HUMBOLDT, KANSAS PLANT

by

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LOCATION

The Monarch Cement Company is located at Humboldt, Kansas - a small southeastern Kansas community on U.S. Highway 169, approximately 110 miles southwest of Kansas City. Humboldt is served by two railroads, the AT & SF and the M K T, both with ready outlets to accommodate Monarch's market area.

HISTORY

The original plant began operations in 1908, and following World War II, the first phase of a long-range rehabilitation program was initiated, with the existing plant to remain in full production during construction of the new facilities.

Since our existing plant was a dry process with waste heat boilers following the kilns, and since a reliable source of power was unavailable at that time, the decision was reached to continue with the same type of operation. Consequently in the spring of 1948 erection of the first 11' x 230' kiln and 30,000 lb. per hour waste heat boiler was started. These units went into operation late in 1949 and duplicate units in 1951. Both boilers served our existing electrical power generating facilities.

Phase two of the rehabilitation program consisted of the erection of a new turbine room and the installation of a 9,375 KVA Turbogenerator and associated switchgear. This together with a new shale crushing and drying plant went into operation in 1955.

By 1956 the rehabilitation program was 45% complete and a plan for completing the program as well as providing for a 50% capacity increase was put into action to bring our yearly production maximum to 2,400,000 barrels. This project involved an additional kiln and waste heat boiler, a combined milling

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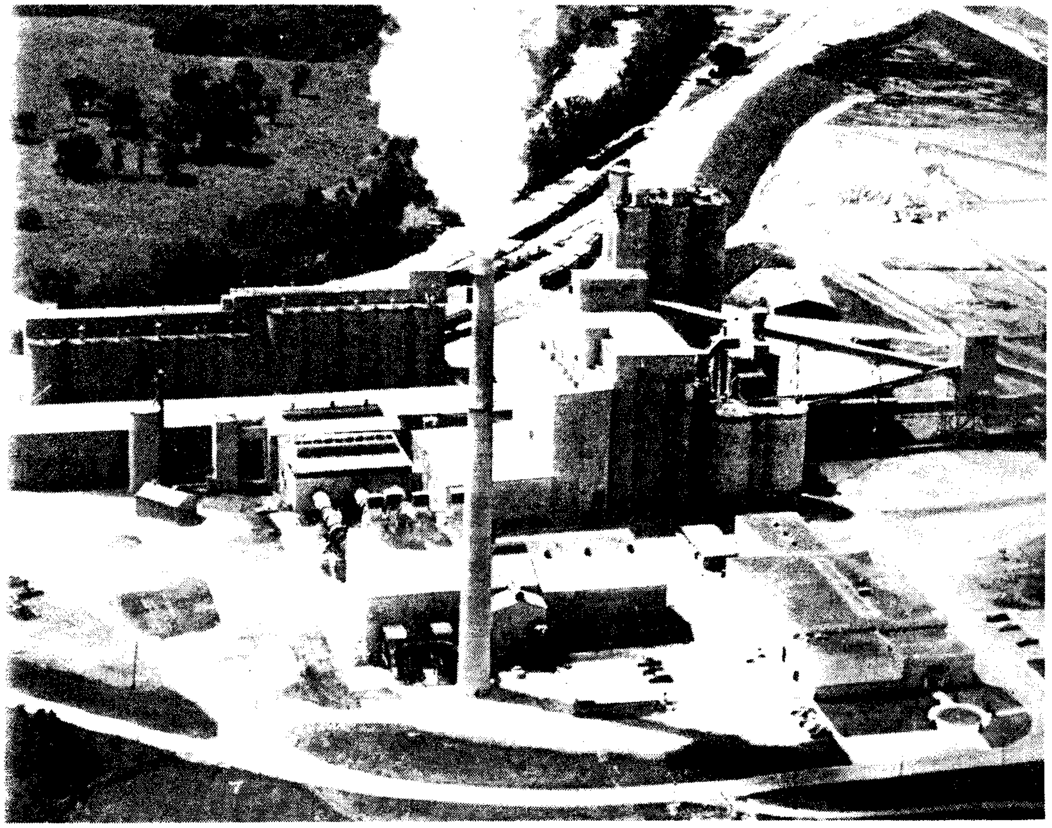

Fig. 1. General View of Humboldt, Kansas Plant.

