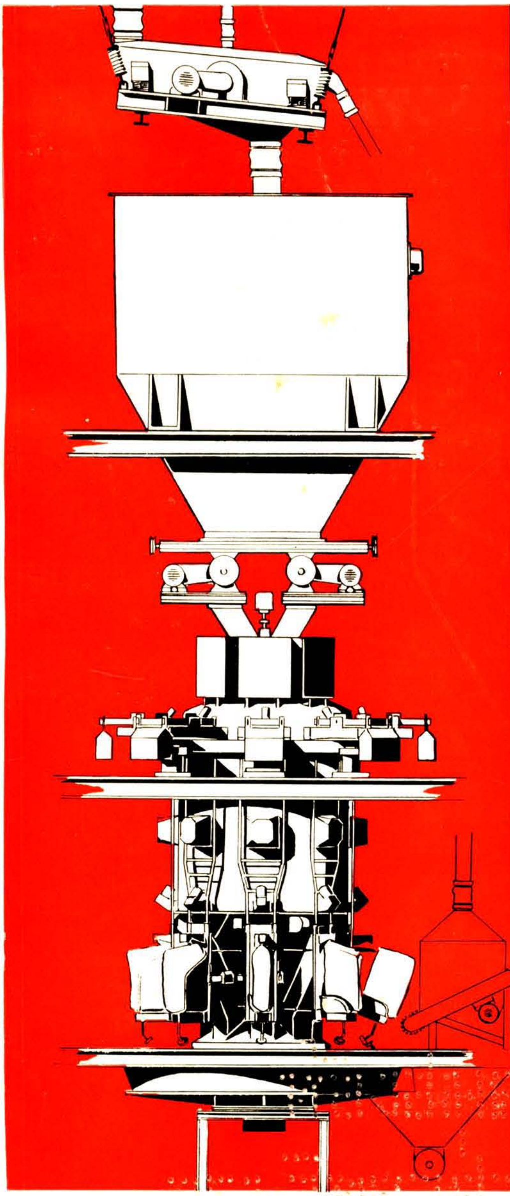
CEMENT
& LIME MANUFACTURE

VOL. XLII. No. 2 MARCH, 1969

Price 2s. per Copy.
Annual subscriptions: Inland 12s. post free.
Overseas 12s. including postage.
Canada and U.S.A. 1.88 dollars incl. post



ESCHER WYSS

The new Air Separator

Type EL

Fineness of finished product can be regulated during operation with of guide vanes immediately below selector

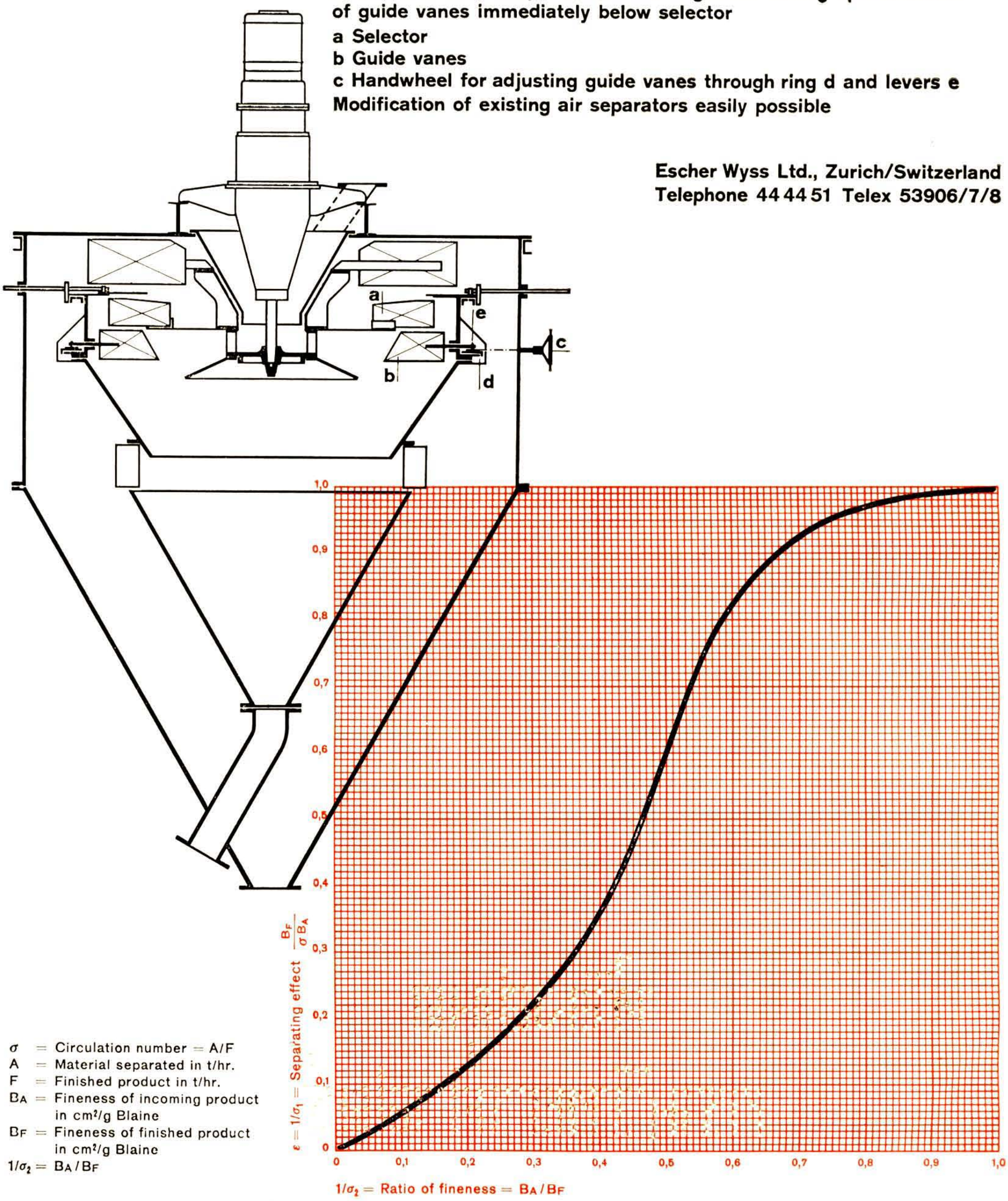
a Selector

b Guide vanes

c Handwheel for adjusting guide vanes through ring d and levers e

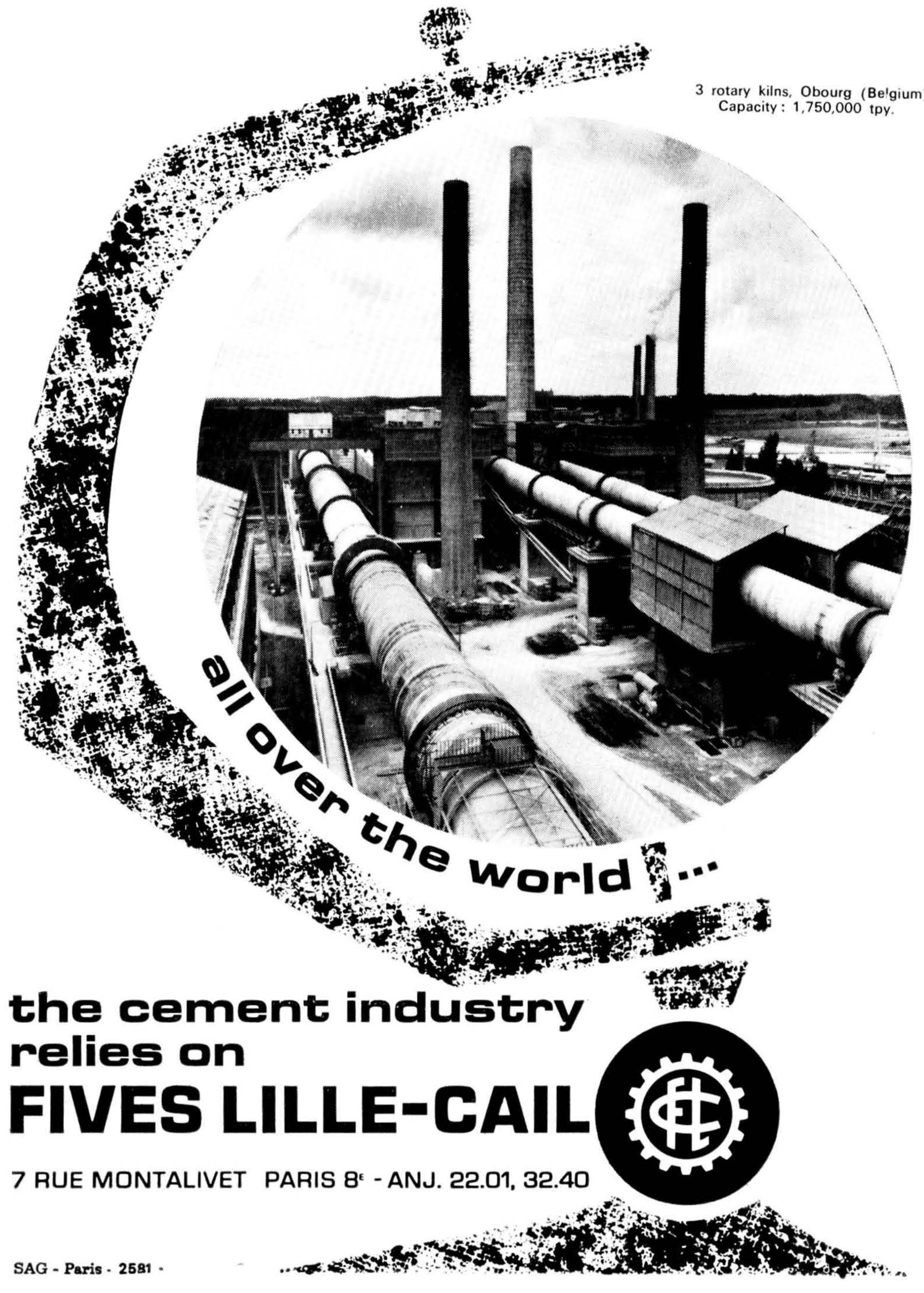
Modification of existing air separators easily possible

