CEMENT AND LIME MANUFACTURE

VOL. XXXV. No. 4

JULY, 1962

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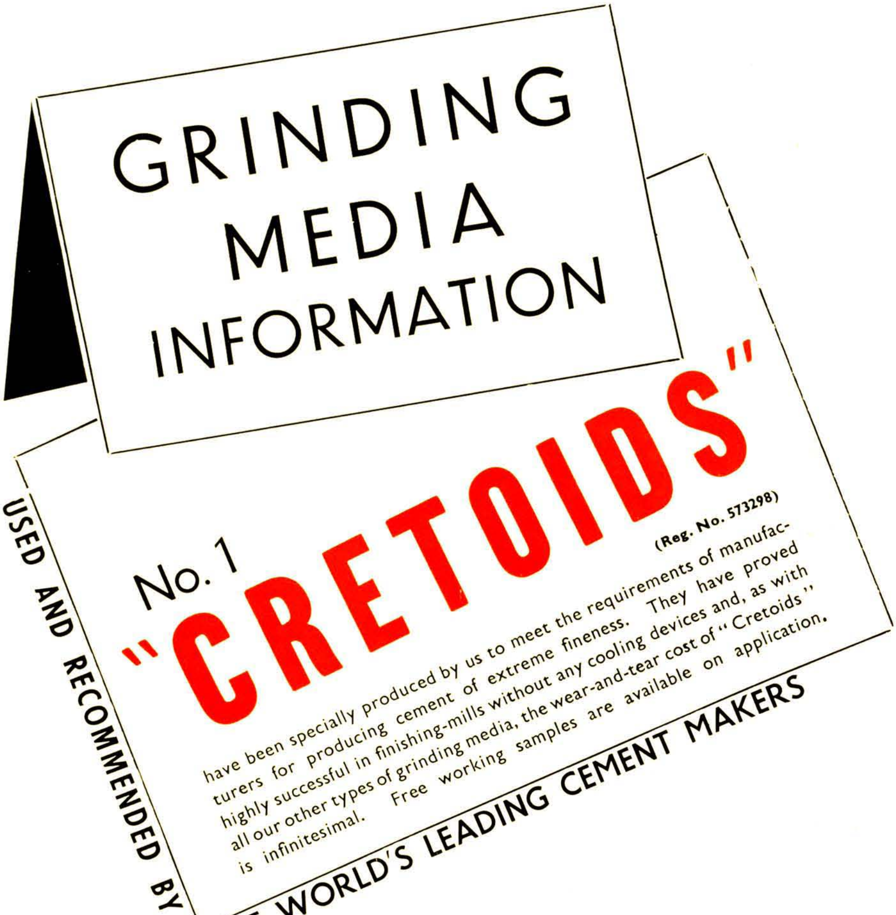

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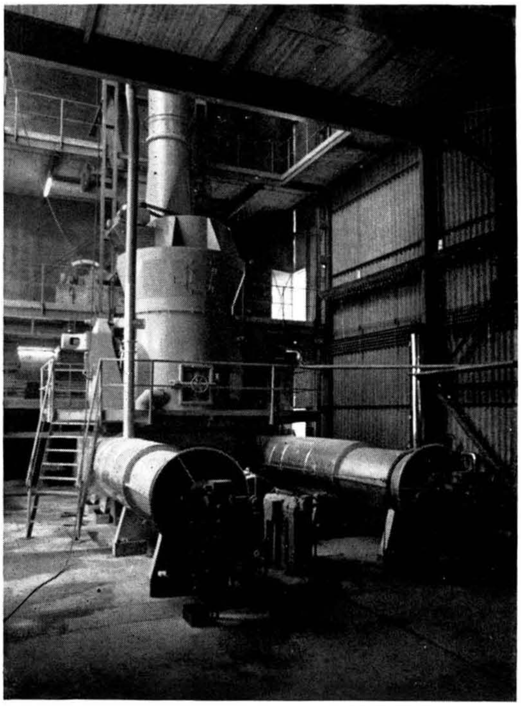

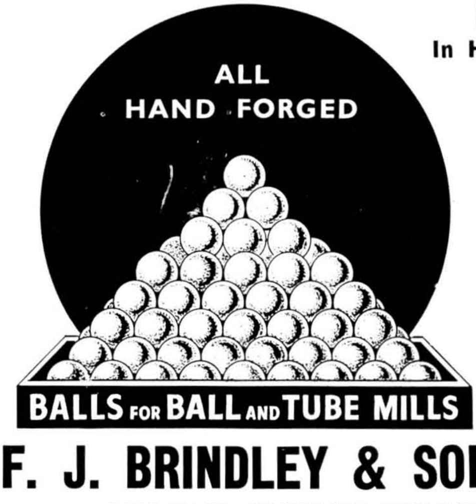
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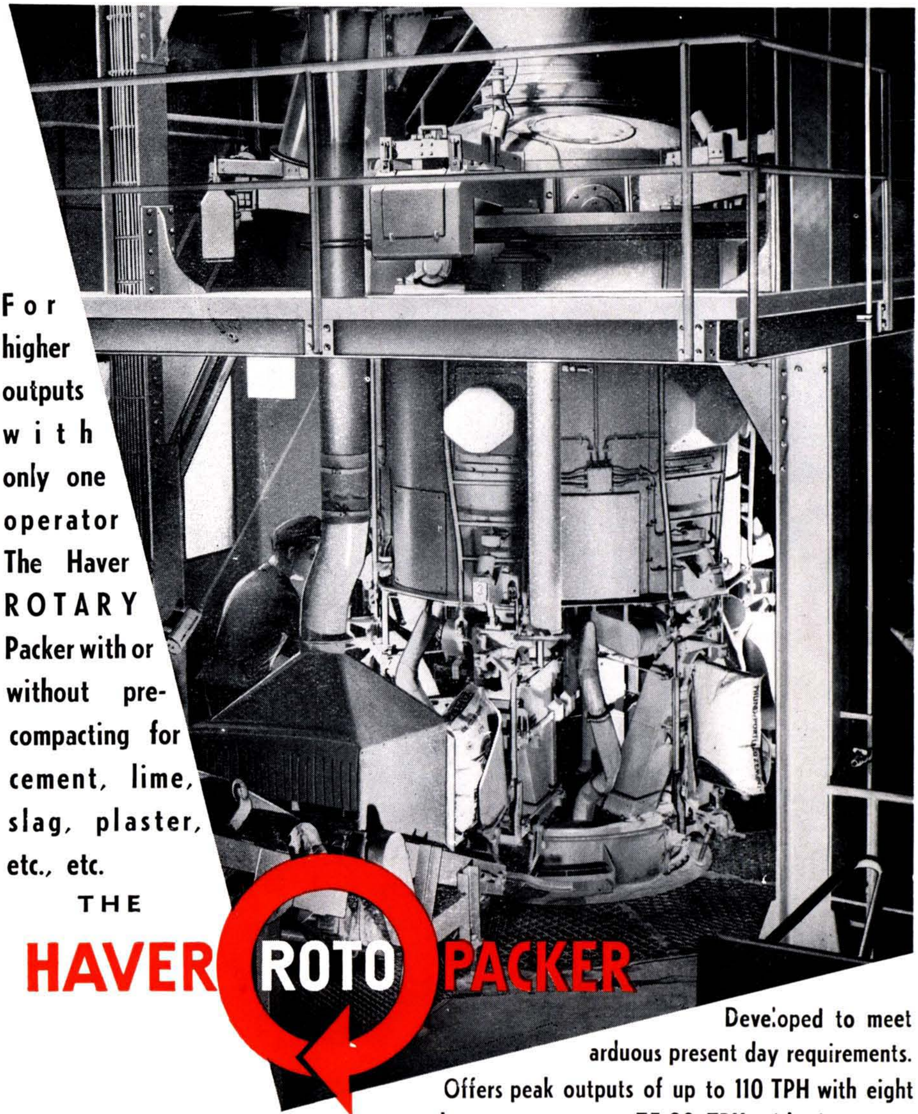