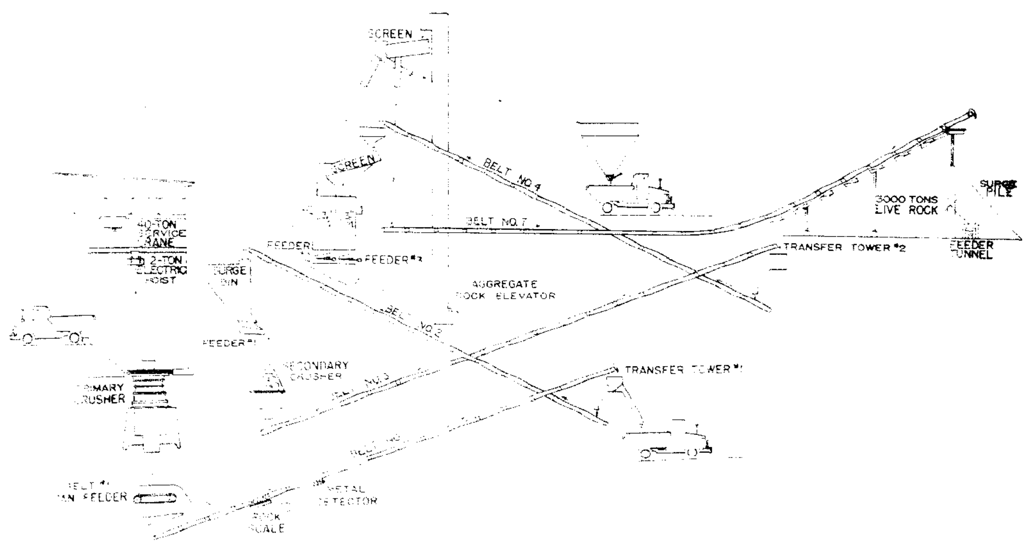

Fig. 2. Diagram of Rock Plant.

department, a rock crushing plant and plant offices. Following a two year construction period, all of the new facilities were in operation by the summer of 1958.

Six new cement storage silos with bulk loading facilities for truck and rail shipment were erected in 1961. Two raw dust blending silos were erected in 1965, and we are currently in the process of installing additional instrumentation to provide central control for our milling and kiln operations.

RAW MATERIALS

All raw materials are located adjacent to the plant. Our shale, geologically known as Lane Shale, is the 15' to 20' of loam and clay overburden. Directly beneath this is a 30' ledge of Iola limestone which is 93% pure Calcium Carbonate. When additional Silica is required an abundant supply is available from the silt along the nearby Neosho River which averages between 70 and 75% SiO_2.

The shale is excavated with a $2\frac{1}{2}$ cubic yard diesel shovel, loaded into a 25 ton diesel truck and hauled approximately three-quarters of a mile to our shale crushing and drying plant. It is dumped into a hopper over a 60 inch pan feeder, fed to a 40 x 40 non-clog hammermill and conveyed via 30" belts to a 10' x 80' rotary dryer. As quarried the shale has a moisture content ranging from fifteen to thirty percent, this is reduced in the dryer to a maximum of one and one-half percent. The dryer is parallel flow with the hot gases originating in a 14' x 36' combustion chamber located at the feed end of the dryer. Either natural gas or oil is used as fuel. After discharging from the dryer the gases pass through mechanical and hydraulic dust collectors before being vented to the atmosphere. The dried shale is discharged onto a 5' x 12' double deck horizontal screen. The plus 1" reject from the screen returns to the primary hammermill for further processing, the plus one-half inch is routed to a secondary hammermill for crushing and the minus one-half inch material discharges directly on a belt conveyer where together with the secondary hammermill discharge it is conveyed to the two mill feed silos and two interstices for storage.

Blastholes in the limestone are drilled 18' apart and 11' back of the ledge face with a $6\frac{1}{4}$" rotary drill. Prilled ammonium nitrate is used as the explosive agent, with a small quantity of dynamite and primacord used as a detonator. A normal ledge shot consists