Escher Wyss Ltd., Zurich/Switzerland
Telephone 44 44 51 Telex 53906/7/8



σ = Circulation number = A/F
A = Material separated in t/hr.
F = Finished product in t/hr.
B_A = Fineness of incoming product in cm²/g Blaine
B_F = Fineness of finished product in cm²/g Blaine
$1/\sigma_2$ = B_A / B_F

A


3 rotary kilns, Obourg (Belgium)
Capacity: 1,750,000 tpy.
all over the world ...
the cement industry
relies on
FIVES LILLE-CAIL
7 RUE MONTALIVET PARIS 8e - ANJ. 22.01, 32.40
SAG - Paris - 2581 -

CEMENT AND LIME MANUFACTURE

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

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

Annual subscription (including postage):
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.

VOLUME XLII NUMBER 2 MARCH, 1969

Computer Control at an Italian Cement Works

Cementir (Cementerie del Tirreno S.p.A.), which is part of the Finsider Group, has its headquarters in Rome and, with eight cement works and a correspondingly large sales organisation, the concern occupies a prominent position in the Italian and international cement industry. The cement works at Taranto, where the major increases in production and sales have been attained, is an outstanding example of technological progress in the cement industry. An IBM-1800 computer has been installed with the aim of introducing automatic supervision and control of all stages of production.

The Taranto cement works was established at the same time as the adjoining Italsider Iron & Steel Works, the granulated slag by-products from which are used at the cement works. The latter has an annual productive capacity of 1,200,000 tons. All stages of manufacture from the winning of the clay to the storage of the cement are planned to be controlled from a central station situated in the main building between the kilns and the cement mills. In the control room are housed the regulation and measuring instruments and the process-control computer, which at present is the only computer operating in a cement works in Italy.

The computer was installed in order to control the various stages of the process so that the best possible compromise may be achieved between the contrasting needs of attaining safe speeds of the machinery and of obtaining a product of the best quality coupled with a high degree of productivity and the reduction of maintenance to a minimum. The computer can be linked directly to the measuring and control instruments, and attains the required aims by virtue of its high logical and processing capacities. A Cementir-IBM team of technicians began the automation project in January 1967, the computer being physically linked to the manufacturing process in August 1967.

The initial task of the computer was to gather on-line data from the raw mills and grinding plant, and to supervise these operations. The task comprises periodical reading of the measuring instruments with a fixed frequency of three minutes; the elimination of disturbance signals by means of numerical filtering techniques; on-line calculation of variables not directly measurable; on-line calculation of particularly significant operational values such as specific consumption rates, yields, etc.; signals indicating poor operation of the measuring instruments; alarms indicating that operational limits have been exceeded; gathering time sequences of data available for later studies; the calculation of operative standards; and print-outs of data logging for the technical management.

In this preliminary stage, the computer is set up as a data collecting and guiding instrument superior to the ordinary recorders and signal devices. The flexible logic of the computer enables it to select data and notify the operator only of abnormal conditions. Its speed of computation allows it to process sizes not otherwise directly measurable and its memory enables it to retain data and make them available on request for subsequent processing operations which it can itself effect.

In the first phase, however, the computer was not linked up in such a way as to allow it to act directly on the system with regulation procedures. That is, the computer is linked in " open cycle." The closure of the control cycle is worked by the operator who, on the basis of the data supplied to him by the computer, decides what corrections to make and then makes them. The supervision phase was nevertheless invaluable and was indispensable to the advancement of the project. It made it possible to focus on those instruments which were giving most trouble and needed correction or replacement, to train staff in running the plant on the basis of theoretically fundamental yield indices but which were not yet available in reasonable time, and to make thorough studies of the dynamics of the plant using the data collected and memorised by the computer during long periods of operation.

The most difficult part of the automation of a cement works is regulating the kiln. Only through charging the kiln with a raw material of virtually constant composition is it possible to keep the operational variables within close limits, thereby facilitating the ultimate attainment of the " closed cycle " control of the kiln. The automation of the preparation of the raw meal therefore represents the logical prerequisite for the accomplishment of kiln control in closed cycle. Besides the technological control involved, this implies effective chemical control, so as to ensure maximum consistency of the composition. The blending of the raw materials and the control of kilns were, therefore, the first regulation objectives.

Regulation of Blending

For the control of the blending operation, two apparatus for analysing were envisaged, the first acting intermittently and being currently in operation, while the second, which is to be installed shortly, would work continuously. Both apparatus are based on the fluorescence principle and, by means of impulse counting, make it possible to determine the composition of a material irradiated with X-rays.

A method of calculation is used to obtain a raw meal having constant chemical

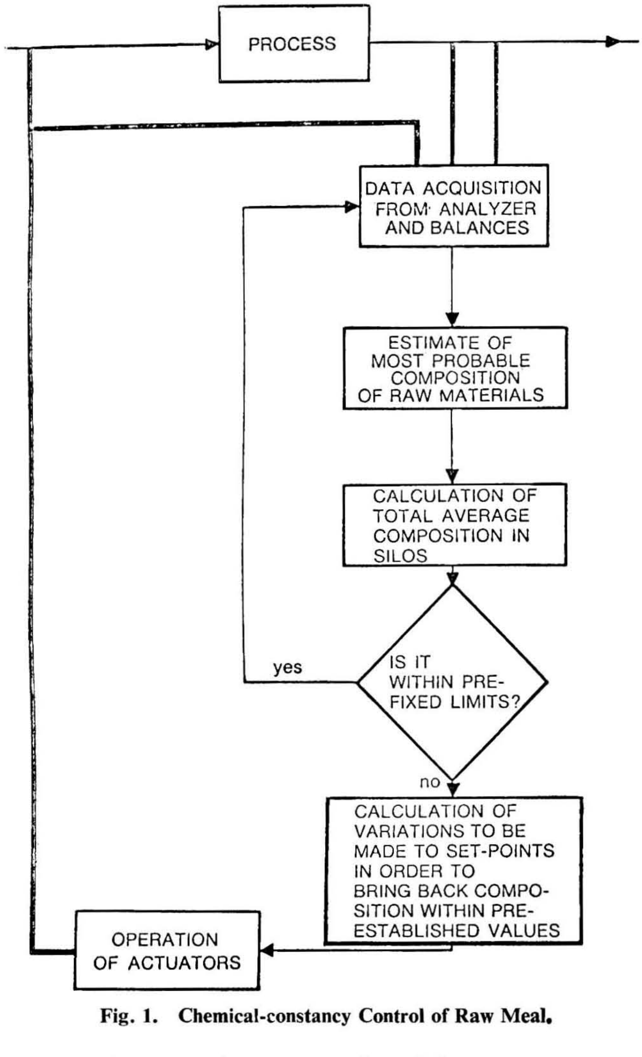


Fig. 1. Chemical-constancy Control of Raw Meal.

characteristics. A diagrammatic representation of the computer process is shown in *Fig.* 1. The composition of the raw meal, which is directed into the assimilation cell as it is discharged from the raw-material mills, is continuously established by the analysing apparatus which sends the data to the computer. The computer simultaneously receives data referring to the instantly produced quantities, and is thereby capable of determining virtually continuously the average composition of the raw-meal produced.