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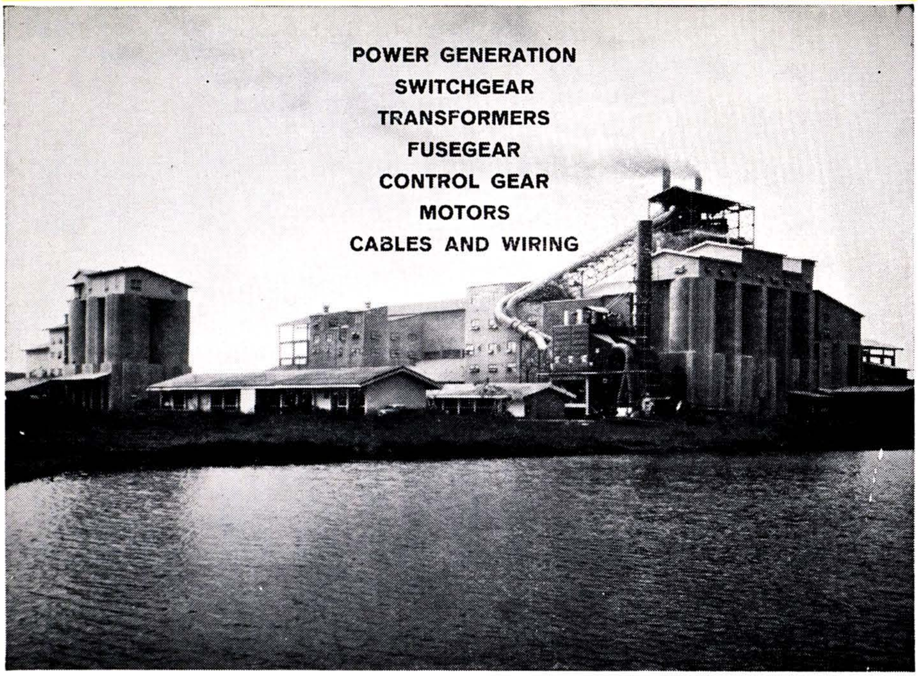

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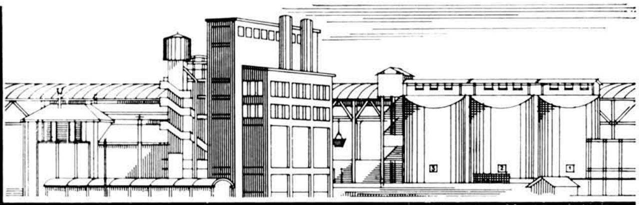

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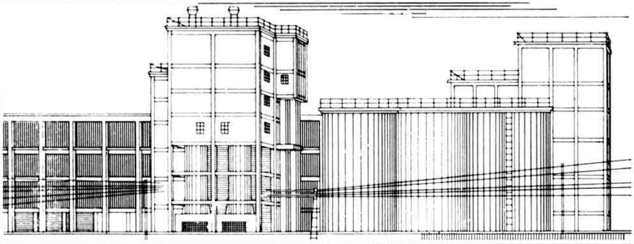

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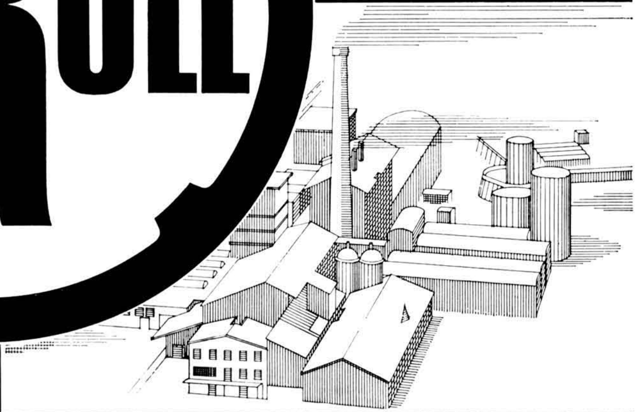

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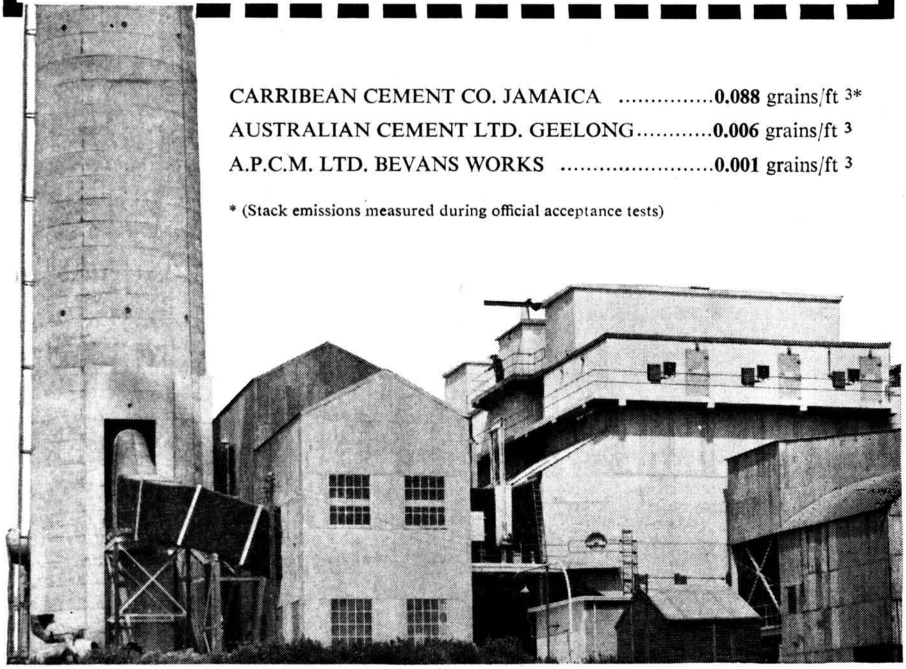

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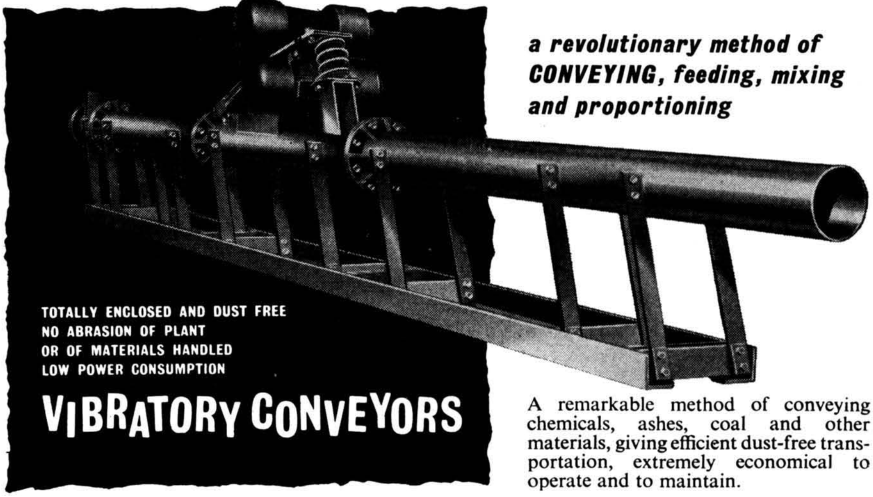