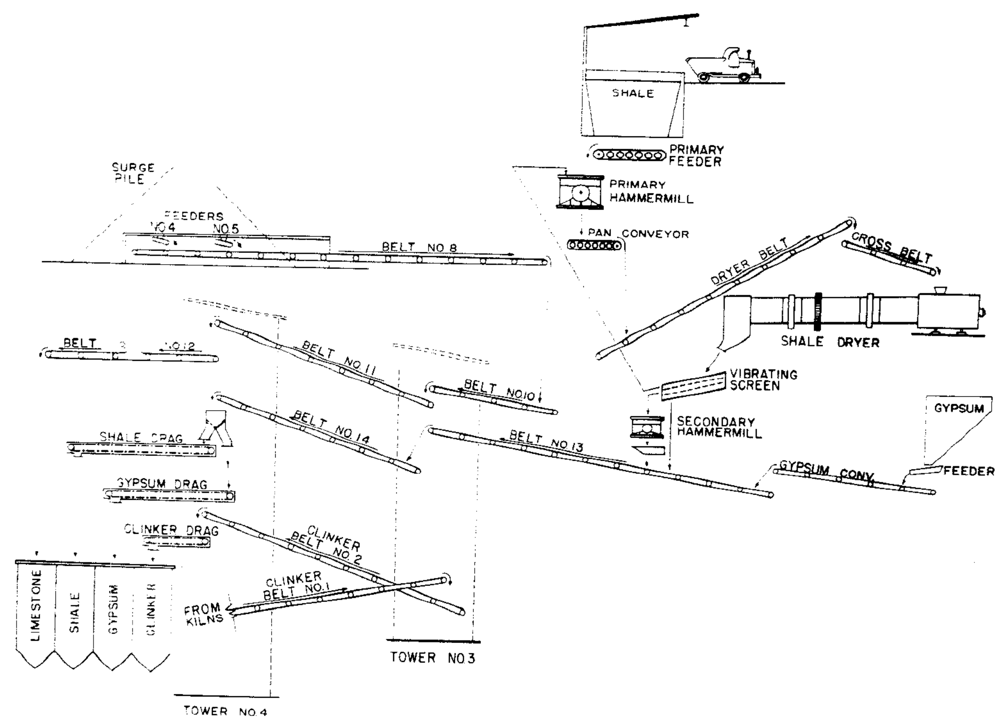

Fig. 3. Diagram of Materials Handling.

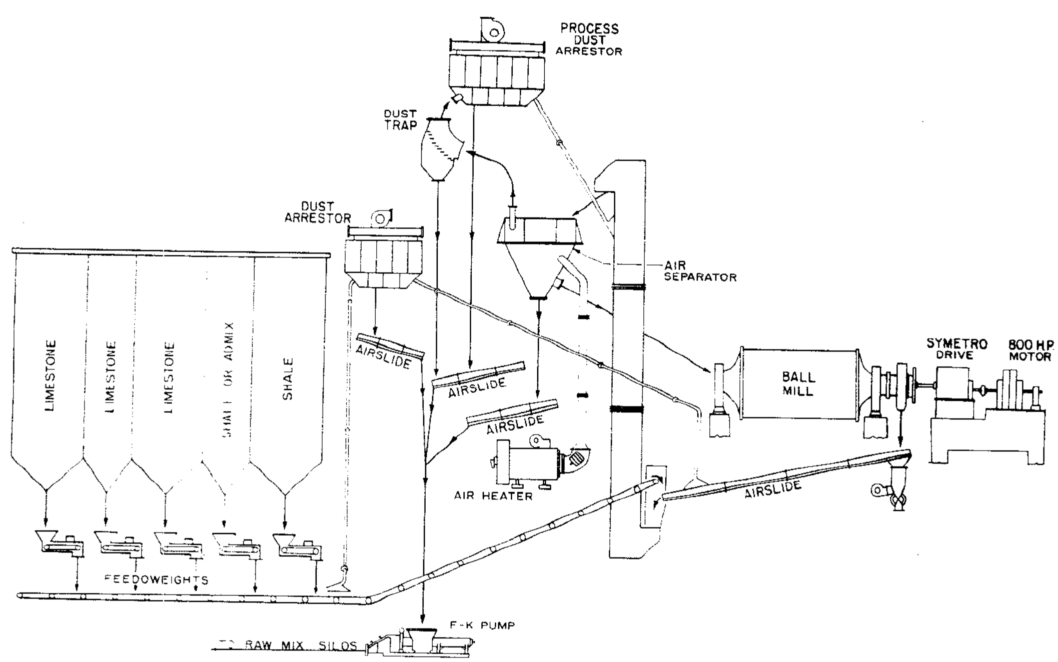

Fig. 4. Raw Circuit Diagram of Combined Milling.

