PLANT DESCRIPTIONS

ASH GROVE LIME & PORTLAND CEMENT CO.
Chanute, Kansas Plant

MONARCH CEMENT CO.
Humboldt, Kansas Plant

DEWEY PORTLAND CEMENT CO.
Tulsa, Oklahoma Plant

M-185

AIR POLLUTION CONTROL

CONTROL OF DUST EMISSION IN CEMENT PLANTS

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TABLE OF CONTENTS

CHANUTE, KANSAS PLANT

by

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Ash Grove Lime & Portland Cement Company's new 2,800,000 barrel wet process plant replaces the 2,000,000 barrel facility operating at Chanute, Kansas since 1908.

The existing quarries, hauling facilities and cement storage facilities were incorporated into the new plant.

The new plant developed from a two-stage construction program. Started in 1959 and completed the following year was the first stage, consisting of raw material handling, crushing, rail unloading and storage which were temporarily connected with the original plant.

In 1963, construction was started on the second stage, consisting of raw and finish grinding mills and a new kiln department, along with related facilities. In November, 1964, this new plant was put into production.

This plant is located 120 miles south of Kansas City, Missouri, 120 miles north of Tulsa, Oklahoma, and 120 miles east of Wichita, Kansas.

At this time the plant supplies one distribution terminal at Kansas City, Kansas. Two railroads serve this plant, the MK&T and the AT&SF.

QUARRY, CRUSHING & STORAGE

Three on-site quarries provide limestone, sandstone and shale. Limestone is from an Iola formation predominant in the

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area. Only 2 to 3 feet of overburden covers the weathered rock, which has an average thickness of about 35 feet. A Joy blast hole drill with 6" tri-cone bit provides the holes for primary blasting operations.

Limestone is loaded by two four cubic yard Bucyrus-Erie shovels. Shale and sandstone are loaded with a 4-1/2 cubic yard Michigan 275 front end loader.

Limestone is loaded into five 32-ton LeTourneau-Westinghouse Haulpak rear dump trucks. The haulage distance from the quarry face now being worked to the crusher dump is two and one-half miles.

The primary crusher is a 250 H.P. 42" x 65" Allis-Chalmers gyratory crusher with a 70-ton surge hopper and Jeffrey vibrating feeder to a Jeffrey 48" belt conveyor.

The secondary crusher is a Pennsylvania 700 H.P. 17" x 50" reversible impactor. Feed back from the electrical load on the impactor drive regulates vibratory feeder speed at the primary crusher discharge. Discharge from the impactor is carried by two flights of 42" belt conveyors to a pair of 8' x 16' two surface Ty-Rock vibrating screens above the impactor. Minus 3/4" material discharges to a 36" belt conveyor delivering by way of a traveling tripper directly to the crane storage.

The storage facility is a 120' wide by 420' long covered structure 75' in height, compartmentalized into seven bins having capacity for 22,000 tons of limestone, 2,500 tons of sandstone, 2,800 tons of shale, 1,800 tons of gypsum, 4,000 tons of coal, 400 tons of iron ore and 90,000 barrels of clinker.

Two P&H overhead cranes equipped with magnatorque electronic stepless controls of 15 tons capacity and with 7-1/2 ton buckets span and travel the building.

On the opposite side from the tripper belts, raw mill feed bins are charged by the overhead cranes. Feed bins discharge directly to Merrick W. S. Feed-O-Weights which are controlled by closed loop instrumentation delivering to a Stephens-Adamson natural frequency vibratory conveyor which discharges into the raw mill.

RAW GRINDING

The raw mill is a Nordberg 11' diameter x 36' long, two-compartment unit driven at 17.7 r.p.m. through a Falk TCD gear unit by a General Electric 720 r.p.m., 2,000 H.P. motor. The rated capacity is 117 t.p.h. with output ground to a fineness of up to 85% passing a 200 mesh screen. Approximately 90% of the water requirements are added with the mill feed.

The first compartment is 10 feet in length, lined with U.S.S. Type "D" rolled steel mill lining and charged with 47.3 tons of 3" to 1" balls. The second compartment is 24 feet long, lined with 2-1/2" Wave type Ni-Hard liners, and charged with 110 tons of 1-1/4" to 3/4" balls. Division and discharge grates are cast chrome molybdenum steel with 1/2" to 5/8" slots.