On the basis of this composition, the compositions of the raw materials and the

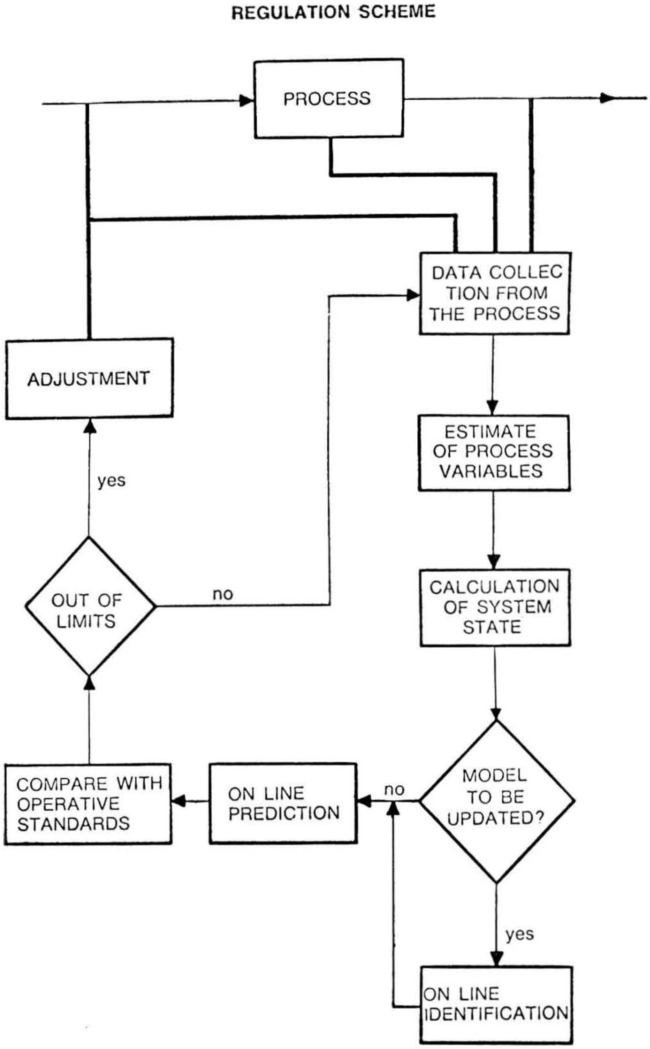


Fig. 2. Regulation Scheme for a Kiln.

desired composition of the raw meal, the computer calculates the requisite corrective action and puts it into effect by acting directly on the feed balances of the various raw materials. The plant operator is confined to taking note of the amount of the corrections made, which are communicated to him by the computer in printing.

In relation to the quantities of raw materials fed in and the analysis of the data on the material after grinding, the computer also establishes at specific intervals the probable composition of the raw materials in order to limit any causes of error arising from an inexact estimate of the composition. With otherwise inconceivable speed, it is possible to keep the composition of the raw-meal virtually constant, thereby making the subsequent homogenisation phase theoretically almost unnecessary.

At present the closed-cycle regulation of the blending of the raw material is completed. The constancy of the composition of the raw meal is controlled within very close limits and the various disturbances are eliminated, especially those caused by variations in the composition of the raw materials. In addition to advantages at the kiln, the need for only slight homogenisation reduces the time and energy expended on this operation.

Regulation of Kiln

The regulation of the operation of the kiln in closed cycle, which is shown diagrammatically in *Fig.* 2, is a more complex problem, but one which is now in an advanced stage of solution. This control is expected to provide more regular operation of the kiln at a rate to suit the desired production, with a consequent saving in fuel and refractory material, as well as a reduction in time spent on maintenance.

A static model of the kiln is deemed not to be satisfactory to establish a regulation policy, and a dynamic " mathematical " model will therefore be used, which will take into account not only the current values of the variables but also of their previous history, because of the amount of data memorised in the computer. The model will represent the quantitative relation of the variables with one another and will make it possible to simulate the running of the kiln on the basis of the present and previous states, thereby affording a forecast of the process in the immediate future. If the forecast indicates that the variables are exceeding specified limits, corrective action can then be calculated and applied sufficiently in advance to allow the effect to be felt early in spite of delay inherent in the physical operation. The model is, moreover, continuously adapted to the current running conditions as soon as the " forecast " proves to be no longer sufficiently precise.

It thus becomes possible to maintain a number of measurements typical of the process; for example, the temperature in the burning zone, within pre-set limits, achieving, subject to good chemical constancy of the raw meal, uniformity of burning which guarantees a standard of quality for the product that could not otherwise be attained.

For the foregoing to be accomplished, the critical variables must be thoroughly known, and it is precisely in this phase that the computer fulfils its purpose by making calculations, correlations and balancings which could not otherwise be tackled in such a complex system. A considerable amount of study and calculation has been and will be effected in order to accomplish what has been done to date and what is still to be done. In these studies, also, the computer is a useful aid. During the time in which it is free from the work of process control, it is capable of performing any other programme introduced into it. Consequently, it is a useful apparatus for the works' engineers, who are thereby enabled to tackle the most varied problems, such as the collection of full knowledge of the process, and studies and evaluation of alterations to the plant. The main objective, however, is still the regulation of the various processes and once this goal has been reached it will be possible to optimise the entire productive cycle, that is to arrive at the most economical compromise between the requirements of maximum production high quality, minimum maintenance cost and operational reliability.

Particulars of Taranto Works

The characteristic data of the principal parts of the Taranto cement works are as follows.

The total area of the works is 313,000 sq. m. of which 13,200 sq. m. are under cover.

The clay pit is equipped with a semi-mobile tracked cup-wheel excavator having a maximum capacity of 300 cu. m. per hour. A series of mobile belt-conveyors feed the material to a plant for pre-assimilation of the clay.

The cement storage bins comprise four silos each of 9,000 cu. m. capacity, and three silos of 1,500 cu. m. each, the total capacity exceeding 50,000 tons of cement.

The bagging plant comprises three rotating twelve-spout bagging machines with

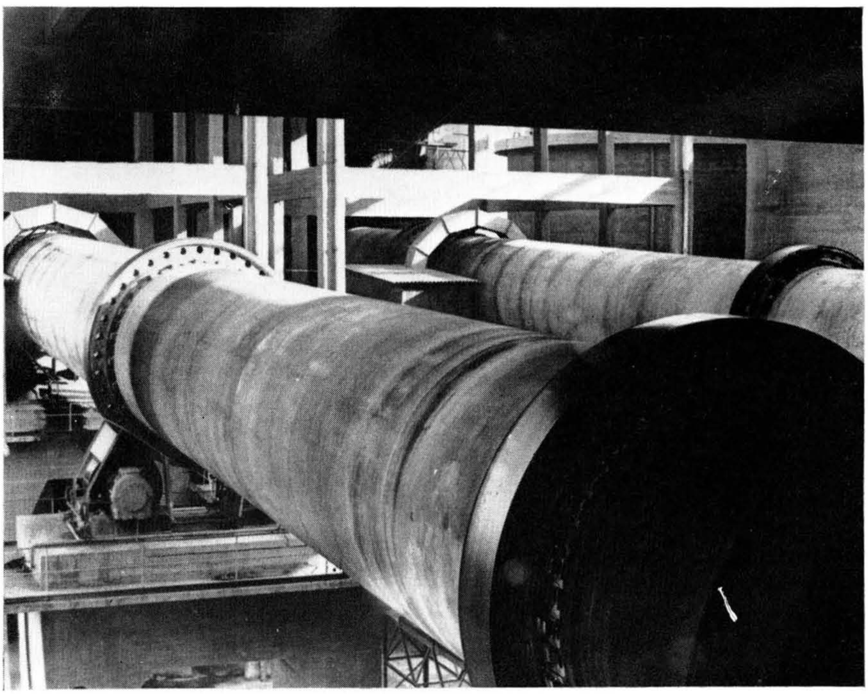


Fig. 3. Kilns at the Taranto Cement Works.

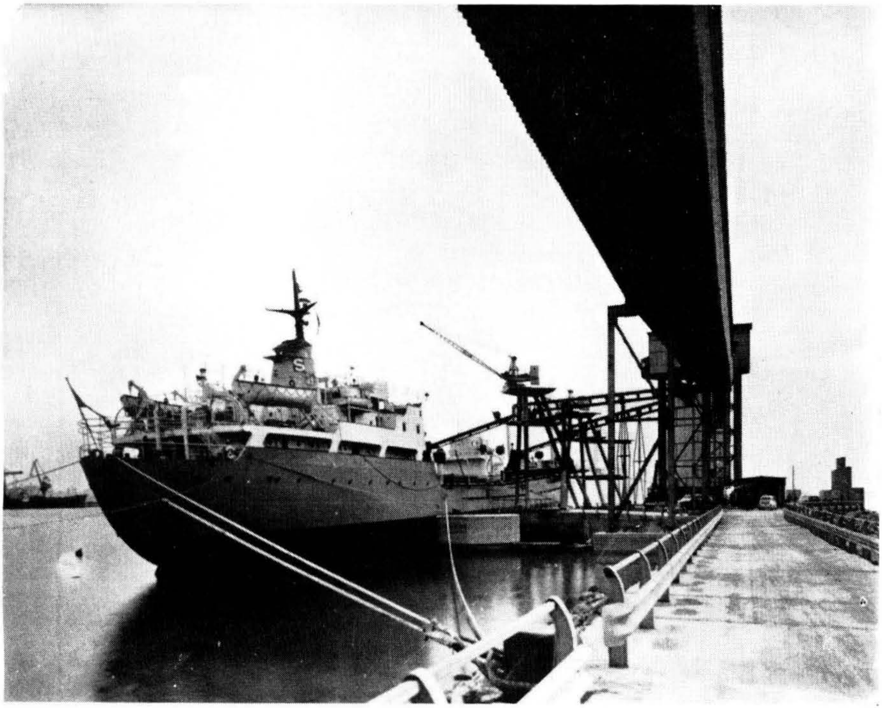


Fig. 4. Equipment for loading ships, Taranto Cement Works.

six load lanes for dispatch of cement in bags, and four loading points with automatic weighing equipment for loose cement. Belt-conveyors having a total length of 850 m. connect the works to a wharf, situated in a new industrial port, for loading loose cement into special ships (*Fig.* 4) owned by Cementir. The loading-wharf is also equipped to enable bags of cement to be loaded into ordinary vessels.