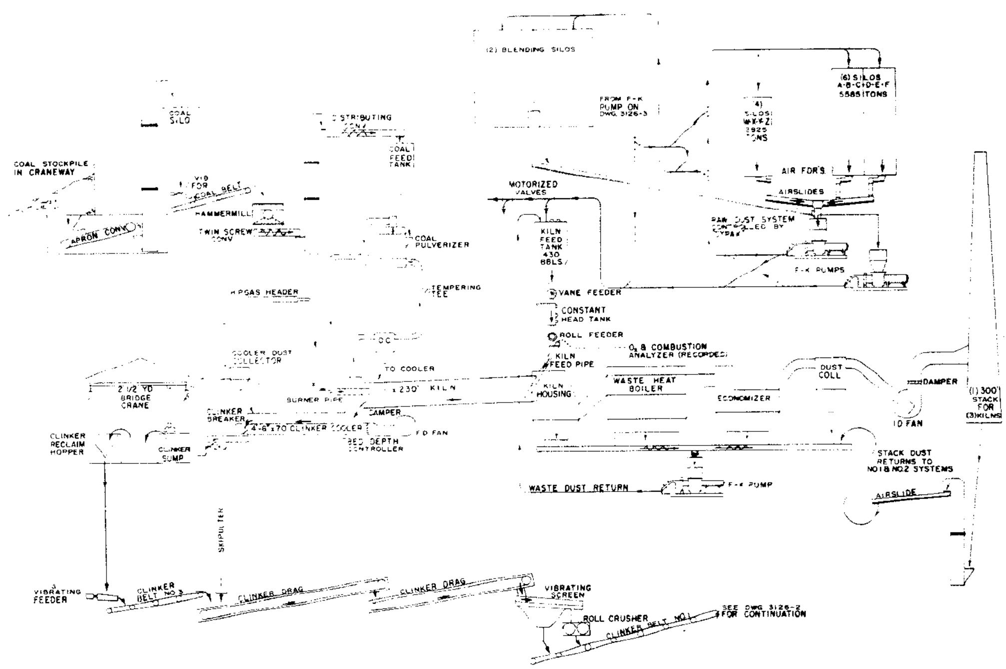

Fig. 5. Diagram of Kiln Circuit.

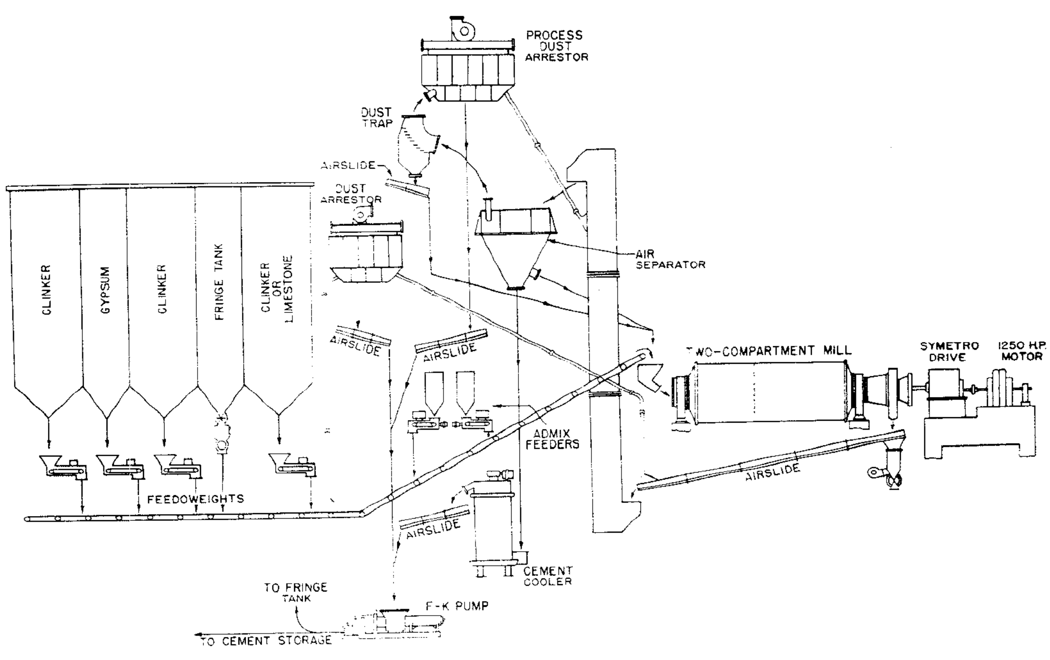

Fig. 6. Finish Circuit Diagram of Combined Milling.

of a series of 18 holes with time delays between them. Fragmentation is very good and requires a minimum of secondary shooting.

The shot rock is loaded into two 35 ton diesel trucks with a 4 cubic yard electric shovel and hauled approximately 3,000 yards to the rock crushing plant located in the center of our main quarry.

The primary crusher is a 42" gyratory which reduces the rock to minus five inches. The product from the gyratory crusher discharges onto a pan conveyer and is uniformily fed to 36" belts which elevate it to a 50 ton surge bin over the secondary crusher.