Discharge from the raw mill is adjusted to 34% moisture content by a Nuclear-Chicago Gamma Ray density gauge. Capacity of the slurry pump is controlled by a load cell supported slurry holding tank signaling an electro hydraulic controller and Clarkson hydraulic valve which regulates flow to a Wilfley 5", Model K, 60 H.P. slurry pump with a capacity of 140 t.p.h. (contained solids). The slurry is pumped, split and discharged onto two 5' x 6' single deck Tyler F-600 screens, each rated at 65 t.p.h. of -50 mesh slurry. Oversize returns to the raw mill feed, and the fines discharge into a second load cell holding tank with valving the same as the mill discharge pump. The second 5" pump lifts the slurry to storage.

The slurry storage structure houses a battery of eight steel tanks, each 29' in diameter and 27' high. Equivalent clinker capacity of each tank is 2,000 barrels. In normal operations, four of the tanks are utilized for storage of slurry as received from the raw mill, two are utilized in blending, and the remaining two hold kiln feed. All tanks are equipped with Dorr-Oliver air mechanical agitators for homogenizing.

Slurry entering the system is received in the first of three motor operated slurry distributing turnheads mounted above the tanks (the other two slurry distributing turnheads are between each of four tanks).

From that turnhead the slurry may be spouted into the four storage tanks holding only raw mill discharge. Transfer from these storage tanks, or recirculation in the blending system, is made via RKL air-operated pinch valves and Wilfley pumps to a second turnhead.

From the latter, the slurry may be spouted into the two blending tanks or into two of the kiln feed tanks. Another recirculating system delivers slurry to the third turnhead which supplies blend tanks and kiln feed storage tanks. All eight slurry tanks are equipped with Gilbert & Barker proximity type slurry level indicators. Material level is shown on a gauge on the outside of each tank near the base, and the instruments also send signals to the remote indicators on the central console.

The RKL valves in the slurry transfer and kiln feed lines below the slurry tanks are opened by air pressure and closed by springs. In the event of interruption or failure of plant power, the valves automatically are closed by their springs, thus stopping recirculation.

KILNS

Inclination of the two 12' x 450' Traylor kilns is 7/16" per foot and each is supported by six sets of tires and trunnion rolls. Drive for each is provided by a single 200 H.P. silicon rectifier supplied adjustable speed General Electric D.C. motor through a Falk reducer. The emergency drive consists of a 30 H.P., D.C. motor to which current is supplied from a General Electric generating set driven by a Cummins diesel engine.

Starting about 18 feet from their feed ends, the kilns are equipped with Traylor chain systems throughout the following 82 feet. The first four feet of the chain section is a curtain type system using 1,086 feet of 3/4" x 3" chain.

In the next 30 feet a garland system is installed involving 2,904 feet of 1" x 3" chain. The final 48 feet has 6,678 feet of 3/4" x 3" chain installed in a garland system for a total of 120,000 pounds of chain per kiln. Abrasion resisting castable refractory was placed throughout the chain sections of the kilns.

Below the chain system, the first 170 feet is lined with 40% alumina super-duty liners, followed by 34 feet of 70% alumina and 45 feet of basic liners. Between the basic lining and the nose ring is 6 feet of 70% brick and 9 feet of 40% super-duty brick. The nose ring itself is semi-silicon carbide blocks.

Closed-loop control instrumentation in the kiln department involves the slurry feed rate, kiln speed, fuel rate, kiln draft, burning zone temperature, cooler speed, cooler draft in two compartments, plus oxygen and combustibles percentage in the flue gases.

The kiln feed pumps and kiln drives are linked via tachometer signal from the kiln drives through feed control valve ratio controls to Clarkson throttling valves in the supply line to the pumps. Mass flow measure of the feed to the kilns is made with Taylor magnetic flow-meters and Nuclear-Chicago density gauges in the feed pump discharge lines, and the signals are fed back to the feed ratio controllers.

Speed of the draft fans is controlled by measurement of draft and oxygen from gas sample probes and pressure taps in the feed hoods. Radiation pyrometers measuring burning zone temperatures control the positioning of the fuel gas valves and/or the speed of the Feed-O-Weights supplying the coal mills.

