percentage of blastfurnace slag. Compliance with the requirements for compressive strength, setting time, soundness and chemical compositions are considered to be adequate safeguards. No limit for tricalcium aluminate is specified, as cement complying with this Standard will not contain a measurable quantity.

Supersulphated cement has an intrinsically low heat of hydration and the test suitable for verifying this property includes a water-content determination specially developed for slag cements, instead of a loss-on-ignition determination, together with a calorimetric procedure which is simpler than that specified for low-heat Portland cement. Nevertheless, the test still involves a protracted and laborious series of observations, and for this reason the test is optional and is only applicable when the cement is to be used for purposes where low-heat properties are advisable.

The principal particular properties are summarised in the following.

Supersulphated cement consists of a finely ground mixture of granulated blastfurnace slag and calcium sulphate together with Portland cement, Portland cement clinker or other source of lime. The slag is to be not less than 75 per cent by weight of the total quantity. The specific surface is to be not less than 4,000 sq. cm. per gramme. The insoluble residue is not to exceed 30 per cent. The maximum quantities of the chemical constituents are magnesia 9·0 per cent, sulphuric anhydride 4·5 per cent, and sulphur, other than that present in the sulphuric anhydride, 1·5 per cent.

The average compressive strength of three mortar cubes is to be not less than 2,000 lb. per sq. in. at three days, not less than 3,400 lb. per sq. in. at seven days, and not less than 5,000 lb. per sq. in. at twenty-eight days. Alternatively, the average compressive strength of three concrete cubes is to be not less than 1,000 lb. per sq. in. at three days, not less than 2,400 lb. per sq. in. at seven days and not less than 3,700 lb. per sq. in. at twenty-eight days.

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

When tested for soundness by the cold-water method, the expansion must be not more than 5 mm.

When the cement is required to have a low-heat property, the heat of hydration

Continued on page 100

TABLE 1.—BRITISH STANDARD

TYPE OF CEMENT			Ordinary Portland Cement	Rapid Hardening Portland Cement	Sulphate Resisting Portland Cement
BRITISH STANDARD			B.S. 12 (1958)	B.S. 12 (1958)	B.S. 4027 (1966)
Fineness	Minimum Specific Surface sq. cm. per gramme		2,250	3,250	2,500
Minimum Tensile Strength	lb. per sq. in. (kg. per sq. cm.)† at one day		★	300 (21) (b)	★
Minimum Compressive Strength (c) lb. per sq. in. (kg. per sq. cm.)†	Mortar	1 Day	★	★	★
		3 Days	2,200 (154)	3,000 (210)	2,200 (154)
		7 Days	3,400 (238)	4,000 (280)	3,400 (238)
		28 Days	★	★	★
	Concrete	3 Days	1,200 (84)	1,700 (119)	1,200 (84)
		7 Days	2,000 (140)	2,500 (175)	2,000 (140)
		28 Days	★	★	★
Setting Time	Initial		Not less than 45 min.		
	Final		Not more than 10 hours		
Soundness	Expansion (Le Chatelier)		Not more than 10 mm. Retest (aerated sample) ≯ 5 mm.		
Heat of Hydration (Cal. per gramme)	7 Days 28 Days		★		
Chemical Composition	SO = SO_2; S = SiO_2; A = Al_2O_3; F = Fe_2O_3; C = CaO		$\frac{C - 0{\cdot}7\,SO_3}{2{\cdot}8\,S + 1{\cdot}2\,A + 0{\cdot}65\,F}$ ≮ 0·66, ≯ 1·02; $\frac{A}{F}$ ≮ 0·66		As B.S. 12 but C_3A ≯ $3\frac{1}{2}$%
	Admixtures after Burning or Grinding		None (except Gypsum and Water) (d)		
	MgO		≯ 4%		
	SO_3		≯ $2\frac{1}{2}$% if 2·65 A — 1·69 F ≮ 7%; ≯ 3% if 2·65 A — 1·69 F > 7%		≯ $2\frac{1}{2}$%
	Insoluble Residue		Not more than 1·5%		
	Loss on Ignition		Not more than 3% (f)		
Notes	★ Not specified. † Metric conversions are approximate. a. Alternative test for high-alumina cement: Maximum residue of 8% (by weight) on B.S. sieve No. 170. b. Optional test (on request).				