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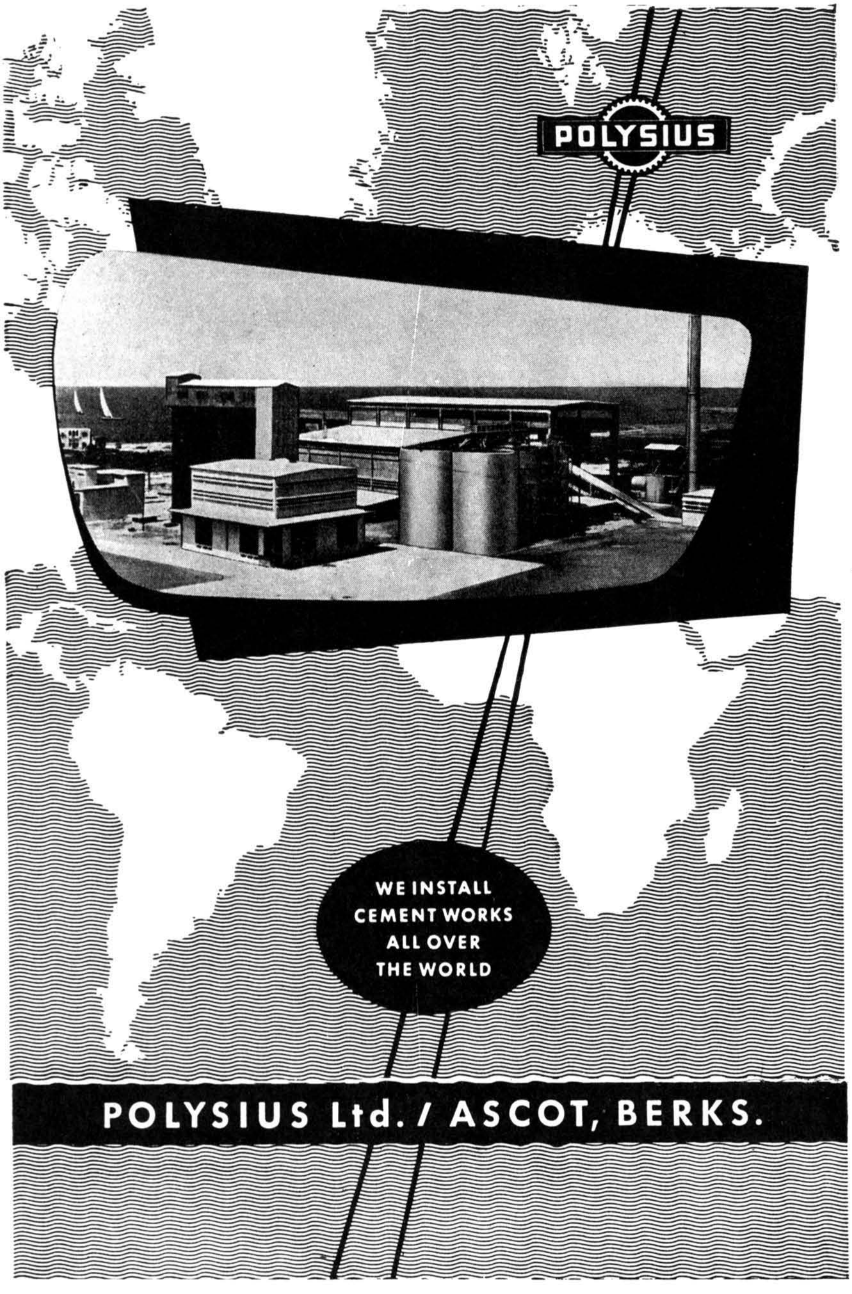
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Lime Production by a Fluidisation Process.

A FLUIDISATION process by which high-grade lime is made from suitable limestone has been introduced recently at the works of Chemical Lime Inc., at Brooksville, Florida, U.S.A. Only two other plants of this description have been installed and these are at the New England Lime Co., at Adams, Massachusetts, and each has a daily capacity of 100 tons. The plant in Florida has a daily capacity of 200 tons and differs from the other plants in so far that two cyclones are incorporated in which an additional 30 tons of the calcined product is collected daily. A general view of the new works at Brooksville is given in *Fig.* 1. The principal components of the plant include the limestone working plant (*Fig.* 2), the drying and crushing plant (*Fig.* 3), and the calcining plant (*Fig.* 4) which includes a calciner of five compartments, and hydration and bagging equipment and facilities for despatch. The lime produced in this plant contains 97·5 per cent. of CaO and from 2 to 2·5 per cent. of insoluble acid material.

The primary advantages of the fluidising process are said to include close operational control through instrumentation, low fuel costs due in part to the "hot" cyclones, low maintenance costs, and a product of high quality. The raw material is a soft high-calcium limestone in the lower stratum of a two-strata

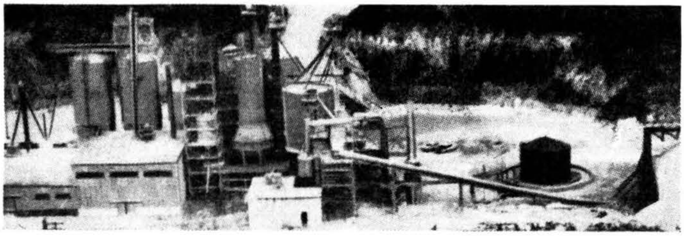

Fig. 1.—Lime Works at Brooksville, U.S.A.

seam, and is particularly suitable for a fluidising process, since it does not decrepitate as does some stone.

The preliminary stone preparation plant includes crushing, washing and screening facilities to produce 1-in. by 48-mesh material, which is heaped over a concrete tunnel leading to the plant where the calciner feed is prepared. The raw material is received from the quarry in 15-ton rear-discharge lorries and the processing is as shown in *Fig. 2*. After being crushed to 6-in. maximum size, the material is washed in a rotary scrubber. Material less than $\frac{5}{32}$in. in size is removed by a trommel screen attached to the discharge end of the scrubber. All material greater than 1-in. is then crushed to this size. The small material in a slurry is further classified and cleaned in a 3-ft. by 30-in. cyclone, and fed on to a 3-ft. by 4-ft. screen, from which the suitably graded and dewatered $\frac{5}{32}$-in. material joins the 1-in. material from the secondary vibrating screen and crusher to make up the 1-in. by 48-mesh material in the stockpile. The washing process in the cyclone removes impurities, which are mainly balls of clay and flints. Waste material from the cyclone and the screen, which is mainly fines, represents about half the $\frac{5}{32}$-in. material in the raw feed. The washing plant prepares material, which is very low in impurities, to feed to the drying and calcining plant. The stockpile area can accommodate 10,000 tons of material for the feed preparation plant, and acts as a buffer store between the quarrying and washing stages and the calcining stage of the operation.

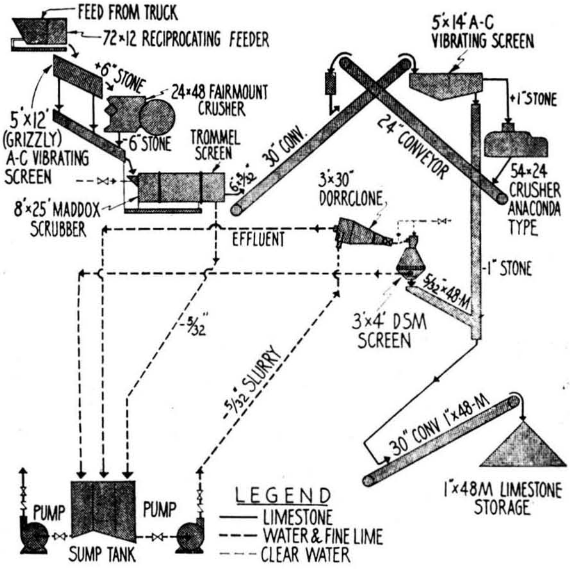

Fig. 2.—Limestone Working Plant.

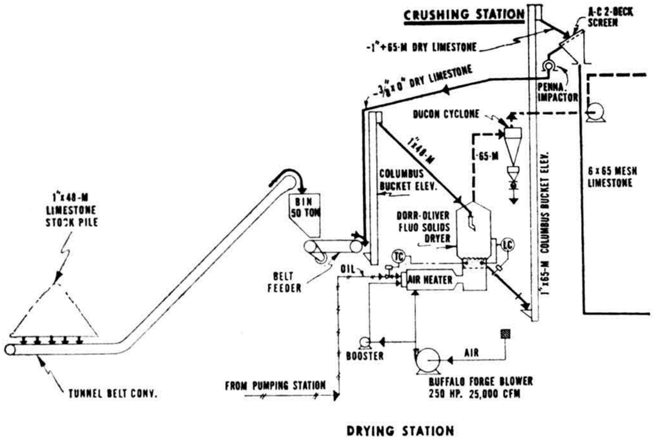

Fig. 3.—Drying and Crushing Plant.

The drying station deals with the final preparation of raw feed for the fluidising reactor; *Fig.* 3 shows the flow diagram for this part of the operation. The final preparation of feed is closely controlled as regards size and moisture content, since these factors are important in the operation of the fluidising reactor. Material from the stockpile is first dried in a fluidising unit, to eliminate moisture from the feed to the calciner. At the stockpile, the average moisture content is 10 to 12 per cent., but at the dryer 5·5 per cent., since dried material ⅜ in. and smaller in size is recirculated and mixed with the material coming from the stockpile to the dryer. Material 1-in. by 48-mesh in size, is introduced above a fluidised bed in the dryer. Fluidisation of the solids is obtained by the introduction of low-pressure pre-heated air through holes in a plate below the bottom of the unit. The pressure of the air is adjusted to overcome the pressure drop due to the restriction at the plate, resistance to passage through the bed, and resistance in the cyclones and ducts. Air is supplied by a 25,000-cu. ft. per min. blower operated by a 250-h.p. motor. The dryer also performs another purpose. Movement of the upward stream of hot gases separates the solids according to particle size. The unit at Brooksville removes material of smaller than 65-mesh which is sent to a collecting cyclone. The gases are again cleaned before discharging to the atmosphere. The limestone dust collected is disposed of. Final dried product is therefore 1-in. by 65-mesh material, and is reduced further in an impactor and screened through a two-deck vibrator to produce 6-by-65-mesh material, which is the size of the final feed to the fluidising calciner. Material of this size is stored in a 1200-ton bin, and travels over a belt-type continuous weighing device before being fed into the calciner (*Fig* 4.)