The kilns are normally fired with natural gas of about 1,000 B.T.U. per cubic foot, which is delivered to the burner pipe at 64 psi. When firing with Kansas bituminous coal (about 13,000 B.T.U. per pound), the fuel is pulverized in Raymond No. 533 coal mills. Hot air for the mills is drawn from the kiln firing hoods and the fuel/air mixture is delivered to the burner pipes by the mill exhausters at about 180° F.

At 4,000 bbl./day production rates, design fuel consumption is about 900,000 B.T.U./bbl. Soon after being placed on stream the kilns were near that figure, current consumption being

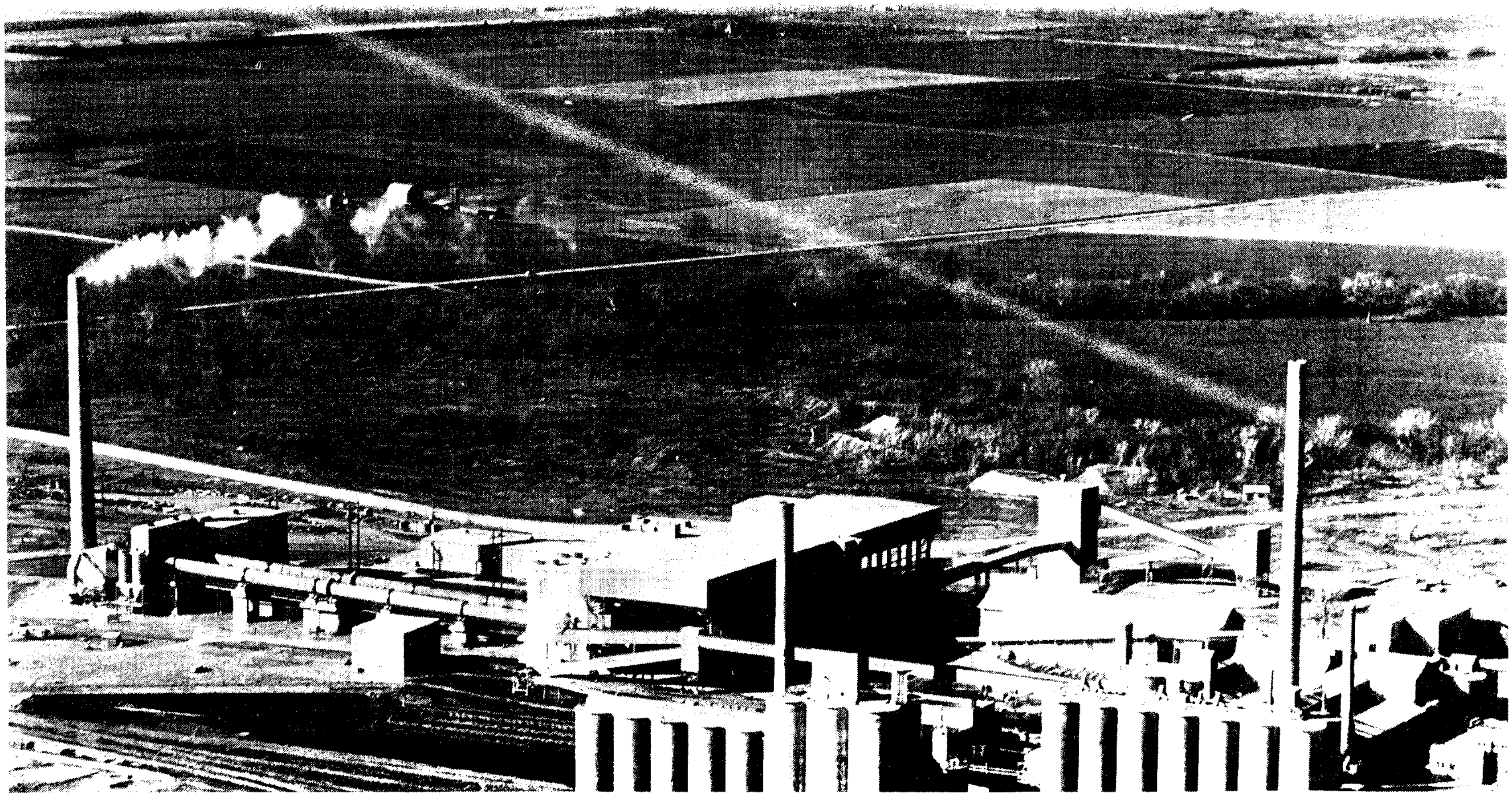

Fig. 1. Aerial View of Ash Grove Lime & Portland Cement Co., Chanute, Kansas Plant.