REQUIREMENTS FOR CEMENT

Super-Sulphated Cement	Portland Blast-Furnace Cement	Low Heat Portland Blast-Furnace Cement	Low Heat Portland Cement	High Alumina Cement
B.S. 4248 (1968)	B.S. 146 (1958)	B.S. 4246 (1968)	B.S. 1370 (1958)	B.S. 915 (1947)
4,000	2,250	2,750	3,200	2,250 (a)
★	★	★	★	★
★ 2,000 (140) 3,400 (238) 5,000 (350)	★ 2,200 (154) 3,400 (238) 5,000 (350)	★ 1,100 (77) 2,000 (140) 4,000 (280)	★ 1,100 (77) 2,000 (140) 4,000 (280)	6,000 (420) 7,000 (280) ★ ★
1,000 (70) 2,400 (168) 3,700 (260)	1,200 (84) 2,000 (140) 3,200 (224)	500 (35) 1,000 (70) 2,000 (140)	500 (35) 1,000 (70) 2,000 (140)	★ ★ ★
		$\nless$ 1 hr. $\ngtr$ 15 hours	$\nless$ 1 hr. $\ngtr$ 10 hours	$\nless$ 2 $\ngtr$ 6 hours $\ngtr$ 2 hours after Initial Set
$\ngtr$ 5 mm. (Cold-water method)	Not more than 10 mm. Retest (aerated sample) $\ngtr$ 5 mm.			$\ngtr$ 1 mm.
$\ngtr$ 60 $\ngtr$ 70	★	$\ngtr$ 60 $\ngtr$ 70	$\ngtr$ 60 $\ngtr$ 70	★
Blast furnace Slag $\nless$ 75% (by weight) plus calcium sulphate and Portland cement or Portland cement clinker	Blast furnace Slag $\ngtr$ 65% (by weight) plus cement clinker complying with B.S. 12 (1958)	Blast furnace Slag $\nless$ 50% $\ngtr$ 90% (by weight) plus Portland cement clinker complying with B.S. 12 (1958)	$C - 0{\cdot}7S_3 \ngtr 2{\cdot}4S + 1{\cdot}2A + 0{\cdot}65F$ and $\nless 1{\cdot}95 + 1{\cdot}2A + 0{\cdot}65S$ $\frac{A}{F} \nless 0{\cdot}66$	$\frac{A}{C}$ $\nless$ 0·85 $\ngtr$ 1·3 A $\nless$ 32%
★	None (except Gypsum and Water)			None (except Water)
$\ngtr$ 9%	$\ngtr$ 7%	$\ngtr$ 9%	$\ngtr$ 4%	★
$\nless$ 4·5% Sulphur $\ngtr$ 1·5%	$\ngtr$ 6·75% (e)	$\ngtr$ 3% Sulphur $\ngtr$ 2%	As B.S. 12 (1958)	★
$\ngtr$ 3%	Not more than 1·5%			★
★	$\ngtr$ 3% (f)	★	$\ngtr$ 3% (f)	★

c. Alternative tests.
Strength at any age must be greater than strength at earlier ages.
d. Portland cements with calcium chloride do not comply.
e. As $SO_3 \ngtr 3\%$: as sulphides $\ngtr$ 1·5%.
f. $\ngtr$ 4% in tropical climates.

Continued from page 97

is to be not more than 60 cal. per g. at seven days and not more than 70 cal. per g. at twenty-eight days.

New Standard for Low-heat Portland-blastfurnace Cement

B.S. 4246 (1968), "Low-heat Portland-blastfurnace Cement", deals with Portland-blastfurnace cement of a type suitable for structures where large masses of concrete have to be placed. The rate of the development of strength is similar to that of low-heat Portland cement but slower than that of Portland-blastfurnace cement. The new Standard takes in all the tests applicable to Portland-blastfurnace cement and in addition includes a heat-of-hydration test, which includes a water-content determination developed for slag cements, instead of a loss-on-ignition determination. The calorimetric procedure is simpler than that described in B.S. 1370, "Low-heat Portland Cement".

The composition and principal properties of this cement are as follows.

Low-heat Portland-blastfurnace cement consists of granulated blastfurnace slag and Portland cement clinker mixed together in the proportions prefered by the manufacturer provided that the proportion of slag is not less than 50 per cent and not more than 90 per cent by weight of the total quantity. The specific surface is to be not less than 2,750 sq. cm. per g.

The chemical composition is to comply with the following requirements. The weight of insoluble residue is not to exceed 1·5 per cent. The weight of magnesia is not to exceed 9·0 per cent. The weight of sulphuric anhydride is not to exceed 3·0 per cent. The weight of sulphur present as sulphide is not to exceed 2·0 per cent.

The average compressive strength of three mortar cubes is to be not less than 1,100 lb. per sq. in. at three days, not less than 2,000 lb. per sq. in. at seven days and not less than 4,000 lb. per sq. in. at twenty-eight days. Alternatively, the average compressive strength of three concrete cubes is to be not less than 500 lb. per sq. in. at three days, not less than 1,000 lb. per sq. in. at seven days and not less than 2,000 lb. per sq. in. at twenty-eight days.

The initial setting time is to be not less than one hour and the final setting time not more than fifteen hours.

When tested for soundness, the expansion is not to exceed 10 mm.

The heat of hydration is to be not more than 60 cal. per g. at seven days, and not more than 70 cal. per g. at twenty-eight days.

Copies of B.S. 4248 and B.S. 4246 are obtainable from the B.S.I. Sales Office, 110 Pentonville Rd., London, N.1. (Price 15s. each).

Steam Locomotives at Cement Works

In the September number of this journal, reference was made to steam locomotives in operation at certain cement works in the U.K. One of these engines, an 0-6-0 saddle-tank built in 1926 by Manning Wardle and lately at the New Bitton works of the Rugby Portland Cement Co., Ltd., has been purchased by the Warwickshire Industrial Locomotive Preservation Group for service on the Severn Valley Railway.

Re-lining Lime Kilns

TWO METHODS recently adopted for the re-lining of lime kilns are described in the following.

Refractory Brick Linings

ONE OF the two mixed-feed fired vertical shaft lime kilns at the Seamer limeworks of Messrs. Slaters Ltd., near Scarborough, which had been installed by Priest Furnaces Ltd., was converted to oil-firing in September 1967, and was lined throughout with specially-designed materials supplied by General Refractories Ltd. The interior of the completed kiln is illustrated in *Fig. 1.* The various G. R. refractories included "Adamantine," "Glenboig Al," "Amberlite 43" and "Durax Castable C 1600". Of particular interest is the use of "G. R. Saxpyre CN" in the calcining zone and constriction arch (*Fig. 2*), a zone of extreme heat and abrasion, for which refractories specifically designed for such arduous duty were essential. *Figs. 2* and *3* are given on pages 102 and 103.