The lime-making unit is a five-compartment fluidising reactor, incorporating a solid hearth between the three top pre-heating zones and the lower calcining and cooling compartments. The purpose of the design is to enable separate collection of calcined materials. The fluidising principle of the reactor involves the partial suspension of solids by an upwardly moving stream of gas. The mixture of solids and gas behaves much like a liquid. The rate of heat transfer between the gases and solids is extremely fast, such action taking place in the calcining compartment of the reactor. The feed and hot gases flow in contrary directions in the reactor (*Fig.* 4). The dried 6-by-65-mesh limestone enters the top of the unit, passes into the first pre-heating compartment, and progresses downwards through the second and third pre-heating zones through connecting valves. The temperature is progressively higher as the material moves downwards until it reaches the 1800 deg. F. in the calcining compartment. Calcined material is then transferred to the cooling compartment below, is further cooled in water-filled hollow-flight screw-conveyors, and passed to two 600-ton storage bins.

Heat for the reactor is supplied by burning oil in the following manner. On starting up, a pre-heater introduces hot low-pressure gas just below the calcining compartment until a temperature of 1000 deg. F. is reached in that compartment. The oil is then fed into the fluidised bed through sixteen jets spaced around the reactor. Air at low pressure is mixed with the oil at the oil pumps, there being a pump for each of the jets. The oil is ignited immediately it enters the bed due to the high temperature. Oil consumption is about 35 gallons per ton. Air is supplied to the reactor at the bottom of the unit by an 8200-cu. ft. per min. blower driven by a 350-h.p. motor. Burning in the unit is controlled so as to have a theoretical balance of oxygen at 1 per cent. for the proper rate of oxidising.

The control system of the unit is completely interlocked to maintain proper temperatures and pressures and to maintain proper depths of beds in each com-

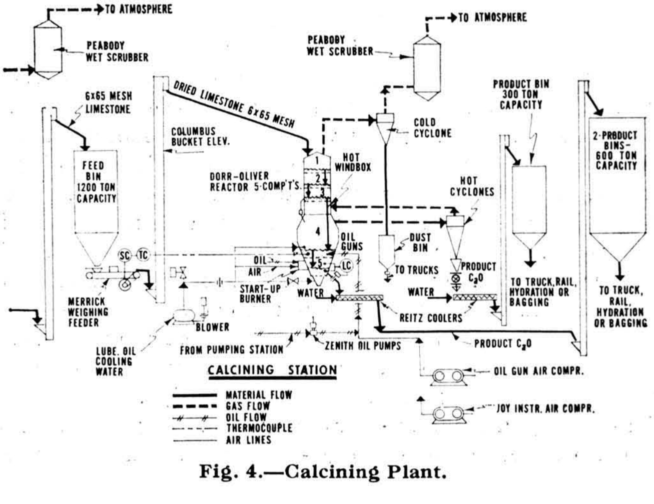

Fig. 4.—Calcining Plant.

partment. Control of the oil-air ratio provides the following temperatures in each compartment (from top to bottom): first pre-heating zone, 1000 deg. F.; second pre-heating zone, 1300 deg. F.; third pre-heating zone, 1550 deg. F.; calcining zone, 1800 deg. F.; and cooling zone, 650 deg. F.

Movement of material downwards through succeeding zones is controlled accurately by bed-depth level controls, which operate as pressure devices. When a proper difference of pressure is reached between the bed in, say, the first pre-heating compartment and the freeboard of the compartment, an internal valve through the plate opens automatically to allow material to drop to the next compartment below. This procedure applies to each successively lower compartment except the third pre-heating zone, where the valve is external so as to circumvent the hot windbox above the solid hearth over the calcining compartment. The solid hearth, which is unique to this plant, allows collection of limestone dust and hot calcined lime separately, the latter material being good lime. Without the solid hearth, lime dust and uncalcined limestone dust would be collected together and would be wasted. The advantage of the arrangement is an additional daily output of 30 tons of lime.

Material to be hydrated passes first through a mixer and then into the hydrater. Hydrated lime leaves the unit at 175 deg. F., and goes to a mill for pulverising to less than 325-mesh. The products are then collected by a separator and a cyclone. The hydrate so collected passes to storage bins for loading in bulk into lorries or railway wagons or for transfer to bins above two bagging machines.

The process used in this plant is the Fluo-Solids system developed by Dorr-Oliver Inc., and is suitable for soft friable limestone which would be difficult to process in kilns. The plant was installed by Frank Murphy & Associates, Lakeland, Florida. The information and illustrations in the foregoing are abstracted from recent numbers of " Rock Products " and " Pit and Quarry."

New Lime Plants in Europe.

Italy.—A new lime works is almost ready to commence operation in Lecco, in northern Italy. It has four shaft kilns and is fired by gas from low-grade coal at a temperature of 200 deg. C. The plant is of Hungarian design and is similar to those installed in Czechoslovakia in 1960 (see this journal for January 1961). The works is being installed by the Hungarian Foreign Trade Company, Nikex, in co-operation with the Austrian Faurungstechnik Co. Negotiations are proceeding for the installation of eight similar plants in Italy.

Poland.—Polimex, the Polish Foreign Trading Corporation, has made arrangements with Sturtevant Engineering Co., Ltd., for the supply of a lime-hydrating plant valued at about £80,000. The main parts of the plant will be exported from Britain. It is claimed that this installation, which works on the Sturtevant-Knibbs system, will be the most up to date in the world and, since it will have an output of 32 tons per hour, it will be one of the largest.

Hydration of the Aluminous Minerals of Portland Cement in the Presence of Finely ground Carbonates.

IN a recent number of " Tsement," Mr. P. P. BUDNIKOV, Mr. V. M. KOLBASOV and Mr. A. S. PANTELEEV describe an investigation on the interaction of C_3A and C_4AF with calcium and magnesium carbonates during the process of hardening. The carbonates were natural marble, dolomite and magnesite. These and the synthetic C_3A and C_4AF were ground to a specific surface of 3000 sq. cm. per gramme. Quartz sand was also ground to the same degree of fineness for use in comparative tests with carbonates. The powders were mixed with the clinker minerals in the proportion of 30 per cent. of the dry mixture.

Thermographs were obtained of C_3A and its mixtures with these powders hydrated in paste of plastic consistence for twenty-eight days. The thermograph of C_3A hydrated in the pure form shows two characteristic endothermic effects at 300 and 460 deg. C. Similar effects occur on the thermograph for the material with quartz flour added, as well as an endothermic effect at 575 deg. C. corresponding to the transformation in the quartz of $\beta-SiO_2$ to $\alpha-SiO_2$.

The introduction of powdered carbonates altered the phase composition of C_3A. The thermographs of hydrated mixtures of C_3A with marble, dolomite and magnesite show a strong endothermic effect at 180 deg. C. and a weaker effect at 230 deg. C. The mixture with magnesite also showed a strong endothermic effect at 300 deg. C. characteristic of the products of hydration of C_3A.

An analogous change in phase composition occurred when these powders were added to C_4AF. The thermograph of C_4AF hydrated both in the pure form and in the presence of quartz flour exhibited characteristic endothermic effects at 160, 310 and 480 deg. C. The thermographs with the additions of marble, dolomite and magnesite show endothermic effects at 180 and 230 deg. C. in the same way as with the mixtures with C_3A.

The X-ray diffraction examination of pure C_3A hydrated in a paste of plastic consistence indicated that the basic product of hydration was $3CaO. Al_2O_3. 6H_2O$. The products of hydration of C_3A mixed with quartz flour contained the same hydrate.