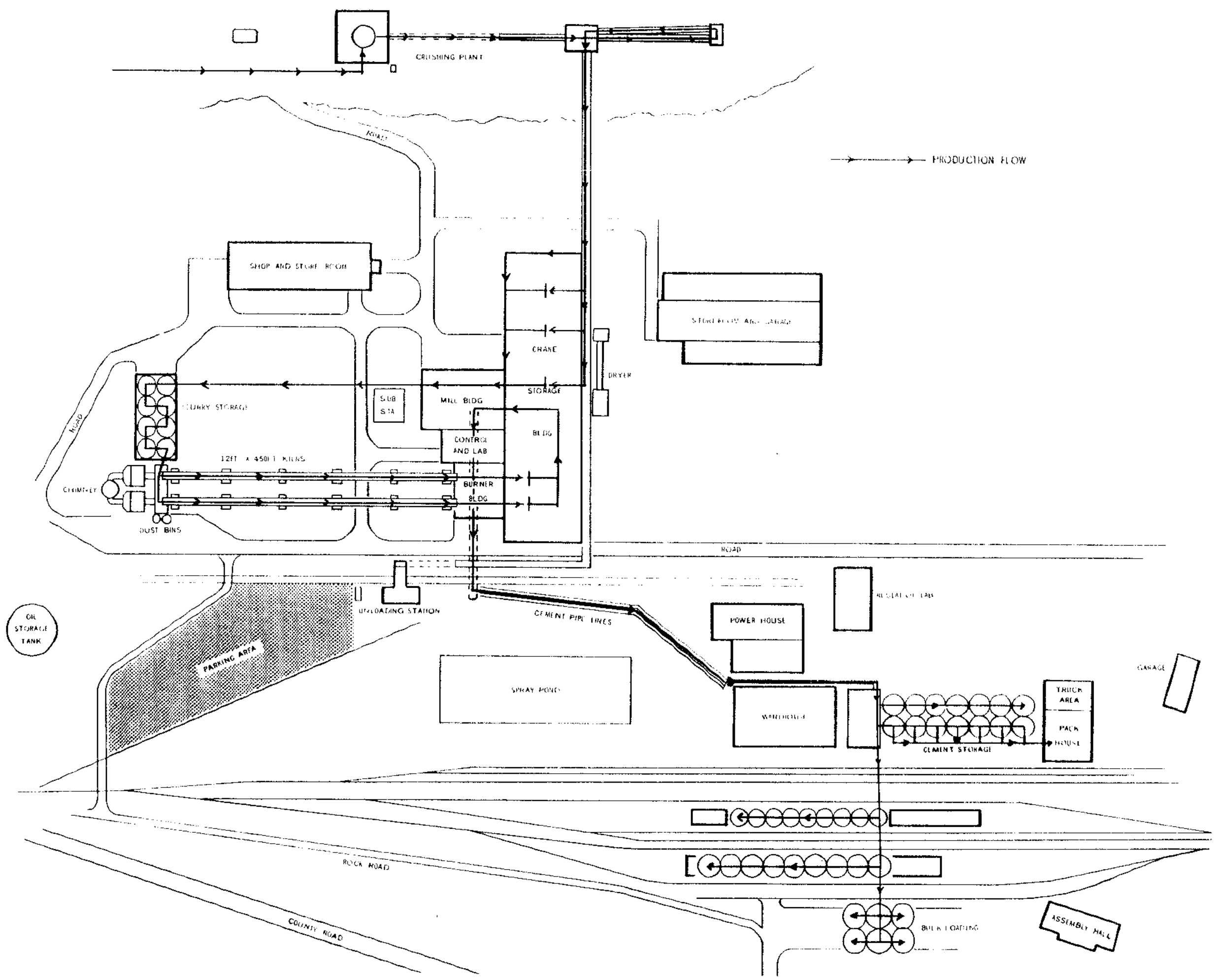

Fig. 2. General Plant Layout. (Ash Grove Lime & Portland Cement Co., Chanute, Kansas.)

about 1,100,000 B.T.U./bbl., with kiln speeds of between 55 and 60 r.p.h. In the average temperature profile, feed hood temperature is 500-550° F., calcining zone temperature is about 1,800°, and burning zone temperature is 2,750-2,800°. Firing conditions in each kiln are monitored by Diamond Conrac TV equipment.