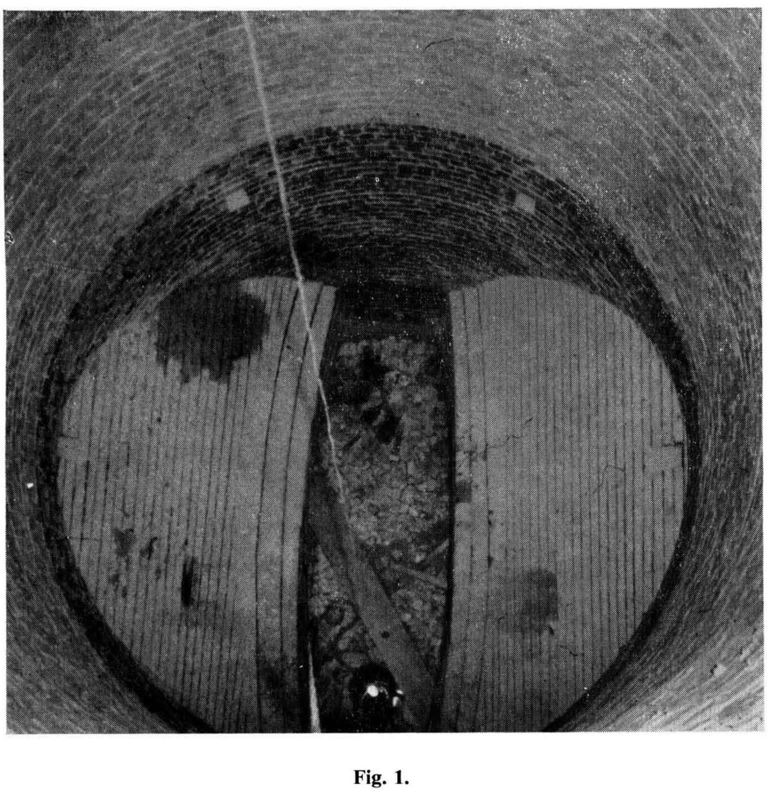


Fig. 1.

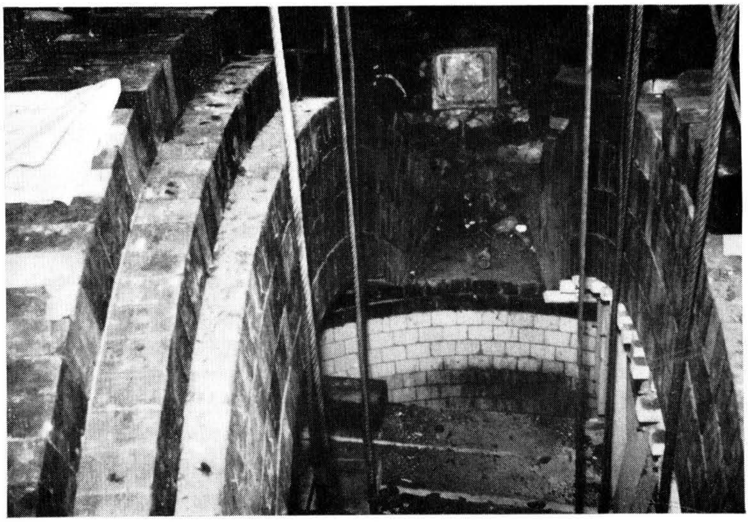


Fig. 2.

Reports from the proprietors of the kiln indicate that the conversion has been successful. The Priest water-oil emulsion firing system is working well and, as a result, an extremely good lime is being produced with low fuel consumption. There is also practically no emission of smoke from the kiln during operation.

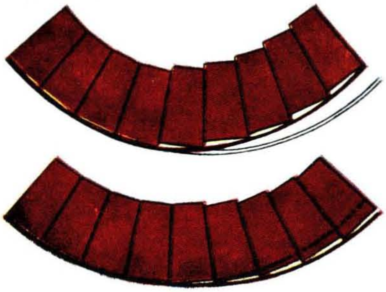
Because of the success of the first kiln, conversion of the second kiln is currently proceeding by Priest Furnaces Ltd., using materials supplied by General Refractories Ltd. The two kilns are illustrated in *Fig. 3* on page 103.

Lining applied by Gun

What is believed to be the first successful gunned repair in this country to the refractory lining of a lime kiln has been carried out at the works of Messrs. W. Singleton Birch & Sons Ltd., at Barnetby, near Brigg, Lincolnshire. The old firebrick lining gave out at a critically busy time and conventional re-bricking was expected to take about a fortnight. Pneumatic-gun application of refractory concrete was carried out. By working double shifts, the work was completed in four days.