When the C_3A was mixed with marble or dolomite, the presence of $3CaO. Al_2O_3. 6H_2O$ was no longer indicated but a series of new diffraction maxima occurred which was attributed to the compound $3\,CaO. Al_2O_3. CaCO_3. 11H_2O$ In the case of the hydrated mixture of C_3A with magnesite, the presence of this compound as well as $3CaO. Al_2O_3. 6H_2O$ was indicated. Analogous results were obtained for mixtures of C_4AF with the powders

Petrographic studies on aqueous suspensions confirmed that in the case of C_3A alone, the predominant product consisted of crystals of $3CaO. Al_2O_3. 6H_2O$. In the case of mixtures of C_3A with finely divided marble or dolomite, the main phase consisted of hexagonal plates and needles clustered around the original surface of the carbonate particles. The refractive index of this phase coincided with that given by Carlson for calcium-carboaluminate.

A similar new product of reaction occurred as a result of hydration of a mixture of C_3A and magnesite, but in a lesser quantity. About 25 to 30 per cent. of $3CaO. Al_2O_3. 6H_2O$ was also present, whereas in the hydrated mixtures containing marble or dolomite 7 to 10 per cent. only was formed. Addition of quartz flour did not alter the products of reaction of C_3A.

Hydration of C_4AF in the pure form and in mixtures with carbonates produced a predominating phase of brown hydrated oxide of iron. The products of hydration of pure C_4AF and its mixture with quartz flour also contained crystals of $3CaO. Al_2O_3. 6H_2O$ on the surface of particles of unhydrated C_4AF and quartz. The same hydrate appeared to a lesser extent in the hydrated C_4AF with addition of magnesite and was absent with additions of marble or dolomite. In the mixtures containing marble and dolomite, the calcium-carboaluminate occurred as the basic crystalline phase, and in the mixture with magnesite it occurred together with $3CaO. Al_2O_3. 6H_2O$.

Indications of the strengths of the hydrates involved were obtained by crushing 1·41-cm. cubes. The specimens of pure C_3A were of low strength. Addition of quartz flour had little effect. In most cases, the introduction of powdered carbonates considerably increased the strength, but the effect was less marked with magnesium carbonate in the early stages of hardening. After several months the strength of the specimens containing magnesium carbonate approached those given by specimens containing marble or dolomite.

Specifications for Portland Cement.

TABLES giving the requirements regarding Strength (*Table III*) of Portland cement in accordance with the standard specifications of various countries are given on pages 62 to 67. Tables giving the requirements regarding Chemical Composition (*Table I*) and Setting Time and Soundness (*Table II*) were published in this journal for May last. The data is up to date to 1961.

Types of Cement.

Abbreviations denoting the various types of cement are as follows: H.S., high strength; L.H., low heat; S.R./L.H., moderate sulphate resistant and low heat; S.R., sulphate resistant; R.H., rapid hardening; O., ordinary; A.E., air entrained.

Table III.—Strength.

Strengths are measured on 3 : 1 sand-cement mortar specimens except where indicated otherwise.

Upper figures are strengths in pounds per square inch; lower figures are strength in kilogrammes per square centimetre.

* indicates optional requirements. † refers to notes in " Remarks " column.

TABLE III.—STRENGTH OF PORTLAND CEMENT.

(For Notes see page 61.)

Country	Type of Cement	Tensile Strength Age of specimen in days				Bending Strength Age of specimen in days			Compressive Strength Age of specimen in days				Remarks
		1	3	7	28	3	7	28	1	3	7	28	
Argentina	O.	—	—	284 20	398 28	—	—	—	—	—	3270 230	4620 325	
	R.H.	285 20	427 30	498 35	712* 50*	—	—	—	3200 225	5690 400	6400 450	8540* 600*	Tensile and compressive at 2 days: (356/25) and (4977/350). At 28 days are for combined wet and dry storage
Australia	O.	—	—	—	—	—	—	—	—	2500 176	3500 246	4500 316	
	L.H.	—	—	—	—	—	—	—	—	2500 176	3500 246	4500 316	
	R.H.	—	—	—	—	—	—	—	—	400 281	5500 387	6500 457	
Belgium	O.	—	256 18	327 23	384 27	—	—	—	—	2845 200	4266 300	5600 400	
	H.S.	—	327 23	384 27	427 30	—	—	—	—	4266 300	5690 400	7110 500	
	R.H.	285 20	384 27	427 30	455 32	—	—	—	3200 225	5690 400	7110 500	8178 575	
Brazil	O.	—	—	—	—	—	—	—	—	1140 80	2133 150	3556 250	
	R.H.	—	—	—	—	—	—	—	1565 110	3129 220	4409 310		
Britain Mortar cubes	O.	—	—	—	—	—	—	—	—	2220 154	3400 239	—	
	R.H.	300 21·1	—	—	—	—	—	—	—	3000 210	4000 281	—	
	L.H.	—	—	—	—	—	—	—	—	1100 77	2000 140	4000 281	

Concrete cubes	O.	—	—	—	—	—	—	—	—	1200 84	2000 140	—	Proportions of coarse and fine aggregate to be such that (i) with 325 ± 1 g. cement and 195 ± 1 g. water they fill the 4 in. cube mould completely when fully consolidated and (ii) that a slump of between ½ in. and 2 in. is obtained
	R.H.	—	—	—	—	—	—	—	—	1700 119	2500 175	—	
	L.H.	—	—	—	—	—	—	—	—	500 35	1000 70	2000 140	
Bulgaria	O.	—	—	256 18	356 25	—	356 25	711 50	—	—	2845 200	4267 300	Tensile and compressive at 28 days combined wet and dry storage: (427/30) and (5688/400)
	H.S.	—	356 25	—	427 30	256 25	—	782 55	—	3555 250	—	5690 400	Ditto (569/40) and (7110/500)
Canada	O.	—	200 14·1	275 19·3	350 24·6	—	—	—	—	900 63	1800 127	3000 211	2·75 : 1 mortar for compressive test
	R.H.	275 19·3	375 26·4	—	—	—	—	—	1250 88	2500 176	—	—	
	S.R.	—	150 10·5	250 17·6	325 22·8	—	—	—	—	750 53	1500 105	2800 197	
Chile	O.	—	284 20	356 25	427 30	—	—	—	—	2844 200	3556 250	4978 350	
	H.S.	—	356 25	427 30	498 35	—	—	—	—	3556 250	4978 350	6400 450	
China	200	—	—	171 12	256 18	—	—	—	—	—	1422 100	2844 200	
	250	—	—	171 12	256 18	—	—	—	—	—	1991 140	3555 250	
	300	—	—	213 15	313 22	—	—	—	—	—	2560 180	4266 300	
	400	—	213 15	270 19	327 23	—	—	—	—	2275 160	3697 260	5688 400	
	500	—	270 19	327 23	384 27	—	—	—	—	3128 220	4977 350	7110 500	
	600	—	299 21	384 27	455 32	—	—	—	—	3697 260	5972 420	8532 600	

TABLE IV.—STRENGTH OF PORTLAND CEMENT (*Continued*).

(*For Notes see page 61.*)

Country	Type of Cement	Tensile Strength Age of specimen in days				Bending Strength Age of specimen in days			Compressive Strength Age of specimen in days				Remarks
		1	3	7	28	3	7	28	1	3	7	28	
Cuba	O.	—	150 11	275 19	350 25	—	—	—	—	1200 84	2100 148	3500 246	2·75 : 1 mortar for compressive test
	M.S.R./ M.L.H.	—	125 9	250 18	325 23	—	—	—	—	1000 70	1800 127	3500 246	
	R.H.	275 19	375 26	—	—	—	—	—	1700 120	3000 211	—	—	
	L.H.	—	—	175 12	300 21	—	—	—	—	—	800 56	2000 141	
	S.R.	—	—	250 18	325 23	—	—	—	—	—	1500 105	3000 211	
Czechoslavakia	250	—	—	242 17	356 25	—	—	—	—	—	2560 180	3556 250	
	350	—	—	327 23	427 30	—	—	—	—	—	3556 250	4978 350	
	450	—	356 25	398 28	469 33	—	—	—	—	3911 275	5334 375	6410 450	
	550	—	398 28	455 32	498 35	—	—	—	—	4836 340	6116 430	7823 550	
Denmark	O.	—	—	284* 20*	356* 25*	—	—	—	—	—	4551 320	5690 400	Tensile and compressive at 28 days combined wet and dry storage: (427/30) and (6399/450)
	R.H.	—	284 20	284 20	356 25	—	—	—	—	4267 300	4551 320	5690 400	Ditto (427/30) and (6399/450)
Eire	O.	—	330 23·2	430 30·2	—	—	—	—	—	—	—	—	
	R.H.	300 21·1	455 32·0	—	—	—	—	—	—	—	—	—	