Exhaust from each kiln is drawn through a four-compartment Western Precipitation electrical precipitator by a 180,000 cfm Buffalo Forge 450 H.P. induced draft fan. The two fans exhaust into a 300 foot brick-lined stack that has inside diameters of 21 feet at the base and 15 feet at the top. Variable speed American Standard fluid drives powering the draft fans are regulated through the closed loop controls described previously.

The 300 foot stack, fast becoming an eastern Kansas landmark, is illuminated at night by 36,000 watts of floodlighting.

A system of 12" Industrial Machinery screw conveyors below the electrical precipitators transfers dust to either of two dust handling installations. In one, for low alkali material, the dust is delivered to a Jeffrey bucket elevator that discharges into a hopper. From the latter, the dust may be transferred by a drag conveyor to a pair of 5" Fuller-Kinyon pumps for delivery to the kiln firing hoods. This dust may also be loaded into trucks for removal.

In the other system, high alkali dust is conveyed to a Jeffrey bucket elevator that discharges into another hopper. Dust is fed out through a dustless rotary mixer, where the dust is treated with water before discharging into a truck for disposal.

Clinker is cooled in air-quenching No. 744 Fuller horizontal grate coolers which are equipped with 40 H. P. General Electric Kinatrol drives. Undergrate quenching air to the first compartment is supplied by a 40 H.P., 9,600 cfm fan, and the primary cooler fan is a 100 H.P., 61,000 cfm unit. The coolers are vented by 75 H.P., 62,000 cfm fans,

Na_2O - 0.26%; K_2O - 52%; CO_2 - 35.4%; and ignition loss - 35.60%. Clinker analysis is: SiO_2 - 22.72%; Al_2O_3 - 5.64%; Fe_2O_3 - 2.72%; CaO - 66.35% (free CaO - 1.03%); MgO - 1.80%; Na_2O - 0.25%; K_2O - 0.40%; and ignition loss - 0.12%.

POWER

With the new plant operation, purchased power became a necessity for the first time. Plant steam power generating facilities handle roughly half of the total demand load of 8,000 to 9,000 K.W.H.

STORAGE LOADING

Finished products are stored in 40 silos, with individual capacities ranging from 5,800 to 24,200 barrels and the total capacity, 650,000 barrels, represents nearly 25% of annual production capacity. The silos are individually filled from the Fuller-Kinyon line through two-way Fuller valves that are controlled from the central console. Each silo is equipped with Fuller level indicators.

An unusual conveying system was installed above one group of older silos in a modernizing modification. The system involves a 177-foot long, 9-inch diameter screw conveyor housed in the bottom of a flared trough with a peaked cover. Designed as a venting system to handle low velocity air movement, the conveyor's screw moves the heavier dust particles along with the air-entrained dust in the "duct" area over the screw to a dust bin.

Most silos can be used for bulk truck or rail loading and to supply the packhouse. One of the new groups of silos accommodates bulk loading exclusively. About 75% of Ash Grove's Chanute production is shipped in bulk.

The new packhouse installed as a part of the final phase of expansion at Chanute incorporates three 150-F four-tube St. Regis packers in a full-flow packing system. In this system, cement is drawn from storage tanks (supplied by 8" Fuller-Kinyon pump from appropriate silos) and transferred by Airslide conveyor to a bucket elevator. The latter, in turn, discharge to Airslide conveyors from which the packers are supplied. Material not taken by the packers from this feed continues back to the storage tanks for recirculation, and excess material in the packers themselves flows to the conveyor feeding the elevator. In effect, the storage tank and elevator are in closed circuit, with the packers "across the line."

With three tanks installed ahead of each of two packers, and a single tank provided for the third packer (bagging masonry cement exclusively), the packhouse can deliver three different bagged cements simultaneously. Since the systems can be quickly purged, a rapid change can be made in the type of cement supplied to either of two packers. Alleviation and dust collection in the packing operation is handled by a Sly Dynaclone unit for each packer.

Each packer has a capacity of 20 sacks/minute, and the bagged products are placed on telescoping Power-Curve conveyor systems connecting with four separate rail and truck-loading points. Operation of the Power-Curve systems is controlled from a central panel in the packhouse, as is bulk loading of truck or rail cars from appropriate silos.