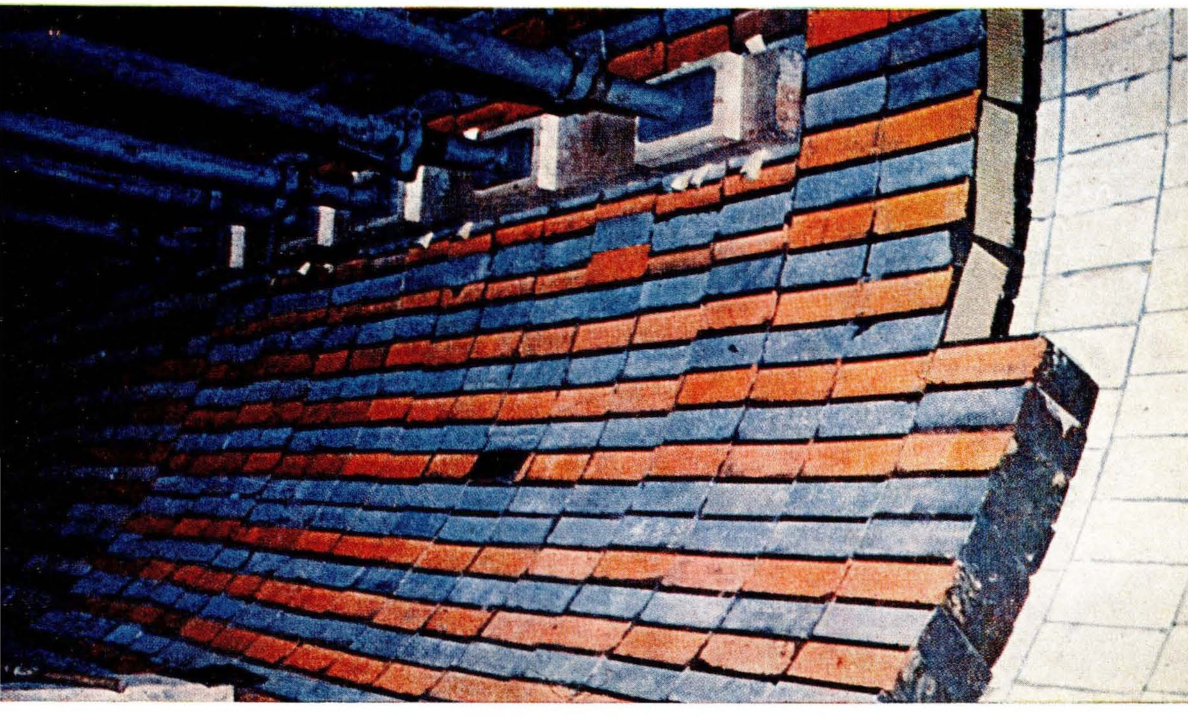
The repaired section of the kiln was about 30 ft. high and 10 ft. in diameter. For the 15-ft. preheating and calcining zone, "Durax 1700G", "Durax B.F. Gun Mix" and "Stein B.F. Gun Mix" were used on account of the high strength and abrasive

Continued on page 103



If this is your problem

Stein Two-Taper System is the solution



In two-taper construction, two sizes of bricks are used, one with "fast" and one with "slow" taper, easily identified by different colours and supplied in the correct ratio to suit a given kiln diameter.

Two-taper construction has the advantages—

- **Linings do not have to be tailor-made giving quicker delivery from the manufacturer.**
- **Brick stocks are simplified and reduced—just vary the ratio of tapers for the different sizes of kilns in the plant.**
- **If kiln shell irregularities are encountered through re-lining, the ratio can be altered as required using proportionately more "fast" or "slow" tapers to maintain a tight build to the shell and at the same time, ensuring that all joints are radial.**

As major suppliers to Rotary Cement Kilns in the United Kingdom and Exporters to Cement Plants throughout the World, we would be pleased to advise on and quote for your requirements from our comprehensive range of Rotary Cement Kiln Refractories.

For further details please consult our Technical Service Department.

STEIN
Refractories

ANTICIPATE THE NEEDS OF INDUSTRY

JOHN G. STEIN & CO. LTD., BONNYBRIDGE, SCOTLAND. TEL: BANKNOCK 255 (4 LINES) 361 & 362

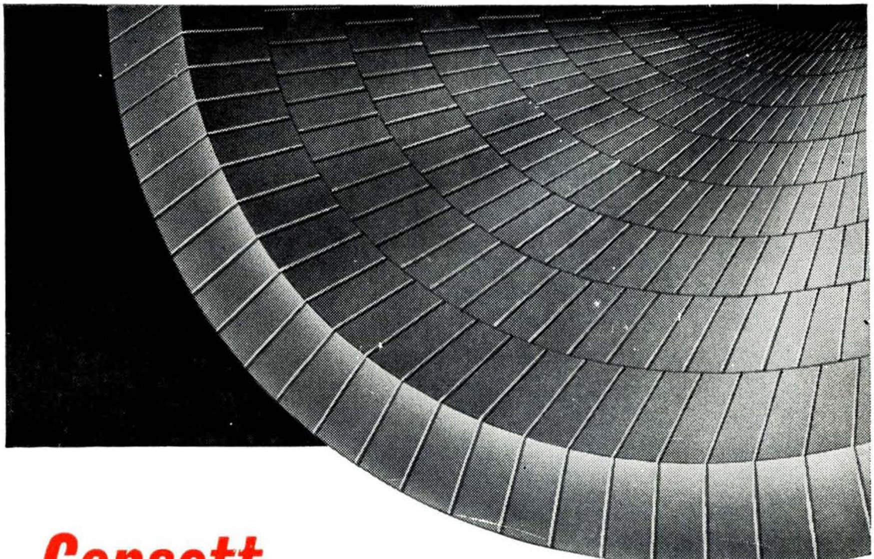


Fig. 3.

Shaft Kilns at Seamer Limeworks

Continued from page 102

resistance of these materials. For the burning zone, "Durax 1600G" was selected because of its low iron and lime contents, high fusion point and mechanical strength. Before undertaking the re-lining, the existing lining was thoroughly cleaned by grit blasting and chipping, to provide a sound surface. In view of the abrasive nature of the charge, special care was taken to properly cure and develop the maximum strength of the lining, particularly in the preheating and calcining zone, by spraying water on the refractory surface regularly.

The contractors were Genefax Monolithics Ltd.

The Cement Industry in the U.K.

THE FOLLOWING notes relate to various aspects of the cement industry in the United Kingdom.

A Review of the Industry

A comprehensive and useful review of the cement industry in the United Kingdom has been prepared for private circulation by Hoare & Co., a London firm of stockbrokers. Some of the data given in this review of well over one hundred pages are reproduced in the following by permission of Hoare & Co.

The average rate of growth of cement production in the U.K. was 4·8 per cent. per annum in the period 1958 to 1967, and this compares favourably with the growth rate of the economy which was 3·1 per cent.

The following data show the proportional uses to which the cement production was put in 1966, together with the average annual growth-rates of each category in the period 1961 to 1966.