The plant, raw-material deposits, by-products and finished cement stores are equipped with efficient dust-collecting and dust-removal systems by means of which fume and dust emission is reduced to a negligible amount. The system comprises the following: five electrostatic filters on the kilns and Loesche mills, the actual volume of gas being filtered by each amounting to 187,000 cu. m. per hour, the total potential capacity being 935,000 cu. m. per hour; three electrostatic filters on the Hazemag driers, the actual volume of gas being filtered by each being 42,000 cu. m. per hour, the total potential capacity being 126,000 cu. m. per hour; four electrostatic filters on the Polysius mills, the actual volume of gas being filtered by each being 32,000 cu. m. per hour, the total potential capacity being 128,000 cu. m. per hour; and two multi-cyclone purifiers on the Humboldt kilns, having a total potential capacity of 200,000 cu. m. per hour. Thirty-six sleeve filters with a total of 143 chambers are also provided in various parts of the works and have a total potential capacity of 500,000 cu. m. per hour.

The covered clay store has a total capacity of 15,000 cu. m. and a mobile gantry excavator is provided for the automatic withdrawal of the material. The limestone is stored in two cylindrical silos each having a capacity of 9,000 cu. m. The store for the wet slag has a total capacity of 30,000 cu. m. Withdrawal of this material is effected by means of a MIAG ZKN-315 scraper mounted on a mobile carriage, this machine having a potential capacity of 120 cu. m. per hour. The slag is carried to the drying hoppers on belt-conveyors.

The raw materials mill building contains two vertical roller Leosche LM23/1800 thermo-ventilated mills with incorporated separator. in which the raw materials are simultaneously ground and dried by waste heat from the kilns. The raw meal homogenisation plant comprises four pneumatic units installed over four reserve silos, the total capacity of the latter being 20,000 tons. The homogenisation cycle is fully automatic.

The burning plant comprises two rotary kilns (*Fig.* 3) each having a diameter of 4 m. and a length of 68 m. Four-stage Humboldt cyclone pre-heaters of 5-m. diameter are provided together with Fuller coolers of the horizontal grille type. Box and scraper chain-conveyors transfer the clinker to the storage silos, of which there are three, each having a capacity of 9 000 cu. m.

There are three Hazemag dryers in the wet-slag drying building, which use the hot gases.

The clinker mill building contains four Polysius mills of 3·4-m. diameter and 87 m. long. The mills, which require 2,800 h.p., operate in closed circuit and are equipped with Heyd dynamic separators.

New Equipment for Pneumatically Conveying Cement

THE ARTICLE under the above heading, published in the number of this journal for September 1968, has aroused much interest as is evidenced by the number of enquiries received by the publishers. The address of Tailor Process Engineering Ltd. in the U.K., which firm supply the equipment described in the article, is 25 Carver Street, Sheffield 1.

We have been informed that Tailor Process Engineering Ltd., which is associated with Tailor & Co. Inc., of Davenport, Iowa, U.S.A., have now appointed representatives in the following countries:

Australasia: Godfrey Engineering (Australia) Pty. Ltd., P.O. Box 84, Niddire, Victoria, 3042, Australia.

Benelux: Droogtechniek en Luchtbehandeling N.V. Nieuw Mathenesserstraat 39–41, Postbus 6047, Rotterdam, Holland.

The Cement Industry In Ceylon

CEYLON expects to be self-sufficient in the production of Portland cement by the end of 1971 or early in 1972. The manufacture of cement was the first of the major industrial undertakings put in hand by the Government after the island became an independent member of the Commonwealth. The Ceylon Government has invested Rs. 325,000,000 in the industry. Some 96 per cent of the materials for cement are found locally. Gypsum, which constitutes the remaining 4 per cent, is at present imported. With the expansion of the salt industry, it is expected that gypsum will also eventually be obtainable locally.

The cement industry in Ceylon started with a single dry-process works installed in 1950 at Kankesanturai in the northern part of the island. A grinding mill and packing plant was installed in 1967 near Galle, in the southern extremity of the island. A new works at Puttalam, in the north-west, is expected to be in operation this year. With the establishment ten years ago of the Ceylon State Cement Corporation, all three works have been brought under its control.

The output of cement from the Kankesanturai works was about 80,000 tons in 1967, but was almost doubled in 1968 and is expected to be trebled by the end of 1969. By the beginning of 1970, the total output of this works is expected to be about 270,000 tons. The grinding plant at Galle will be producing about 100,000 tons by 1970. The new works at Puttalam has an annual productive capacity of 220,000 tons but additional capacity of 220,000 tons is being installed and will come into production in 1971 or early in 1972.

Kankesanturai Works

The works at Kankesanturai is situated on a 450-acre site in an area of deposits of limestone, which constitutes nearly 80 per cent of the raw material required. The limestone quarry is in the vicinity of the works and was established by the Ceylon Government Department of Industries, the annual output being originally planned to be 100,000 tons. Clay of the requisite chemical composition is obtained from a source nearly 140 miles away.

The works has been expanded in two stages, the first including the installation of a new rotary kiln and ancillary equipment with an annual capacity of 165,000 tons. This stage, which cost Rs. 64,500,000, was completed in 1967. The second stage consisted of the modernisation of the old kiln to increase its annual capacity to 110,000 tons. The modernised kiln which cost about Rs. 12,000,000, was commissioned in 1968. The suppliers of the plant for this expansion as well as that for the Puttalam works were Klockner Humboldt Deutz of West Germany.

The establishment at Kankesanturai comprises, in addition to the operational equipment required for the cement plant; the limestone quarry, a concrete products works, a power house and other ancillary installations. A wide range of concrete products are made and include cable ducts and telegraph and transmission poles.

The cost of fuel, power, gypsum, packing materials, consumables, customs duties, licence fees and the like amounts to about 52 per cent of the local cost of production of cement. Fuel and power have been the principal items of cost at Kankesanturai, the price of diesel-oil being the main factor in the cost of generating thermal power. The cost of fuel is enhanced by internal transport charges and a heavy import duty. The production costs per ton ex-works in 1967/8 was about Rs. 108, and was made up as follows:

	Rs.		Rs.
Fuel	18·55	Selling and packing	9·82
Power	13·75	Administration	6·85
Labour	9·48	Works supervision	6·47
Depreciation	24·50	Repairs and renewals	4·12
Raw materials	12·52	Consumables	1·79

There was an increase in production costs in 1969 on account of the devaluation of the Ceylon rupee, higher salaries and wages and the introduction of the Foreign Exchange Entitlement Certificate, resulting in costlier materials and spares. The Corporation's profit, before taxation, in 1967/8 was about Rs. 13,800,000, that is about £1,000,000. The local manufacture of cement is estimated to have saved Ceylon so far nearly Rs. 70,000,000 in foreign exchange on cement imports.

Grinding Mill at Galle

Although the original plan of expansion provided for the clinker for the terminal grinding and packing plant at Galle to be obtained by coastal shipping from the Kankesanturai works, the Galle plant was commissioned and uses mainly imported clinker because of delays in the development of the harbours at Galle and Kankesanturai. Arrangements are now being made to transport some clinker from Kankesanturai by rail and, during 1969, the major part of clinker required is likely to be transported in this manner. From 1970, however, the entire annual requirement of 100,000 tons of clinker is expected to be supplied from Kankesanturai by sea.

The clinker is transported from Galle harbour, two miles from the mill, in special hopper wagons from which it is discharged on to a belt-conveyor which loads the material either into dumpers or into a pit from which a dragline excavator picks up the material to load the dumpers. A more economical system of handling the clinker, namely, conveying it from the hopper wagons through underground hoppers into the store by belt-conveyors, is being designed.

The operations of transport, processing and the like are all interlocked either electrically or pneumatically. The weight of a bag of cement is controlled mechanically by the twelve-spout rotary "Fluxo" packer having an accuracy of 9 oz. in 112 lb. (1 kg. in 200 kg.). The "Pendan" feeders controlling the supply of clinker and gypsum to the mill have an accuracy of 0·1 per cent on the cumulative total, using a negative feedback mechanical loop. The entire milling operation is controlled by a single panel comprising various control switches, interlocking relays and precision instruments measuring the varying and controllable parameters.

The suppliers of the equipment at Galle were Messrs. F. L. Smidth. The brand name of the cement from this plant is "Ruhunu", which is the ancient name for this part of Ceylon.