The minus 5" rock is fed from the surge bin by a 60" x 72" vibrating feeder at the rate of 450 - 600 TPH to a Pennsylvania Impactor. The discharge from the impactor is again elevated by 30" belts to a 3/4", 5' x 14' ripple-flo screen. The coarse material is returned to the impactor for further crushing and the minus 3/4" product is conveyed to a 9,000 live ton surge pile. As needed, the crushed limestone is withdrawn through a tunnel under the surge pile by two 30" x 60", 225 TPH vibrating feeders.

Thirty inch belt conveyers carry the limestone from the surge pile through transfer points in the shale plant and transfer towers to the mill feed silos. Atop the mill feed silos the limestone is distributed to one of four regular or two interstice silos with a travelling belt tripper.

RAW MILLING

Material is withdrawn from the bottom cones of the rock and shale mill feed silos through automatically controlled gravimetric feeders. Exact proportions of rock and shale mill feed are determined hourly by laboratory technicians and supervised by them through GE/Mac analog control instruments. Raw grinding is accomplished in two 10' 6" x 15' raw mills, powered by 900 HP motors through Symetro reducers. The capacity of each raw milling circuit is approximately 60 TPH with 87% of the product passing a 325 mesh screen.

The two raw mills operate in a closed circuit with a 16' air separator. Each of the gravimetric feeders discharges onto a common belt which carries the rock and shale mixture to a

27" x 86' elevator, where together with the mill discharge it is elevated to the separator. Hot gases from a 12 million BTU air heater pass through the separator for further drying of the raw materials.

The fines from both separators discharge to a common 10" Fuller pump where it is conveyed to the two 40' x 60' blending silos. From the blending silos, the homogenized mix goes either directly to the kiln feed tanks or to a bank of ten interim storage silos for later consumption.

KILNS

The kiln feed tanks are supplied with raw dust from either the blending silos or interim silo storage by controls which automatically start, stop and regulate the flow. Volumetric feeders control the flow of feed from the tanks to the kilns. Burning temperatures in the kilns range from 2700^{o}F to 2800^{o}F with exit gas temperatures ranging from 1000^{o}F to 1200^{o}F. After passing through the waste heat boilers where steam is generated at 400 lbs. pressure and 750^{o}F temperature the exit gas passes through mechanical dust collectors at 450^{o}F, induced draft fans and on out the 300' stack.

The clinker is discharged from the kilns into 4½' x 70' horizontal air quenching coolers. The speed of the coolers is controlled by Nuclonic bed depth controllers which assure a uniform cooling of clinkers and a source of constant temperature combustion air for the kilns. From the coolers the clinkers pass through clinker breakers which reduce the oversize lumps to a maximum of 1½". From here the clinker may be diverted via elevators and chutes to the craneway for storage or to an oscillating pan conveyer and directly to storage in the mill feed silos via drag and belt conveyers. Clinker from the craneway storage is reclaimed from crane supplied hoppers over the same system of drag and belt conveyers. At the first transfer point in the conveyer system the clinker passes over a rod deck screen and the plus half-inch material is crushed in a double roll crusher before continuing on to storage in one of the six 22' x 72' mill feed silos.

FINISH MILLING

Two 10' x 28' two-compartment finish mills are located adjacent to the two raw mills in the combined milling room. As in the raw section, feed, in this case clinker or gypsum, is withdrawn from the bottom of the mill feed silos onto constant weight gravimetric feeders. Again, as in the raw section, analog controllers supervised by the laboratory analysts control the ratio of material withdrawn from each silo and the amount of total feed to the mills. The feeders for each mill discharge onto a common belt which discharges directly into the mill. Each mill is driven by a 1250 HP, 720 RPM motor through a Symetro gear reducer. The mills operate through a closed circuit with the mill discharge going via an elevator to an air separator with the tailings returning to the mill and the fines going through a water cooled cement cooler before being pumped to storage by a 7" Fuller pump.

In order to simplify and reduce the number of spare parts carried in stock, duplication of equipment in the milling section was stressed. Hence all four elevators, separators, dust collectors, feeders and other auxiliary equipment are identical. Twelve identical silos, 22' in diameter and 72' high, 3 behind each mill circuit, provide the feed for the mills. Gypsum is stored and fed from one of the six interstices.

SHIPPING

Over 400,000 barrels of cement storage is provided in twelve 30' x 70', ten 30' x 90' and six 33' x 100' silos. Four packing machines, equipped with four spouts each, are located directly beneath the flat bottomed 30' diameter silos and packaged cement is conveyed from these machines to rail cars or trucks as needed.

The six new 33' x 100' storage silos are for bulk loading only and are equipped with platform scales for both rail and truck shipments. Most of our bulk shipments are loaded here, although the smaller silos are also equipped for bulk rail loading.