Finland	O.	—	—	—	—	427* 30*	569 40	853 60	—	2133* 150*	3200 225	4978 350	All types.—Mortar = 2 (coarse): (fine): 1 (cement) Bending strength at 1 day: (1422*/100*) R.H. only Bending and compressive strengths at 90 days: (853/60) and (4977/350) L.H. only
	R.H.	—	—	—	—	712 50	853* 60*	996 70	1422* 100*	4267 300	5334* 375*	6400 450	
	L.H.	—	—	—	—	—	427* 30*	712 50	—	—	1778* 125*	3556 250	
France	O.1	—	—	284* 20*	356* 25*	—	—	—	—	—	2270 160	3556 250	
	O.2	—	—	284* 20*	356* 25*	—	—	—	—	—	3555 250	4479 315	
	R.H.	—	—	356* 25*	427* 30*	—	—	—	—	—	4479 315	5689 400	Tensile and compressive at 2 days: (256*/18*) and (2276/160)
	H.S.	—	—	427* 30*	498* 35*	—	—	—	—	—	5049 355	7112 500	Tensile and compressive at 2 days: (285*/20*) and (2850/200)
Germany (East)	O.	—	—	—	—	427 30	569 40	853 60	—	2133 150	3200 225	4977 350	Bending strength at 1 day is (335/25)
	R.H.	—	—	—	—	711 50	853 60	995 70	1422 100	3910 275	5119 360	6399 450	
Germany (West)	275	—	—	—	—	—	427* 30*	712 50	—	—	1565* 110*	3910 275	All types.—Mortar = 2 (coarse): (fine): 1 (cement) Bending strength at 1 day: (427*/30*) for 475 only
	375	—	—	—	—	427* 30*	569 40	853 60	—	2133* 150*	3200 225	5333 375	
	475	—	—	—	—	711 50	853* 60*	996 70	1422* 100*	4267 300	5120* 360*	6755 475	
Greece	O.	—	—	256 18	356 25	—	—	—	—	—	2560 180	3911 275	Tensile and compressive at 28 days combined wet and dry storage: (427/30) and (4977/350)
	R.H.	—	356 25	—	427 30	—	—	—	—	3555 250	—	5688 400	Ditto (569/40) and (7110/500)
Hungary	400	—	—	284 20	370 26	—	—	—	—	—	3982 280	5688 400	
	500	—	—	384 27	427 30	—	—	—	—	—	4977 350	7110 500	Tensile and compressive at 2 days: (284/20) and (2844/200)
	600	—	—	455 32	498 35	—	—	—	—	—	6420 450	8532 600	Ditto (356/25) and (3555/250)

TABLE III.—STRENGTH OF PORTLAND CEMENT (*Continued*).

(*For Notes see page 61.*)

Country	Type of Cement	Tensile Strength Age of specimen in days				Bending Strength Age of specimen in days			Compressive Strength Age of specimen in days				Remarks
		1	3	7	28	3	7	28	1	3	7	28	
India	O.	—	285 20	355 25	—	—	—	—	—	1650 115	2500 175	—	
	R.H.	285 20	425 30	—	—	—	—	—	1650 115	3000 210	—	—	
	L.H.	—	—	—	—	—	—	—	—	1000 70	1650 115	3800 265	
Israel	O.	—	284 20	356 25	—	—	—	—	—	1422 100	2204 155	—	
	R.H.	284 20	427 30	—	—	—	—	—	1422 100	2631 185	—	—	
Italy	O.	—	—	370 26	455 32	—	—	—	—	5405 380	7112 500	—	
	H.S.	—	299 21	441 31	526 37	—	—	—	4125 290	7112 500	9672 680	—	
Japan	O.	—	—	—	—	213 15	356 25	569 40	—	782 55	1564 110	3128 220	2 : 1 mortar (all types). Bending strength at 1 day: (142/10) for R.H.
	R.H.	—	—	—	—	356 25	569 40	853* 60*	569 40	1280 90	2560 180	3982* 280*	
	L.H.	—	—	—	—	142 10	284 20	427 30	—	498 35	995 70	2133 150	
Mexico	O.	—	142 10	270 19	341 24	—	—	—	—	853 60	1706 120	2986 210	2·75 : 1 mortar for compressive test
	R.H.	270 19	370 26	—	—	—	—	—	1209 85	2489 175	—	—	
	M.S.R./ M.L.H.	—	128 9	242 17	327 23	—	—	—	—	711 50	1422 100	2986 210	
	L.H.	—	—	185 13	299 21	—	—	—	—	—	782 55	1991 140	
	S.R.	—	128 9	242 17	327 23	—	—	—	—	498 35	1422 100	2986 210	

Netherlands	O.	—	242 17	299 21	384 27	—	—	—	—	2489 175	3555 250	4622 325	
	R.H.1	—	327 23	384 27	455 32	—	—	—	—	3555 250	4980 350	6045 425	
	R.H.2	327 23	384 27	455 32	498 35	—	—	—	3555 250	4980 350	6045 425	7466 525	
Norway	O.	—	228 16	312 22	384 27	—	—	—	—	2844 200	4266 300	5688 400	
	R.H.	—	—	384 27	427 30	—	—	—	—	—	5688 400	7110 500	Tensile and compressive at 2 days: (313/22) and (4266/300)
Poland	O.1	—	—	—	—	—	427 30	711 50	—	—	1849 130	3555 250	2 (coarse) : 1 (fine) (cement)
	O.2	—	—	—	—	356 25	569 40	853 60	—	1849 130	3200 225	4977 350	
	H.S.	—	—	—	—	498 35	640 45	924 65	—	2560 180	3983 280	5689 400	
Portugal	O.	—	—	—	—	356 25	498 35	711 50	—	1565 110	2560 180	3911 275	
Roumania	O.1	—	—	284 20	356 25	—	—	—	—	—	2845 200	4267 300	
	O.2	—	284 20	356 25	398 28	—	—	—	—	2844 200	3982 280	5688 400	
	H.S.	—	356 25	427 30	484 34	—	—	—	—	3692 260	5405 380	7112 500	
	E.B.	—	300 22	375 27	—	—	—	—	—	1600 113	2500 176	—	
South Africa	O.	—	—	—	—	—	250 18	400 28	—	2200 155	3000 211	—	
	R.H.	—	—	—	—	—	400 28	550 39	—	3400 239	4000 284	—	

(*To be continued*).

Computer Control at a Japanese Cement Works.

A COMPUTER control system has been installed in the new works of the Chichibu Cement Co., at Kumagaya, near Tokyo. This is the first application of a computer to the direct control of cement manufacture in Japan. The American firm of Thompson Ramo Wooldridge Inc., are supplying this equipment, which includes an RW-300 computer to control directly the wet blending and clinker burning. Four wet-process rotary kilns will be controlled and optimised by this computer. The benefits expected from computer control are increased production and more uniform quality of the various grades of Portland cement. In addition to making the optimum settings of the kiln controls, the computer system controls the passage of the raw materials from the hoppers to the mills, from the mills to the slurry tanks, and from the slurry tanks to the slurry basins.

The computer control system for the kilns operates as follows. The computer holds a mathematical model of the process which describes the temperature and chemical composition of the material at each point along the kiln for a given set of operating conditions. The actual operating conditions are measured by the computer and referred to the model to determine what adjustments to the plant are required. An optimising programme takes into consideration the characteristics of the kiln, the composition of the slurry, and weather conditions to evaluate the best conditions for each kiln at any time. A dynamic stabilisation programme maintains the desired values of these operating conditions in relation to independent disturbances. The computer adjusts the controller settings directly.

A similar installation has been operating successfully in the Riverside Cement Co.'s works in California for the past two years; at this works, which is said to be the first of its kind in the world, a computer system guides quarrying operations and blending of raw materials, collects data on the raw materials, and exercises closed-loop control over the rotary kiln.

Recent Publication.

"Hydraulics in Mechanical Handling." By J. R. Fawcett. (Trade & Technical Press Ltd. Morden, Surrey. 1962. Price 42s.)

THE combination of a hydraulically-operated mechanical handling system with that of a machine itself is a feature of present-day engineering that has been brought about by the general acceptance of hydraulics as a medium for power transmission. In this book, attention is paid to the potentialities of hydraulic power in many different directions, and its application to fixed and mobile mechanical handling systems is considered. Engineers, designers and draughtsmen will find the extensive range of information of value and the data should form a sound basis for knowledge of the characteristics of various items of hydraulic equipment and the design of hydraulic and electrical circuits.