Seventh in succession

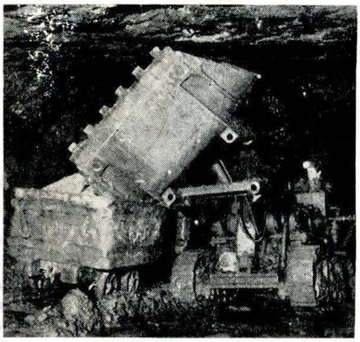
Stein have seven tunnel kilns at Manuel Works near Linlithgow. They produce Firebrick, High Alumina and Basic Refractories. This is No. 7. It is one of the most modern and efficient kilns in the world and it typifies the planning and enterprise that have gone into the b[illegible] of Manuel Works. [illegible]

The length of No. 7 [illegible] feet–allows extreme [illegible] in firing basic brick [illegible] the best possible [illegible] structure. It can [illegible] temperatures far [illegible] [illegible] of 1700°C.

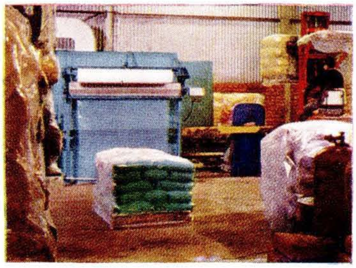
Feeding this kiln are modern presses capable of applying up to 1200 tons total pressure and drawing their raw materials

High purity in raw materials is an essential feature of Stein Quality. This is the modern Fireclay Treatment Plant. ▶

…asic batching plant. …argely automatic …ximum uniformity c… …acilities like these c… …ake Stein high fire… …y basic bricks am… …and most unifo… va… …e anywhere in the world.



Production in the Stein mines is mechanised with tractor-shovels.

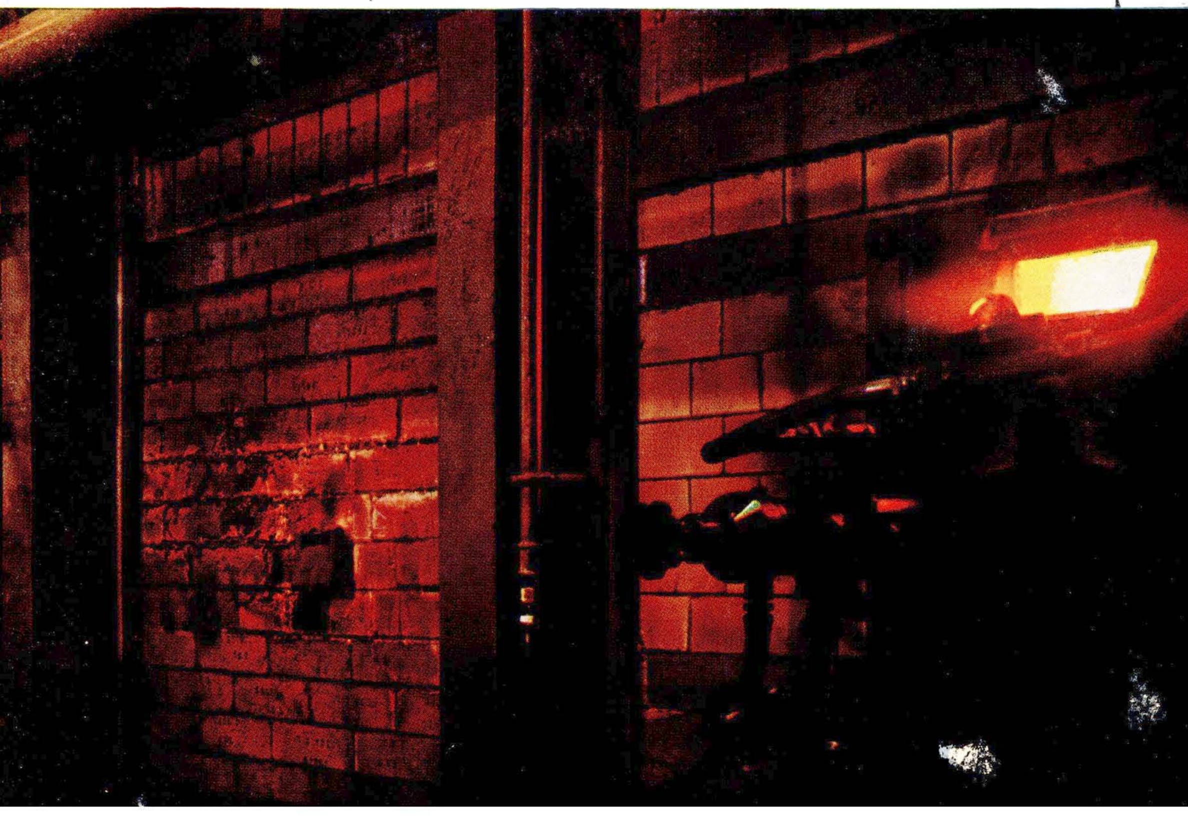


The packaging machine that wraps and seals an entire pallet of sacked monolithics in a tough polythene bag.

Similarly advanced manufacturing resources are employed for all the other Stein products.
In the expanding field of monolithics – refractory concretes, plastics, cements etc. – Stein have kept pace with demand by building a special plant at the Castlecary Works. Separate flow lines for each type of material prevent contamination of the product. Improved packaging techniques ensure that every consignment, large or small, reaches the customer in perfect condition.

John G Stein & Co. Ltd
Bonnybridge
Scotland
Banknock 255

STEIN Refractories



National Standards for Portland Cement

ON PAGES 30 to 37 are given the first of a series of tables giving particulars of the requirements of most of the national standard specifications for Portland cement. These tables, which in the present number relate to the chemical composition, are similar to those published in past years in this journal, but are brought up to date in accordance with the latest available information. Some of the data are abstracted from "Cement Standards of the World 1968", the publication of which was referred to in the number of this journal for November last, but in some cases, for example the data for the United Kingdom, the information is in accordance with the requirements of later available Standards. The requirements of the British Standards for all types of cement, that is true Portland cements and non-Portland cements, were given in this journal for November last.

The introduction of new standards complying with the RILEM/CEMBUREAU tests for Portland cement is expected shortly in the case of Belgium, Czechoslovakia, Denmark, Hungary and Italy. Revisions are expected, and may have been effected since these tables were prepared for the press, in the case of Australia, Bulgaria, Finland, Greece, Mexico, Norway and Venezuela.

In later numbers of this journal it is intended to publish additional tables giving data relating to the strength and other physical properties of Portland cements.

Abbreviations

The following abbreviations for the various types of Portland cement are used in all the tables:

O—Ordinary
RH—Rapid hardening (or high early strength)
LH—Low heat
SR—Sulphate resistant
AE—Air entrained

Other abbreviations include the following:

$>$ greater than
$<$ less than
$\ngtr$ not greater than
$\nless$ not less than

The following abbreviated symbols are used for the chemical constituents:

$C = CaO$ $F = Fe_2O_3$ $Mn = Mn_2O_3$
$S = SiO_2$ $A = Al_2O_3$ $C_3A = 3CaO.Al_2O_3$.

Chemical Composition of Portland Cements (Table I)

These Notes apply to Table I giving the chemical composition of Portland cements.

(*a*) ADDITIVES.—Permitted additives exclude water and $CaSO_4$ (added to regulate the setting time) unless specifically stated otherwise.

(*b*) CUBA.—It is not known if these standards are still valid since no information regarding new standards is available.

(*c*) MEXICO.—Reference should be made to the published Standards regarding additives permitted at the manufacturer's option.

(*d*) U.S.S.R.—Reference should be made to the published Standards for the amounts of hydraulic material agreed as permissible additives in cements of different types.

TABLE I.—CHEMICAL COMPOSITION OF PORTLAND CEMENT.

(For notes see page 29.)

Country (Date of Standard)	Type of Cement	Chemical Ratios Based on percentages	Maximum Percentages Permitted tolerances in brackets					Remarks
			MgO	SO_3	Insoluble residue	Loss on ignition	Permitted additions	
Argentina O (1964; revised 1966) RH (1966)	O RH	— —	5·0 5·0	2·5 3·0	1·0 1·0	3·0 3·0	2† 2†	† Certain special materials
Australia (1963; amended 1964 & 1966)	O RH LH	$\frac{A}{F} \nless 0{\cdot}66$	4·2	3·1	2·1	3·1	None	LH $C_3A \ngtr 8{\cdot}0$ $C_4AF \ngtr 20{\cdot}0$ $C_3S \ngtr 40{\cdot}0$ $C_2S \nless 35{\cdot}0$
Austria (1963)	O I O II HS	—	5·0	3·5	—	5·0	1·0†	† Hydraulically active materials up to 15%
Belgium (1959)	O HS RH	—	3·0	3·75	—	—	None	—
Brazil (1967)	O RH	— —	6·0 5·0	3·0 3·0	1·0 1·0	4·0 4·0	None 1·0	— —
Bulgaria (1956)	O HS	—	4·5	3·0	—	5·0	1·0	—
Canada (1961; revised 1963, 1964 and 1966)	O	—	5·0	2·5 ($C_3A \ngtr 8$) 3·0 ($C_3A > 8$)	0·7	3·0	1·0	—
	RH	—	5·0	3·0 ($C_3A \ngtr 8$) 3·5 ($C_3A > 8$)	0·7	3·0	1·0	—
	SR	—	4·0	2·5 ($C_3A \ngtr 8$)	0·7	3·0	1·0	—