CATEGORY	PERCENTAGE OF TOTAL SALES IN 1966	AVERAGE GROWTH RATE PER ANNUM 1961–1966
Housing	21·7	6·6
Industrial building	9·4	—0·2
Roads and bridges	7·3	4·3
Railways and harbours	2·4	15·5
Defence works and airports	0·8	—6·9
Fuel and power	4·5	4·1
Water and sewer undertakings	2·4	—0·6
Miscellaneous building	16·5	5·3
Concrete products	20·6	5·4
Asbestos-cement	2·4	—2·0
Merchants (final use not known)	12·0	2·4

The increasing importance of consumption in the public sector is demonstrated by the average rate of growth for housing, roads and bridges, railways and harbours, and fuel and power. Similarly, the rate of growth for concrete products shows the increasing use of such products in the building industry. At present, 30 per cent. of the total cement production goes to the producers of ready-mixed concrete.

The review gives the annual output and relevent data for the year 1966 of the principal cement manufacturing companies in the U.K. The comment is made that the three main manufacturers have extensive interests abroad and the growth of overseas production has compensated for the declining export trade which fell from 1,500,000 tons in 1956 to 103,000 tons in 1967.

It is estimated that cement production in the U.K. may reach 17,800,000 tons in 1968, that is, over 2½ per cent. above the production in 1967. Productive capacity in the U.K. is likely to increase by 1,000,000 tons to 20,000,000 tons by the end of 1968, and an even higher rate of growth is expected abroad.

The long-term prospects for the cement industry in the U.K., the review states, are more favourable than the short-term outlook. In the period 1969 to 1972, cement production may expand at an annual rate of nearly 5 per cent. per annum. The productive capacity is at present being increased, including a new works for The Associated Portland Cement Manufacturers Ltd., at Northfleet, in Kent, in order to meet an estimated home demand of 21,300,000 tons in 1972, which will be 23·5 per cent. above the 1967 level. Expansion of this magnitude is likely to be due to two factors: cement consumption per capita in the U.K. at present is low, and the demand for concrete will be stimulated both by the expected growth of the construction industry and by the substitution of concrete for other building materials.

New Equipment at Rugby Works

OUTLET VALVES FOR SILOS (*See page 106*).

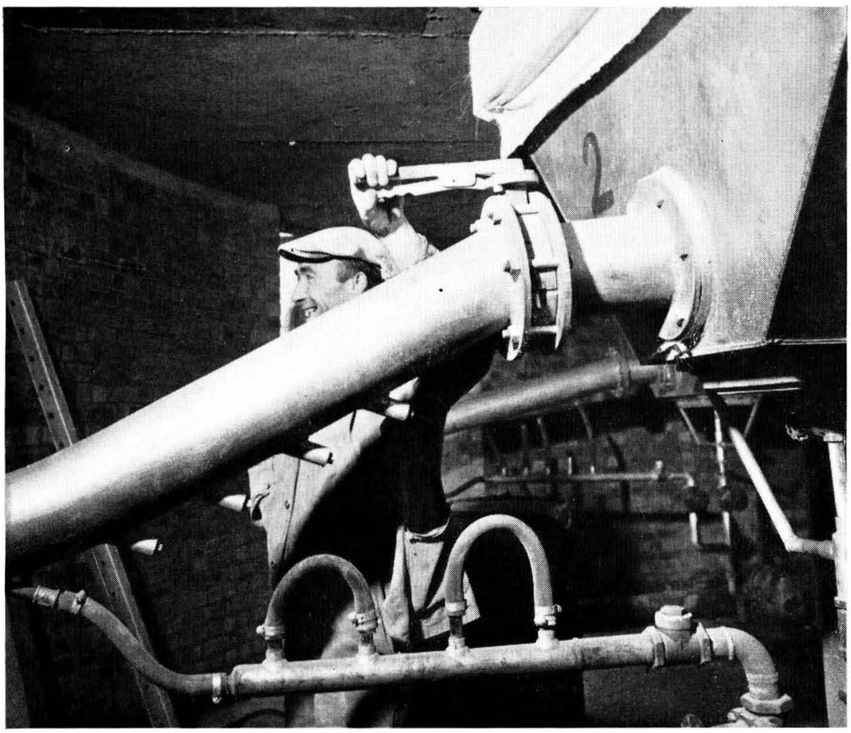


Fig. 1.

THE RUGBY Portland Cement Co., Ltd., recently commissioned two cement silos 70 ft. high at the Rugby works. Each silo, capable of holding 2,500 tons of cement, has five outlets, three for bulk loading into lorries and two for loading into railway wagons. To control the flow of cement, the company has fitted a 6-in. "Keystone" butterfly valve to each outlet as shown in *Fig*. 1 on page 105. These manually-operated valves are designed to allow the maximum open area during flow and have a resilient rubber-seated wafer-type disc allowing a flow of 91 per cent. With a rating of 150 lb. per sq. in., the valves installed weigh 19 lb. each and are each 13 in. high. The length of the lever-lock handle is 11 in. and a turn of only 90 deg. is necessary to open the valve fully.

"Keystone" 10 in. and 8 in. butterfly valves are also used in the 57-mile pipeline, through which chalk slurry is pumped from the quarry at Kensworth, near Dunstable, to the two processing plants in Warwickshire. The pipeline, which is the only one of its kind in Europe, is buried in the ground to a depth of from 3 ft. to 6 ft.

The valves were supplied by I. V. Pressure Controllers Ltd.

INSTRUMENTS

The supply, erection and commissioning of analogue control equipment at Rugby Works was completed recently by Kent Instrument Ltd. The equipment will control the manufacturing processes on the new kiln, a coal mill and two cement grinding mills in the present extension which will give an additional annual output of 350,000 tons of clinker.