The book, the author of which is well known in the field of hydraulics, deals specifically with mechanical handling in machine shops; rams and cylinders; hydraulic motors; valves with manual and automatic control; pipes, hoses, packings and joints; reservoirs, filters and oils; power steering hydro-kinetic drives and the like; and instruments. There are twenty-four tables and numerous clear diagrams.

Inside Information

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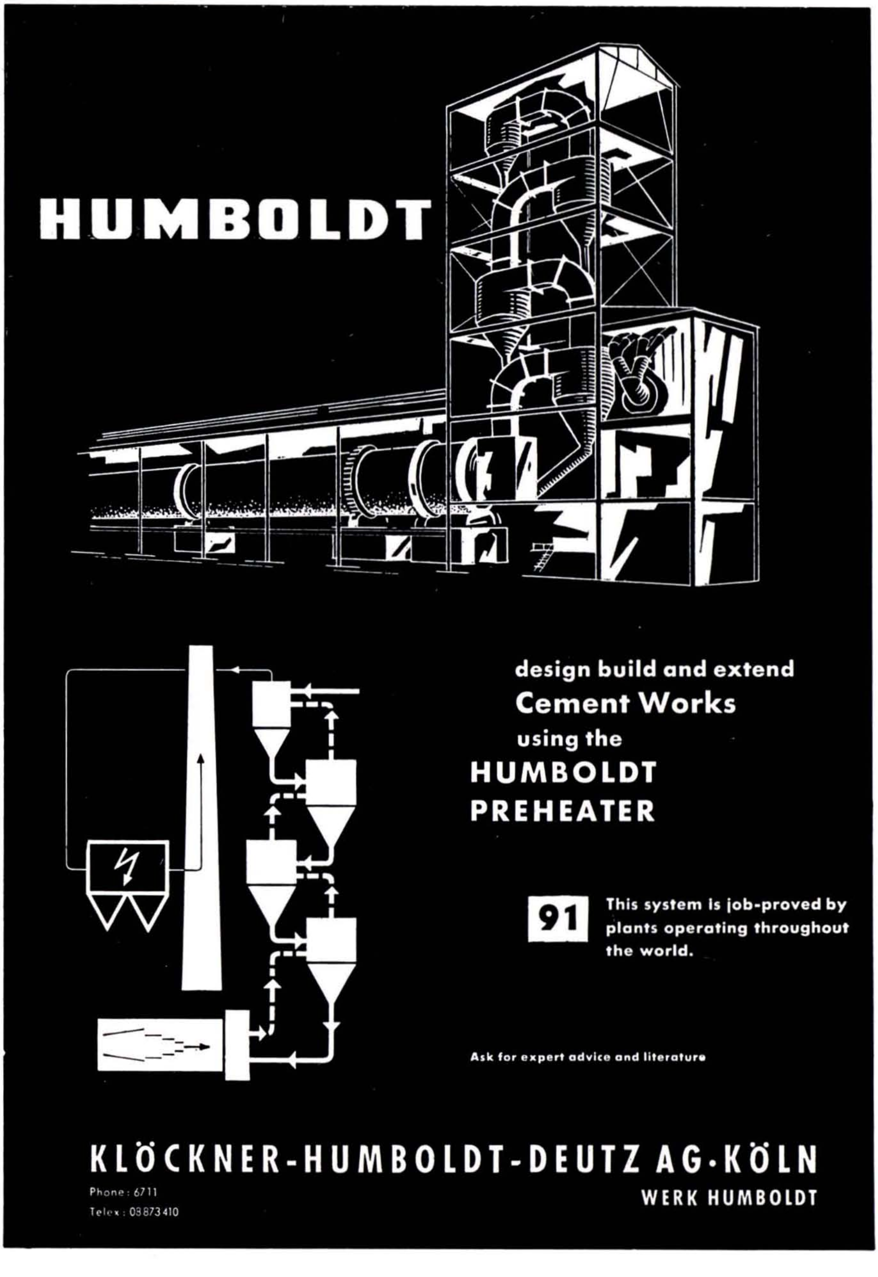
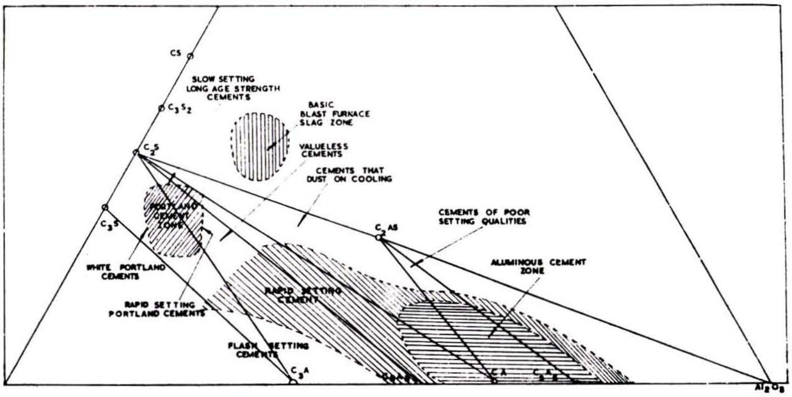


Physico-chemical Considerations of Cement.

A PAPER entitled "Cement: Some Physico-chemical Considerations," which was the basis of an address delivered by MR. A. D. MERRIMAN, G.C., O.B.E., D.Sc., before the State Scientific and Technical Committee of the U.S.S.R. in Moscow in December 1960, has been published in full in "The Edgar Allen News" for August, September, October and November 1961.



The paper is in two parts, in the first of which are given standard free energy diagrams for reactions of the various constituent compounds. The reactions all relate to a fixed amount of oxygen or silica. The second part is concerned with phase diagrams, development of strength, and related matters. An interesting diagram, which is reproduced above, shows the zones of a CS-CA diagram applicable to various types of cement.

Recent Publications.

"Solid Fuel Installations."

THIS manual, issued by the National Coal Board (in 1962), is intended to aid those who are concerned with the design of boiler houses and ancillary works. The subject matter includes solid fuel boilers and boiler houses, mechanical firing, storage of fuel, ash handling, and chimneys. The requirements of the Clean Air Act are given.

"Glossary of Terms relating to the Manufacture and Use of Refractory Materials." [British Standard No. 3446 (1962).] Contains the definition of about eight-thousand terms. (Price 25*s.* from the British Standards Institution.)

"The Platinum Metals in Thermometry." By J. R. Knight and D. W. Rhys. (Published by Engelhard Industries Ltd. 1961. No price stated.)

THIS publication of about a hundred pages deals with temperature scales, the use of metal of high purity in thermometers, and the preparation of such material. Platinum resistance thermometers and thermo-couples are then considered together with refractory sheaths. The calibration, maintenance and applications of these instruments are also considered.

The Cement Industry in Europe

Switzerland.—Sales of cement in the first six months of 1961 were 1,319,064 tons, which is an increase of 21 per cent. compared with the same period in 1960. Construction of power stations used 15 per cent. of this amount. The price of cement in Switzerland has been reduced by 10 per cent. in the past two years.

Sweden.—The production of cement in Sweden in the year 1961 was 3,000,000 tons compared with 2,810,000 tons in 1960 and about the same amount in 1959. The increase in production is not due to the establishment of new works but some old kilns have been replaced by new plant, the number of kilns being unchanged. Exports were about 170,000 tons which is approximately the same as in the preceding year.

Yugoslavia.—A new automatic cement works is to be put into operation soon at Split.

Eire.—The Cement (Amendment) Bill, 1962, which was passed by the Dail recently, proposes to revoke the Government's ban on the importation of cement. Part 3 of the Cement (Amendment) Act, 1938, prohibits imported cement except under licence granted by the Minister for Industry and Commerce. The Bill provides for the repeal of this section of the Act, but imposes a customs duty of 20 or 30 per cent. It is reported that Cement Ltd., has been able to supply the entire requirements of the country and has also developed a substantial export trade.

The last occasion on which cement was imported in large quantities into Eire was after the strike of cement-making works at Drogheda and Limerick, which created a severe shortage of cement for building projects.

Hungary.—With the construction and modernisation of cement works at Vác, Labatlan and Hejoecsaba, all of which are due to be completed by 1965, cement production should reach 2,600,000 tons per annum; imports of cement should then cease.