Chile (1951)	O	$\frac{C - 0{\cdot}7SO_3}{S + A + F} \not< 1{\cdot}7$	5·0	3·0	1·5	3·0	3·0	Specific gravity $\not<$ 3·0
	HS	$\frac{C - 0{\cdot}7SO_3}{S + A + F} \not< 1{\cdot}7$	5·0	3·25	1·5	3·0	3·0	Specific gravity $\not<$ 3·0
China (mainland) (1959)	O I 200 O II 250 O III 300 O IV 400 O V 500 O VI 600	—	4·5	3·0	—	5·0 (7·0 for shaft-kiln)	†	† Depending on the type of cement, 15% max. hydraulic or 10% max. non-hydraulic material is permitted to be added during grinding
Cuba (1956)	O	—	5·0	2·5 ($C_3A \not> 8$) 3·0 ($C_3A > 8$)	0·75	3·0	1·0	— (See Note b)
	SR/LH	—	5·0	2·5	0·75	3·0	1·0	$S \not< 21{\cdot}0$ $A \not> 6{\cdot}0$ $F \not> 6{\cdot}0$ $C_3A \not> 50{\cdot}0$ $C_3A \not> 8{\cdot}0$
	RH	—	5·0	3·0	0·75	3·0	1·0	$C_3A \not> 15{\cdot}0$
	LH	—	5·0	2·3	0·75	2·3	1·0	$C_2S \not< 40{\cdot}0$ $C_3S \not> 35{\cdot}0$ $C_3A \not> 7{\cdot}0$
	SR	—	4·0	2·3	0·75	3·0	1·0	$C_3S \not> 50{\cdot}0$ $C_3A \not> 5{\cdot}0$ $C_4AF + 2C_3A \not> 20{\cdot}0$
Czechoslovakia O (1957) HS (1962) RH (1960)	O 250, 350, 450, 550 HS RH	—	6·0	3·0	2·0 clinker	5·0	None†	† For O: special material 1%; slag 0 to 20%.
Denmark O (1933) RH (1942)	O RH	$\frac{C}{S + A + F} \not< 1{\cdot}8$	3·0 3·0	3·0 3·0 (0·2)	— —	— —	3·0 6·0	— —
Eire (1963)	O RH	$\frac{C - 0{\cdot}7SO_3}{2{\cdot}8S + 1{\cdot}2A + 0{\cdot}65F} \not< 0{\cdot}66 \not> 1{\cdot}02$ $\frac{A}{F} \not< 0{\cdot}66$	5·0	3·5	1·5	4·0	1·0	—

TABLE I.—CHEMICAL COMPOSITION OF PORTLAND CEMENT (*Continued*)
(*For notes see page* 29.)

Country (Date of Standard)	Type of Cement	Chemical Ratios Based on percentages	Maximum Percentages Permitted tolerances in brackets: MgO	SO_3	Insoluble residue	Loss on ignition	Permitted additions	Remarks
Finland (1945)	O	—	5·0	—	—	—	15·0	
	RH	—	5·0	—	—	—	3·0	
	LH	—	5·0	—	—	—	15·0	Heat evolved (1:6 mixture) 3 days: 55 cal. per g. (max.) 7 days: 65 cal. per g. (max.) Tolerance 10%
France (1964)	O I 250, O II 325, RH I 400, RH II 500	—	5·0	3·5	3·0	4·0	None†	† Grinding aid: 0·05%
Germany (East) (1968)	O, RH 1, RH 2	—	5·0	3·5	—	5·0	0·5	Types of cement: ON — Normal hardening; OW — For heat curing
Germany (West) (1969)	O I, O II, HS I, HS II, HS III	—	5·0 (Clinker)	3·5 (spec. surf. ≯4000) 4·5 (spec. surf. >4000)	—	5·0	1·0†	† No chloride
	SR/LH	C_3A ≯ 3						
Greece (1954)	O I, RH I	—	5·0	3·0	1·0	5·0	1·0	
	O II, RH II	—	5·0	3·0	10·0	5·0	10·0†	† Santorin earth (pozzolana)
Hungary (1956)	O 400, RH I 500	—	5·0	3·0	2·0	5·0	15·0	—
	RH II 600	—	5·0	3·0	2·0	5·0	None	—

India (1968)	O, RH	$\frac{C - 0{\cdot}7SO_3}{2{\cdot}8S + 1{\cdot}2A + 0{\cdot}65F} \nless 0{\cdot}66 \ngtr 1{\cdot}02$; $\frac{A}{F} \nless 0{\cdot}66$	6·0	2·75	1·5	4·0	None†	† Except air-entraining agents. For low-alkali cement $Na_2O \ngtr 0{\cdot}5$
	LH	$\frac{C - 0{\cdot}7SO_3}{2{\cdot}4S + 1{\cdot}2A + 0{\cdot}65F} \ngtr 1$; $\frac{C - 0{\cdot}7SO_3}{1{\cdot}9S + 1{\cdot}2A + 0{\cdot}65F} \nless 1$; $\frac{A}{F} \nless 0{\cdot}66$						
Indonesia (1965)	O, RH, LH	—	5·0	3·0	3·0	—	—	—
Israel O (1962) HS (1964) SR (1965)	O	—	5·0	3·0	1·5	4·0	1·0	—
	HS	—	5·0	3·0	0·75	3·0	1·0	—
	SR	$C_3A \ngtr 5$; $C_4AF + 2(C_3A) \ngtr 20$	4·0	2·3	0·75	3·0	1·0	—
Italy (1965)	O, HS	—	4·0	3·0	3·0	5·0	None	—
Japan (1964)	O	—	5·0	2·5	—	4·0	—	Specific gravity $\nless$ 3·05
	RH	—	5·0	2·8	—	4·0	—	$C_3S \ngtr 50{\cdot}0$, $C_3A \ngtr 8{\cdot}0$
	LH	—	4·0	2·5	—	4·0	—	
Mexico (1967)	O I	—	4·0	(*a*)	0·75	3·0	—	See Note *C*.
	SR/LH II	$\frac{A}{F} \ngtr 0{\cdot}7$	4·0	(*a*)	0·75	3·0	—	$S \nless 21{\cdot}0$ $A \ngtr 6{\cdot}0$; $F \ngtr 6{\cdot}0$ $C_3S + C_3A \ngtr 58{\cdot}0$; $C_3A \ngtr 8{\cdot}0$
	RH III	—	4·0	(*a*)	0·75	3·0	—	—
	LH IV	$\frac{A}{F} \ngtr 0{\cdot}7$	4·0	(*a*)	0·75	3·0	—	$F \ngtr 6{\cdot}5$ $C_3S \ngtr 35{\cdot}0$; $C_3A \ngtr 7{\cdot}0$ $C_2S \nless 40{\cdot}0$
	SR V	$\frac{A}{F} \ngtr 0{\cdot}7$	4·0	(*a*)	0·75	3·0	—	$C_3A \ngtr 5{\cdot}0$

TABLE I.—CHEMICAL COMPOSITION OF PORTLAND CEMENT. (*Continued*)

(*For notes see page* 29)

Country (Date of Standard)	Type of Cement	Chemical Ratios Based on percentages	Maximum Percentages Permitted tolerances in brackets: MgO	SO_3	Insoluble residue	Loss on ignition	Permitted additions	Remarks
Netherlands (1953)	O, RH I, RH II	—	5·0	3·0	3·0	—	None	Calculated on cement dried at 100 to 105°C.
New Zealand O, RH (1964), LH (1962)	O, RH	$\frac{C-0{\cdot}7S}{2{\cdot}8S+1{\cdot}2A+0{\cdot}65F}$ $\nless 0{\cdot}66 \ngtr 1{\cdot}02$; $\frac{A}{F} \nless 0{\cdot}66$	4·0	2·5† ($C_3A \ngtr 7$); 3·0† ($C_3A > 7$)	1·0	3; 4 in tropics	None	† When equivalent $Na_2O > 0{\cdot}7$: 2·75 ($C_3A \ngtr 7$); 3·5 ($C_3A > 7$)
	LH	$\frac{C-0{\cdot}7S}{2{\cdot}4S+1{\cdot}2A+0{\cdot}65F} \ngtr 1$; $\frac{C-0{\cdot}7S}{1{\cdot}9S+1{\cdot}2A+0{\cdot}65F} \nless 1$; $\frac{A}{F} \nless 0{\cdot}66$	4·0	2·75	1·0	3; 4 in tropics	None	Heat of hydration: 7 days: $\ngtr$ 65 cal. per g. 28 days: $\ngtr$ 75 cal. per g.
Norway (1961)	O	$\frac{C-0{\cdot}7S}{2{\cdot}8S+1{\cdot}18+0{\cdot}65F}$ $\nless 0{\cdot}66 \ngtr 1{\cdot}02$	5·0	3·2	1·0	4·0	None	
	RH		5·0	3·5	1·0	4·0	0·1	
Pakistan (1962)	O, RH	$\frac{C-0{\cdot}7S}{2{\cdot}8S+1{\cdot}2A+0{\cdot}65F}$ $\nless 0{\cdot}66 \ngtr 1{\cdot}02$; $\frac{A}{F} \nless 0{\cdot}66$	4·0	2·5; 3·0 ($C_3A > 7$)	1·5	3·0; 4·0 in tropics	None	
Poland OI, OII (1960)	O I 200	—	5·0	3·0	2·0	5·0	None†	† Hydraulically-active material 20%
	O II 350	—	5·0	3·0	1·5	5·0	None	
RH (1964)	RH 400	—	4·0	3·5	—	—	1·5††	†† Material to accelerate hardening
HS I (1961)	HS I 450	—	5·0	3·0	1·5	5·0	None	
HS II (1967)	HS II 550	—	5·0	3·0	—	—	None	
SR/LH (1965)	SR/LH 250	—	4·0	2·5	—	—	None	Heat of hydration: 3 days: $\ngtr$ 50 cal. per g.