The equipment includes "Commander" electrical transmitters, "Transdata" electronic controllers and actuators from Kent Instruments Ltd., amplifiers, miniature indicators and recorders from Record Electrical Co., Ltd., while Kent Instruments (Stroud) Ltd., supplied magnetic-flow metering equipment. Messrs. Evershed & Vignoles Ltd., provided differential-pressure transmitters and "no-flote" relays. A special in-line water-meter with remote electrical transmission was supplied by Leeds Meter Co. Ltd., and Eltromet Ltd. supplied the comprehensive control desks and combined mimic diagrams which facilitated centralised control and supervision of all plant variables. A separate panel was provided to allow local supervision of the cement mills.

Tunnel Cement Ltd.

The name of the Tunnel Portland Cement Co., Ltd., has been changed to Tunnel Cement Ltd., subject to Board of Trade approval.

The designation of 'Portland' has sometimes in the past led to confusion with other cement makers, who also incorporate the word in their names. The change reflects the streamlining of the Company's organisation which has taken place in the past two years. A new look based on the 'BIG T' has already been implemented in all visual applications of the Company's name.

Some details relating to the new work proceeding at the Pitstone works of this Company are given on page 107.


Matosinhos Cement Factory
(Brazil)
all over the world ...
the cement industry
relies on
FIVES LILLE-CAIL
7 RUE MONTALIVET PARIS 8e - ANJ. 22.01, 32.40

Progress at Pitstone Works

Fig. 2.

The illustration in *Fig.* 2 shows the progress being made in the construction of the cement plant being installed at the Pitstone works of the Tunnel Cement Co., Ltd.

At the bottom (left), the roof of the clinker store is shown and above this can be seen the initial stages of the burner platform. Fourteen sections of the kiln have now been erected. The kiln leads into the cyclone tower and a building to house dust-precipitation equipment. In the centre of the illustration is the raw-mill building and the raw-meal building and silos. At the top (right) is the raw-materials store and the conveyor crossing the railway line to the new chalk quarry.

Work on the site began in September 1967 and the civil engineering work is well up to schedule, being now at the half-way stage. The kiln is expected to be fully operational in the early summer of 1969. This major extension to the Pitstone Works involves the installation of a new kiln 145 m. long and ancillary plant having an annual productive capacity of more than 400,000 tons. With the new plant, the Pitstone works will have a total productive capacity of 1,000,000 tons a year.

The principal plant and the dimensions thereof will be as follows:

Kiln.—145 m. long; 5·25 m. in diameter; nineteen sections (20·66 tons each). Total weight: over 600 tons. Four supporting steel tyres (65 tons each).

Chimney.—109 m. high.

Clinker store.—Span: 58 m. To contain 40,000 tons of clinker and 8,000 tons of gypsum. Height to eaves: 5 m. Height to ridge: 26 m. Roof pitch of 30 deg., conforming with angle of repose of clinker.

Raw materials store.—To contain 370,000 tons of chalk (of two qualities). 140 m. long; 30 m. wide; 24 m. high.

Raw-mill silos.—Two silos. Capacity: 3,500 tons. 21 m. high; 9 m. in diameter.

Raw-meal silo.—Capacity: 14,000 tons. 28 m. high; 16 m. in diameter.

Blending silos.—Group of four. Capacity: 12,000 tons (total). 8 m. in diameter; 23 m. high.

Metric measurements are being used for all dimensions in the building and civil engineering work.

The Consulting civil engineers are Sir Frederick Snow & Partners. The consulting architects are Messrs. Edward D. Mills & Partners and the landscape architect is Mrs. S. M. Haywood. The suppliers of cement making machinery are Messrs. F. L. Smidth & Co., Ltd. The contractors for the clinker and gypsum sto e and for certain site works was Cementation Ltd., and the contractors for the raw materials store, the silos and chimney, and certain ancillary works, are Messrs. J. L. Kier & Co. Ltd. The kiln is being erected by Messrs. Thomas W. Ward Ltd.

Lafarge Aluminous Cement Co., Ltd.

In company with the parent company, the Lafarge Organisation Ltd., the Lafarge Aluminous Cement Co., Ltd., has now moved its London office to 207 Sloane Street, London, S.W.1. (Telephone: 01-235 4300.)

Cement-Sulphuric Acid Process

WITH REFERENCE to the article dealing with the production of cement and sulphuric acid which was published in the September 1968 number of this journal, we have been informed by The Power Gas Corporation Ltd., that the Corporation has an exclusive world-wide licence for the Marchon process.

In accordance with an announcement made in February last, the Power-Gas Corporation Ltd., a member of the Davy-Ashmore Group, and Marchon Products Ltd., agreed on a preliminary basis of collaboration with the intention to exploit the Marchon cement-sulphuric acid process throughout the world. The Power-Gas Corporation have the exclusive right to design and construct such plants for manufacturing companies and collaborate with Marchon Products Ltd., on the further development of the process.

CEMENT AND LIME MANUFACTURE

Published by Concrete Publications, Ltd., 60 Buckingham Gate, London, S.W.1

INDEX TO VOL. XLI, 1968

PAGE

Asbestos-cement merger 90

AUTHORS

van Aardt, J. H. P., et al, on Reaction products at early ages of C_3A and C_3AH_6 with calcium sulphate .. 19

Barrell, K. C., on Bed-blending of raw materials for the dry process 37

Barrell, K. C., on Manufacturing processes of Portland cement 91

Danielsson, U., on Studies of effects of some simple organic admixtures on the properties of cement paste 83

Heindl, R. A., et al, on Refractory concrete 79

Mandelik, B. G., et al, on Cement and sulphuric acid from gypsum 54

Pierson, C. U., et al, on Cement and sulphuric acid from gypsum 54

Post, Z. A., et al, on Refractory concrete 79

Ruegg, Dr. R., on Separating effect and efficiency of cement classifiers 1, 30

Visser, S., et al, on Reaction products at early ages of C_3A and of C_3AH_6 with calcium sulphate 19

Bed-blending of raw materials for the dry process .. 37

Calcium sulphate: see also "Gypsum."