The construction of the new works of the Danube Cement & Lime concern at Vác, is proceeding rapidly. Production, which will be 1,000,000 tons annually, is expected to commence before the end of this year. Some of the buildings are of steel construction, but others have reinforced concrete frames.

Iceland.—The amount of cement sold in Iceland in 1961 was 61,500 tons compared with 94,000 tons in 1958. The decrease reflects the decrease in new building. The State cement works reports that arrangements have been made to export 20,000 tons of cement to the United Kingdom in 1962.

Greece.—The American firm of U.S. European Growth Inc., has received approval to finance the construction of a cement works in the Aetoloa-Karnania district. The works is to have a capacity of 250,000 tons annually and will operate on a dry process closed-circuit system.

Poland.—During 1961, the amount of cement exported was 714,000 tons. About 52,000 tons of clinker was exported to the United Kingdom.

The present five-year economic development plan of the Polish Government includes the construction of a new cement works at Dzialoszyn. The preliminary survey has already been completed and work has started on the erection of the kiln and clinker-grinding plant.

WORLD CEMENT DIRECTORY

An International Directory of the Cement Industry

Published by **Cembureau** (The Swedish Cement Statistical Association).

THE data, which are up to date to the beginning of 1960, are presented in 152 pages of tables and 31 maps giving the, size location and ownership of cement works in about a hundred countries. Includes the names and addresses of the operating companies and of their works, the number and type of kilns, the method of manufacture, the capacity of the kilns, the capacity for the production of clinker and cement, the types and trade names of the cements manufactured, and in some cases the number of workers.

The Directory is indispensible to makers of cement, suppliers to the cement industry, exporters of cement and concrete products, libraries and statistical authorities, and planning organisations.

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The Associated Portland Cement Manufacturers Ltd.

THE following are extracts from the Chairman's statement at the recent Annual General Meeting of the Associated Portland Cement Manufacturers Ltd.

The percentage increase in demand in 1961 was the highest ever and deliveries were 8·57 per cent. higher. It was only by using up all stocks and importing a limited tonnage from the Continent that the demand was met.

The expected damaging effect that the hydro-carbon oil duty would have on export trade was unfortunately realised; exports fell by one-third, which is equivalent to about 300,000 tons. There was no alternative but to withdraw from many of the old traditional markets because the oil duty turned a profit, already only marginal, into a loss. There was also increasing competition from Mediterranean countries who earn foreign currency by the export of cement. In these cases, prices are not based on normal commercial considerations but are subsidised by increased charges made to consumers in the country concerned. The main advantage of this country joining the Common Market will be the rationalising of fuel costs compared with other European countries.

The expansion programme is well under way both as regards increased capacity and the provision of more bulk depots. It is expected to have the third kiln in operation at Cauldron Works by August and the new works at Westbury should be in production by the end of 1962.

There were record sales by overseas interests, amounting to 2,608,339 tons. Production abroad has grown over four and a half times since the end of the war and the policy of expansion continues where favourable opportunities exist. In some parts of the world, commercial considerations are becoming subordinated to politics to such an extent as to lessen the inducement to capital investment from abroad.

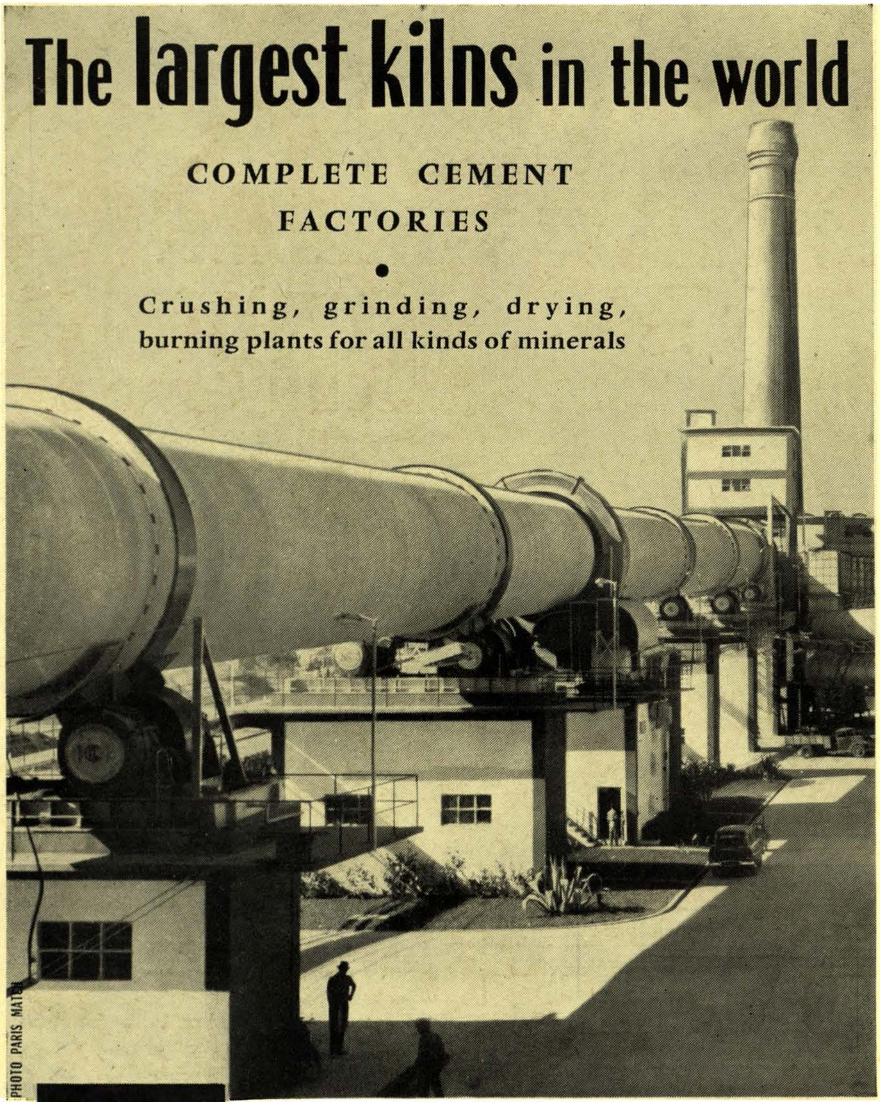
In Australia, The Commonwealth Portland Cement Co., Ltd., and its wholly owned subsidiary, Metropolitan Portland Cement Proprietary Ltd., delivered a record tonnage, which exceeded that of any other manufacturer in New South Wales. Construction of the new 300,000-ton works near Geelong by the subsidiary, The Victoria Portland Cement Company Proprietary Ltd., is proceeding as planned and the plant is expected to be in production in the latter part of 1963. Once again Malayan Cement Ltd., established new records, and further expansion is proposed. Trading conditions in Mexico were somewhat quieter than in 1960 but there has since been an increase in demand.

In New Zealand, The Golden Bay Cement Co., Ltd., had a satisfactory year in spite of competition. The acquisition of the entire share capital of Waitomo Portland Cement Ltd., was completed, and a rotary kiln, which was surplus to requirements at Golden Bay, is being installed at the Waitomo works. In South Africa, the creation of the Republic did not affect trade to the extent which once seemed likely, but trade in Southern Rhodesia and Kenya has been seriously affected by political uncertainties. The Salisbury Portland Cement Co., Ltd., maintained its position relative to other manufacturers but sales were lower than in 1960. Construction work is now at a low ebb and it has been found necessary to restrict cement production. Trading results of The West African Portland Cement Co., Ltd., were adversely affected as a result of large scale imports from Iron-Curtain and other countries. The position has since been rationalised by the introduction of a licensing system and the prospects are regarded as satisfactory.

In Canada there was some improvement in trade in British Columbia, with a resultant improvement in the working of Ocean Cement & Supplies Ltd.

Road Tankers of 20 - tons Capacity.

FOR transporting about 26,000 tons of cement in bulk to the site of the new Bangala dam, the Rhodesia Railways have obtained three tank trailers each of which has a capacity of 20 tons. As shown in the accompanying illustration, each tanker is hauled by a three-axled Leyland Hippo tractor. By substituting one tractor for another during servicing periods, the tankers are in use for 24 hours a day. The cement is transported in rail-tankers to Rutenga (about 250 miles from Bulawayo) where it is pumped into silos before being transferred by gravity to the road-tankers which are expected to carry 2,500 tons a month during peak periods. The tankers may average 1½ return trips a day over the 68 miles from the rail-head to the site of the dam. Compressed air is used to activate the cement while discharging.



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