Portugal (1956)	O	—	4·0	3·0	2·0	4·0	—		
Rumania O I, O II (1967)	O I O II	—	2·5	2·5	1·0	3·0	None		
RH I, RH II (1961)	RH I RH II	—	4·5	2·75	1·0	2·0	None		
South Africa (1959)	O RH	$\frac{C - 0{\cdot}7SO_3}{2{\cdot}8S + 1{\cdot}2A + 0{\cdot}65F}$ $\not< 0{\cdot}66 \not> 1{\cdot}02$ $\frac{A}{F} \not< 0{\cdot}66$	5·0	2·5 ($C_3A \not> 7$) 3·0 ($C_3A > 7$)	1·5	4·0	—		
Spain (1964)	O I 250 O II 350 O III 450	O I and O II: $C_3A \not> 18{\cdot}0$	5·0	4·0	3·0	4·0	10†	† If not harmful	
	SR I 250 SR II 350	$C_3A \not> 5{\cdot}0$	5·0	4·0	3·0	4·0	—		
Sweden (1960)	O RH LH	—	5·0	3·5	—	—	3·0† for special purposes	† CaCl: $\not> 1{\cdot}0\%$ Heat of hydration (LH): 3 days: 50 cal. per g. 7 days: 60 cal. per g.	
Switzerland (1953)	O HS	— —	5·0 5·0	3·2 3·5	2·0 2·0	4·0 4·0	1·0 1·0	Loss on ignition 5·0 on site sample	
Taiwan (1962)	O	—	5·0	2·5 ($C_3A \not> 8$) 3·0 ($C_3A > 8$)	0·75	3·0	—		
	SR/LH	$S \not> 21{\cdot}0$; $A \not> 6{\cdot}0$ $F \not> 6{\cdot}0$; $C_3A \not> 8{\cdot}0$	5·0	2·5 ($C_3A \not< 8$)	0·75	3·0	—		
	RH	$C_3A \not> 15$	5·0	3·0 ($C_3A \not> 8$) 5·0 ($C_3A > 8$)	0·75	3·0	—		

TABLE I.—CHEMICAL COMPOSITION OF PORTLAND CEMENT. (*Continued*)

For notes see page 29.

Country (Date of Standard)	Type of Cement	Chemical Ratios Based on percentages	Maximum Percentages Permitted tolerances in brackets					Remarks
			MgO	SO_3	Insoluble residue	Loss on ignition	Permitted additions	
Turkey (1959)	O 350 HS 500 RH 600	—	5·0	3·0	1·0	4·0	1·0	
Uruguay (1962)	O RH	— $C_3A \ngtr 15$	5·0	3·0	0·85	3·0	1·0	
United Kingdom O, RH, LH (1958; amended 1960 and 1962)	O RH	$\frac{C - 0{\cdot}7SO_3}{2{\cdot}8S + 1{\cdot}2A + 0{\cdot}65F} \nless 0{\cdot}66 \ngtr 1{\cdot}02$ $\frac{A}{F} \nless 0{\cdot}66$	4·0	2·5 ($C_3A \ngtr 7$) 3·0 ($C_3A > 7$)	1·5	3·0 or 4·0 in hot climates	None	
SR (1966)	LH	$\frac{C - 0{\cdot}7SO_3}{2{\cdot}4S + 1{\cdot}2A + 0{\cdot}65F} \ngtr 1{\cdot}0$ $\frac{C - 0{\cdot}7SO_3}{1{\cdot}9S + 1{\cdot}2A + 0{\cdot}65F} \nless 1{\cdot}0$	4·0	2·5 ($C_3A \ngtr 7$) 3·0 ($C_3A > 7$)	1·5	3·0 (4·0 in hot climates)	None	Heat of hydration (max.): 7 days: 60 cal. per g. 28 days: 70 cal. per g.
	SR	$\frac{C - 0{\cdot}7SO_3}{2{\cdot}8S + 1{\cdot}2A + 0{\cdot}65F} \nless 0{\cdot}66 \ngtr 1{\cdot}02$ $\frac{A}{F} \nless 0{\cdot}66$	4·0	2·5	1·5	3·0 (4·0 in hot climates)	None	

U.S.A. (A.S.T.M. 1967)	I IA	—	5·0	2·5 C_3A ≯ 8 3·0 C_3A > 8	0·75	3·0	None†	† At maker's option
I O IA O/AE	II IIA	C_3A ≯ 8; F ≯ 6 A ≯ 6; S ≯ 21	5·0	2·5	0·75	3·0	None†	For II & IIA Heat of hydration: 7 days: ≯ 70 cal. per g. 28 days: ≯ 80 cal. per g.
II SR/LH IIA SR/LH/AE	III IIIA	C_3A ≯ 15	5·0	3·0 C_3A ≯ 8 4·0 C_3A > 8	0·75	3·0	None†	
III RH IIIA RH/AE	IV	C_3A ≯ 7; F ≯ 6·5	5·0	2·3	0·75	3·0	None†	
IV LH V SR	V	C_3A ≯ 5 $C_4AF + 2C_3A$ ≯ 20	5·0	2·3	0·75	3·0	None†	
U.S.S.R. (1962; amended 1967)	O 300 O 400 O 500 O 600	—	5·0 (clinker)	1·5 to 3·5	—	—	15†	† Hydraulically active materials
	RH	—	5·0 (clinker)	3·5	—	—	10†	†† Agreed amounts in special cases
	SR/LH	—	5·0 (clinker)	3·5	—	—	††	See Note *d*.
Venezuela (1960)	O	—	5·0	3·0	1·0	3·0	—	
	SR/LH	S ≮ 21; A ≯ 6·0 F ≯ 6; C_2S ≯ 58 C_3A ≯ 8	5·0	2·5	1·0	3·0	—	
	RH	C_3A ≯ 15	5·0	4·0	1·0	3·0	—	
Yugoslavia (1967)	O I O II RH	$\frac{C - 0{\cdot}7SO_3}{2{\cdot}8S + 1{\cdot}2A + 0{\cdot}65F}$ ≮ 0·66 ≯ 1·02	5·0	3·5	2·0	5·0	—	

China Clay for the Cement Industry

THE ILLUSTRATIONS in the article entitled "China Clay for the Cement Industry" in the January number of this journal became transposed and some were omitted. The correct descriptions of the various illustrations are as follows, those marked with an asterisk (*) being originally correct.

FAL VALLEY WORKS

Fig. 2.*—Washing down face of pit.
3. —Storage and dewatering tank.
4. —Scrubber and water tanks.
5.*—Skimming pipe in dewatering tank.
6.*—Filter presses.
7.*—Hydraulically-operated pumps.

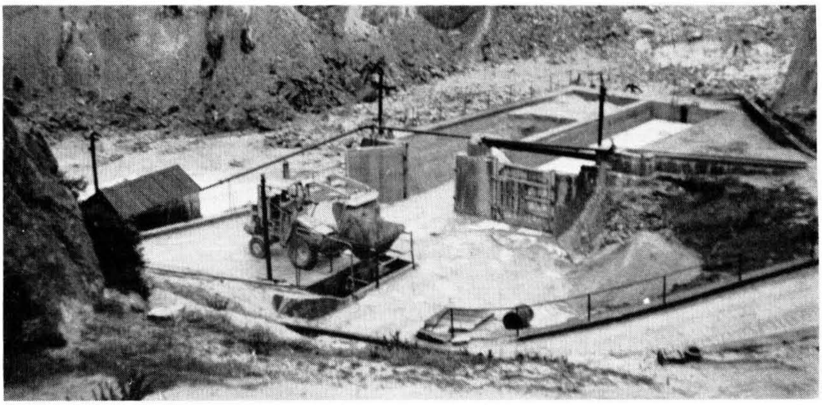


Fig. 12.—Sand Settler.