" " Reaction products at early ages of C_3A and of C_3AH_6 with 19

Calcimatic lime kilns 90

CEMENT INDUSTRY ABROAD

Australia .. 87, 88
Canada .. 77, 88
East Germany .. 18
Eire .. 36
France .. 37
Holland .. 18
Iraq .. 86
Japan .. 47, 67
Kenya .. 30, 88
Malaysia .. 88
Mexico .. 88
New Zealand .. 88
Nigeria .. 23, 88
Qatar .. 17
South Africa .. 88
Spain .. 37, 88
Sweden .. 18, 86
Switzerland .. 1
Tanzania .. 88
Turkey .. 86
U.S.A. .. 17
U.S.S.R. .. 36
Uganda .. 87
West Germany .. 86
Yugoslavia .. 36
Cement industry in the U.K. .. 33, 66, 72, 89, 104

CEMENT WORKS

Belfast .. 72
Calabar .. 27
Clarksville, U.S.A. .. 17
Cookstown .. 13, 35, xix (May)
Ipswich .. 33
Limhann .. 18
Maastricht .. 18
Pitstone .. 13, 35, 72, 89, 107
Qatar .. 17
Ruedersdorf .. 18
Rugby .. 33, 72, 89, 105
St. Constant, Canada .. 77
Southerham .. 33
South Ferriby .. 72
Ukpilla .. 23
Whitehaven .. 34, 35

Chemistry of Cement, International symposium on the 51

Classifiers, Separating effect and efficiency of cement .. 1, 30

Clinker, Transport of .. 35

Conferences etc. on: Chemistry of cement .. 51

" " " Durability of concrete .. 62

" " " Gypsum .. 61

" " " Silicates .. 80

Conveying cement, New equipment for pneumatically .. 73

Dry process, Bed-blending of raw materials for the .. 37

Durability of concrete, Symposium on the .. 62, 81

Earle trophy, Sir George .. 71

Early-strength cement, New .. 95

PAGE

Gypsum: see also "Calcium sulphate"
,, Congress on 61
,, Production in the U.K. 61
,, ,, of cement and sulphuric acid from 53, 75

High alumina cement 72
,, ,, ,, concretes, Effects of temperature on 49

Insulating coating for kilns 67

Kiln in U.S.A., World's largest cement 17
Kilns, Calcimatic lime 90
,, Insulating coating for 67
,, Re-lining lime 101

Lime-dust scrubber, Improved 85
Lime kilns, Calcimatic 90
,, ,, Re-lining 101
,, shaft-kiln, Refractory gunite lining of .. 31, 102
Locomotives in cement works, Steam 84, 100

Mills of 3,000 h.p., Cement .. .. 18, xix (May)
Mural, A concrete 78

Preheaters in Japan 47
Process industries, Investment by the 90
Processes of Portland cement, Manufacturing 91

PUBLICATIONS (including Papers)

PAGE

Admixtures on cement paste, Effects of organic. By U. Danielsson 83
Cement and sulphuric acid from gypsum. By B. G. Mandelik and C. U. Pierson 54
Cement Standards of the world 96
Chemistry of cement, International symposium on .. 51
Durability of concrete, Symposium on 62, 81

Raw materials for dry process, Bed-blending of 37
Reaction products at early ages of C_3A and C_3AH_6 with calcium sulphate 19
Refractory concrete, Basic investigation of 79
,, gunite lining of lime shaft-kiln .. 31, 102

Safety 71, 72
Scrubber, Improved lime-dust 85
Shaft-kiln, Refractory gunite lining of lime .. 31, 102
Silicates, Conference on 80
Silo for white cement 33
Silos at Ipswich 33
Standards for cement, British 96–100
,, ,, ,, National 96
,, ,, supersulphated cement 96
,, ,, low-heat Portland-blastfurnace cement .. 100
Sulphuric acid and cement plant at Whitehaven .. 34
,, ,, -cement process 108
,, ,, from gypsum, Production of cement and 53, 75

Temperature on high-alumina cement concretes, Effects of 49

Wagons, New cement railway 66

BOUND VOLUMES OF "CEMENT AND LIME MANUFACTURE"

BINDING cases for annual volumes of "Cement and Lime Manufacture" can be supplied in cloth-covered boards lettered in gold on the spine with the title, volume number, and year of publication. Copies for binding should be sent post paid to Concrete Publications Ltd., 60 Buckingham Gate, London, S.W.1.

When possible, missing numbers will be supplied at the published price to make up incomplete sets, but as many of the numbers published during the past few years are not available it is advisable to ask the Publishers whether they have the numbers required before sending incomplete sets.

The cost of cloth-covered lettered cases is 15s. for each volume. The cost of supplying a case and binding a volume is 25s. including packing and carriage.

PUBLISHER'S ANNOUNCEMENT

Owing to the increased costs of production and postage, the subscription rates for "Cement and Lime Manufacture" will be increased from January 1969 to the following:

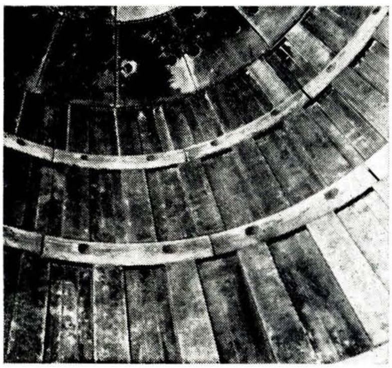
Annual subscription: **12s. inland and overseas.**
$1.88 in Canada and U.S.A.

Single copies: **2s. inland and overseas.**
$0.35 in Canada and U.S.A.

The foregoing rates include postage.

YOU TOO CAN GRIND CHEAPER WITH BOFORS...

Each Bofors bar lining made of high quality Swedish Steel gives the greatest reliability in operation



Only about 30% of the holding screws normally needed.

Rapid and easy to assemble.

935 637 tons of cement with one Bofors bar lining.

One example from many

In the first grinding compartment of a 2.8 m diameter separator mill.

Cost of lining in compartment I.

Type of lining	12—14% Mn-Steel	Bofors bar lining
Time running in hrs	13 854	30 417
Throughput in tons	391 220	935 637
Specific net wear	11.6 g/t	3.07 g/t
Breakdowns	Broken screws	None
Costs per 100 tons of cement	8/9d	5/11d

The costs of repair after breakage of screws and loss of production are not taken into consideration in this calculation. For the most part Bofors bar lining still remained fit for further use.

About 500 mills throughout the world operate under optimum conditions with a Bofors bar lining.

Large mills of even more than 4-metre diameter are no problem for us. A Bofors bar lining is entirely safe when using hard grinding elements.

When using Bofors bar lining you can completely forget the idea of broken screws. First of all there are very few screws in a Bofors bar lining and secondly such screws as are required are secure against breakage.

You will save on storage costs by using the standardised Bofors bar lining. Most parts are suitable for different varieties of mill.

Agency:
Bofors (Gt. Britain) Co. Ltd.
81, Gracechurch Street
LONDON, E.C.3.
Telephone: MAN 5631

BOFORS STEEL

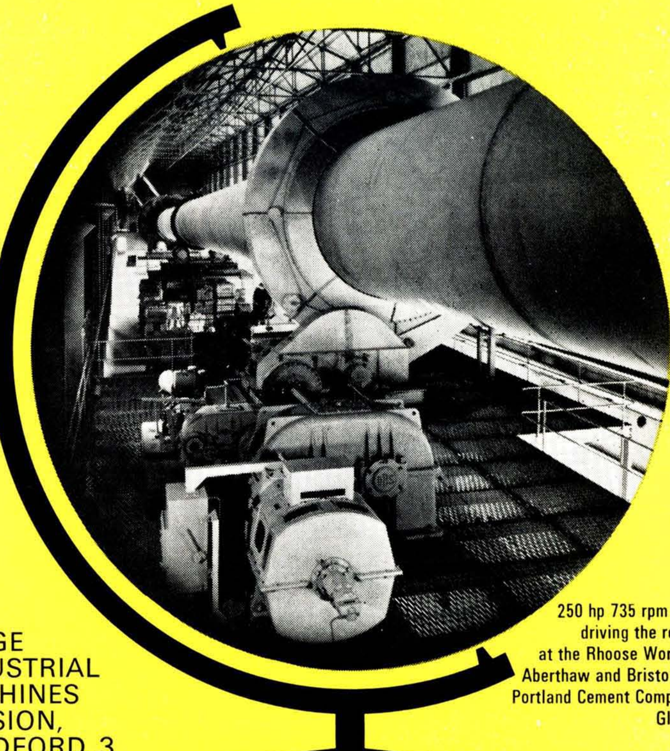
AB Bofors
S-690 20 Bofors
Sweden

universal

Drives for the largest pumps, compressors, fans, mills, mixers and crushers for any application in any industry.

international

Complete factory electrification including the generation of power anywhere in the world.



250 hp 735 rpm dc motor driving the rotary kiln at the Rhoose Works of the Aberthaw and Bristol Channel Portland Cement Company Ltd., Glamorgan.

LARGE INDUSTRIAL MACHINES DIVISION,
BRADFORD, 3
Tel: 65221

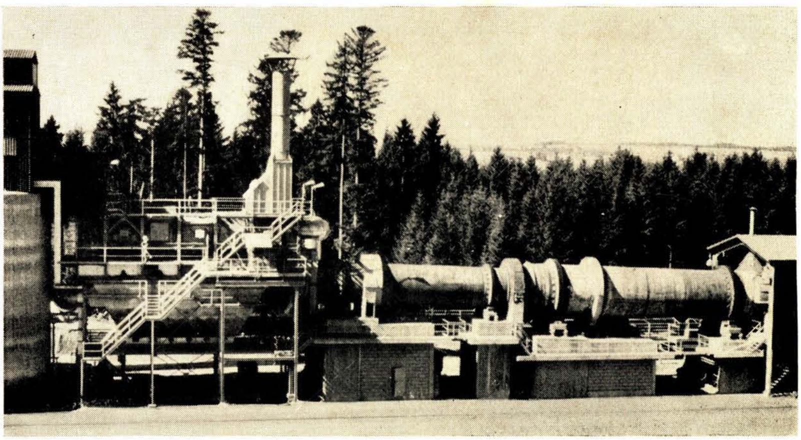
Never too big – or too small – for ENGLISH ELECTRIC

EM. 56

Published by CONCRETE PUBLICATIONS LTD., 60 Buckingham Gate, London, S.W.1, England.
Printed in Great Britain by FLEETWAY PRINTERS, 17 Sumner Street, London, S.E.1.

Production of Expanded Clay

with Rotary Kiln and Grate Preheater for throughputs of approx. 50 to 1.000 t/day



Plant: Süddeutsche Blähtonwerke GmbH & Co. KG TUNINGEN, Throughput per day: 270 t

Heat Consumption:

below **750 kcal/kg** of expanded clay at a medium bulk density of **350 g/litre**

MIAG

BRAUNSCHWEIG
GERMANY

Agency for Great Britain:
INDUSTRIAL EQUIPMENT CO. (N.I.) Ltd. 58, Howard St. Belfast