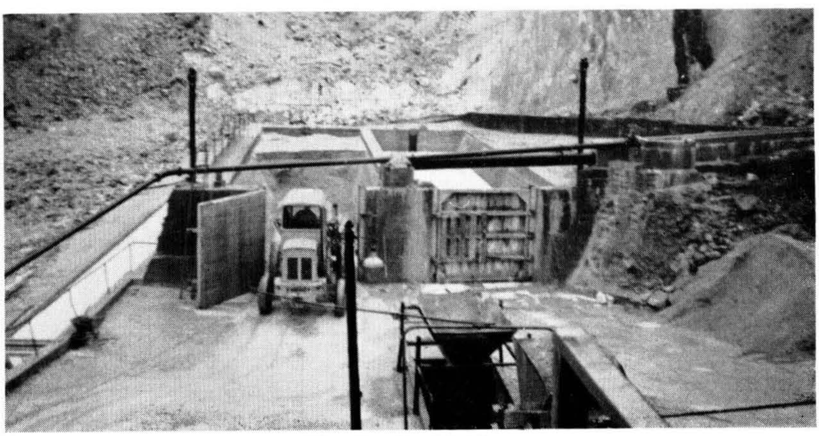


Fig. 13.—Sand Settler.

Fig. 14.—Mica Drag.

8.*—Rotary drier.
9.*—Air heater.
10.*—Finished clay store.
11.*—Old settlers, drying floors and linhays.

Views of the sand settler, which is referred to as *Figs*. 3 and 4 in the previous article, are now shown in the illustrations *Figs* 12 and 13 on page 38.

The mica drag referred to on page 6 of the January number is now illustrated in *Fig*. 14 above. In the background of *Fig*. 14 can be seen the two clay-settling pits referred on page 7 of the January number.

100-ton Cement Wagons

AN ORDER has been received by Metropolitan-Cammell Ltd. from The Associated Portland Cement Manufacturers Ltd. for sixty-seven bogie cement wagons each of 100 tons weight. Each wagon comprises twin tanks of cherron pattern; has a total capacity of 94 cu. yd. (about 8 cu. m.) and is designed for air-assisted gravity discharge.

Advice on Special Cements

THE MINISTRY of Public Building & Works issued recently a revised edition of Advisory Leaflet No. 39 entitled "Special Cements". The leaflet, copies of which are obtainable from H.M.S.O., (price 6d.), explains the characteristics, selection and methods of using special Portland and other cements for various conditions and work on building sites in the United Kingdom.

The Cement Industry Abroad

Europe.—The annual review, entitled " The Cement Industry Statistics 1967 and Trend 1968," was published in September last by the Organisation for Economic Co-operation & Development (O.C.D.E.). Copies are obtainable from O.C.D.E., 2 Rue André Pascal, Paris 16°, France. (Price 1.50 dollars; or 10*s*.)

South Africa.—The following abstracts are from the Chairman's review of the activities of Anglo-Alpha Cement Ltd., given in the Annual Report for 1968.

In 1964, it was decided to establish a new works at Dudfield, but although it was erected in record time, it was unable to operate as planned because of commissioning problems which recurred spasmodically until the early part of the financial year 1968. However, it is now recorded that production by the latest kiln increased steadily throughout the year and it is now producing clinker at well above the rated capacity. Planned improvement of the older works is continuing and the programme for major overhauls is being carried out in accordance with seasonal fluctuations of demand. During 1968, demands and sales continued to increase.

The present annual productive capacity of the Group, including kilns which were erected in 1934, is about 40,000,000 pockets of cement. Sales for the past financial year amounted to 35,000,000 pockets giving an 87·5-per cent utilisation and leaving current spare capacity of 12·5 per cent. It is considered essential to have at least 15 per cent spare capacity to meet peaks in demand and to operate at optimum profitability. Furthermore, profitability can be improved to some extent by the diversion of production from the older works to the newer installations, provided spare capacity is available at the latter. It is, therefore, planned to increase the rated capacity of the kiln at the Dudfield works by about 48 per cent by the installation of a two-stage heat-exchanger. This will represent an increase of about 4,750,000 pockets per annum. Work will proceed in order to have the additional capacity available by December 1969.

Some major fertiliser companies in South Africa are currently studying a process for the recovery of sulphur and sulphur derivatives from by-products of the manufacture of fertilisers. An additional by-product of the latter process is a clinker which could prove suitable for the manufacture of cement. The Company, together with other major South African cement producers, is in consultation with fertiliser companies and will participate in developments in this field should it prove to be an economic proposition.

During the year arrangements were concluded whereby South West Africa Portland Cement Pty. Ltd. has undertaken the distribution of cement in its own right in the territory of South West Africa. The Company is also in the process of establishing a packing and bulk loading plant in Windhoek for the supply of bagged and bulk cement.

The anticipated drop in sales of low-grade limestone by Union Lime Co. Ltd., arising from the reduced demand by Anglo-Alpha Cement Ltd., was partly offset by improved sales of unslaked lime.

THIS IS ONE METHOD OF DUST COLLECTION

THIS  IS ANOTHER

Mikro-Pulsaire dust collectors are compact, versatile and fully automatic units, with no internal moving parts. Continuously self-cleaning, they have a high air capacity, are capable of handling dust streams up to 425° F, and require far less floor space than comparable units. The economical and highly efficient range of Mikro-Pulsaire dust collectors is serving collection and recovery requirements, in many widely varied fields, throughout industry. They are attaining extremely high standards, with significant economies and very low maintenance requirements.

There must be a Mikro-Pulsaire to suit your particular requirement — if not we'll design one!

For further information contact: W. G. Foot, Sales Manager

ASSOCIATE COMPANIES
SLICK INDUSTRIAL CO. (CANADA) LTD.,
4214 DUNDAS STREET WEST
TORONTO 18, ONTARIO

PULVERIZING MACHINERY G.M.B.H.
ROSRATHER STR. 267
COLOGNE 5 RATH,
GERMANY

Mikropul Ltd.
TOWERFIELD INDUSTRIAL ESTATE
SHOEBURYNESS ESSEX Tel. 2373/5

SUBSIDIARY OF PULVERIZING MACHINERY, SUMMIT, NEW JERSEY
DIVISION OF SLICK CORPORATION

MISCELLANEOUS ADVERTISEMENTS

SCALE OF CHARGES FOR MISCELLANEOUS ADVERTISEMENTS

5s. per line (average seven words per line).

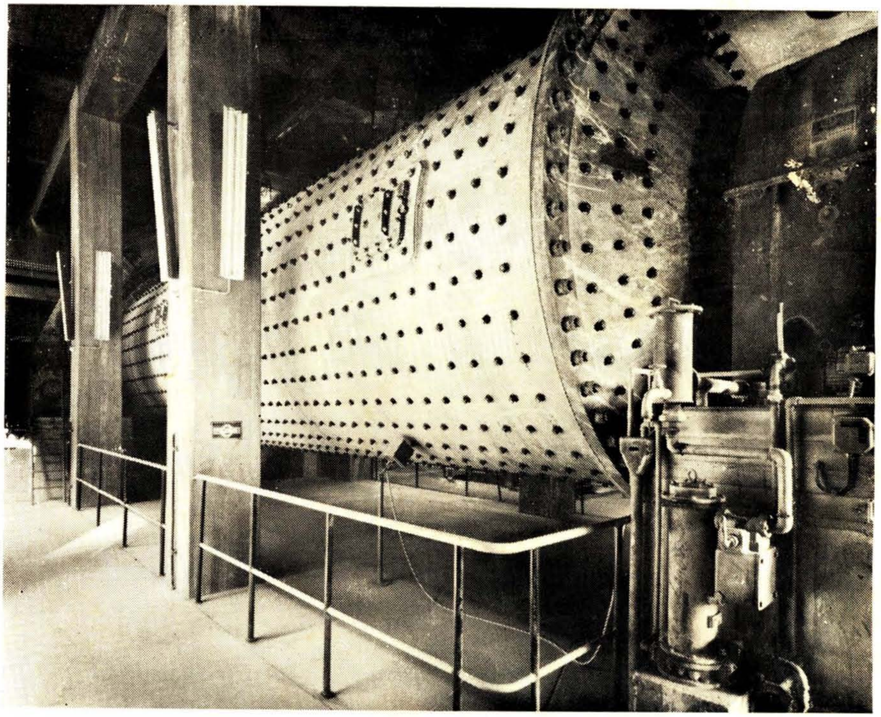
For use of Box Number, allow two lines.

Minimum £1 for not more than four lines.

DISPLAYED ADVERTISEMENTS

45s. per single column inch.

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



CORRECT LAYOUT IS OF MAJOR IMPORTANCE

About 50 POLYSIUS mills go into operation every year. A wealth of experience is available to solve your grinding problems. Polysius design and construct complete open and closed circuit plants for dry and wet process grinding with drives up to 6000 KW.

The illustration shows a closed circuit grinding mill, 4 metres diameter, 12 metres long, with twin pinion drive. This mill has an output of 80 tons/hour of cement at a fineness (Blaine) of 3000 cm^2/g when grinding hard clinker from a rotary kiln.

POLYSIUS

POLYSIUS GMBH
4723 Neubeckum
(Germany)
Telephone (0 2525) 711
Telex 08 92 1581

POLYSIUS LTD.
The Brackens,
Ascot, Berks. (England)
Telephone Winkfield Row 2011
Telex 84 102

POLYSIUS S.A.R.L., Paris

POLYSIUS S.A., Madrid

POLYSIUS (PTY.) LTD.
Johannesburg