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Prospect Hill Plant of Missouri Portland Cement Company

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By

Charles W. Grube*

I want to welcome you to the Fort Bellefontaine quarry and the Prospect Hill plant of the Missouri Portland Cement Company. You have received booklets which give the highlights of these locations, and I will endeavor to supply some additional details.

In 1947 the company embarked on a program to completely modernize its manufacturing and distributing facilities. It was planned that some of the oldest equipment would be removed as the installation of the new equipment was completed, but the demand for cement has delayed carrying out this part of the program. The orderliness of the plant is further disrupted by construction work necessary for a new 4,500 barrels a day kiln now being installed.

The first stop will be at the quarry property of 462 acres located on U. S. Highway 67 and the Missouri River ten miles from the Prospect Hill plant. Since 1904 rock has been quarried at this location for cement production. The strata of rock is part of the St. Louis limestone ledge and runs approximately 90 per cent calcium-carbonate. This quarry is not as fortunate as some locations, because there is a preliminary step of removing 45 feet of loess clay before quarrying and crushing the rock. The removing of this clay becomes a sizeable item, and at present is being accomplished by hydraulic stripping using water from the Missouri River. The clay is wasted in a 40 acre lake that was constructed in an adjacent valley. This lake acts as a settling basin, and the water overflow returns to the river. Sometimes there appears a form of hard pan in the clay just above the rock, which ranges up to 15 feet in height. To break up this material vertical blast holes are auger drilled, and a light charge of DuPont Nitramite is placed in the bottom. This not only breaks up the hard pan, but shocks the loess clay material above it making the clay wash easier. The high clay bank is very unstable, discouraging the use of horizontal auger holes for this shooting. Last year 512,000 cubic yards of clay were removed hydraulically at a cost of $0.177 per cubic yard. For those individuals that are interested in more details of this part of the operation, a side tour will be available at the sacrifice of some of your time at the Prospect Hill plant.

The quarrying, truck hauling, and crushing of the rock is conventional. Because of the presence of a variable strata of dolomite in the lower part of the rock formation, it is quarried in a 50-foot upper face and a 45-foot lower face to permit control over the magnesia content. Preliminary blending is accomplished at the quarry by regulating the sequence of trailers as they come from the shovels at each face and dump into the primary crusher hopper. Two kinds of rock are made; one is high in upper face rock, the other high in lower face rock.

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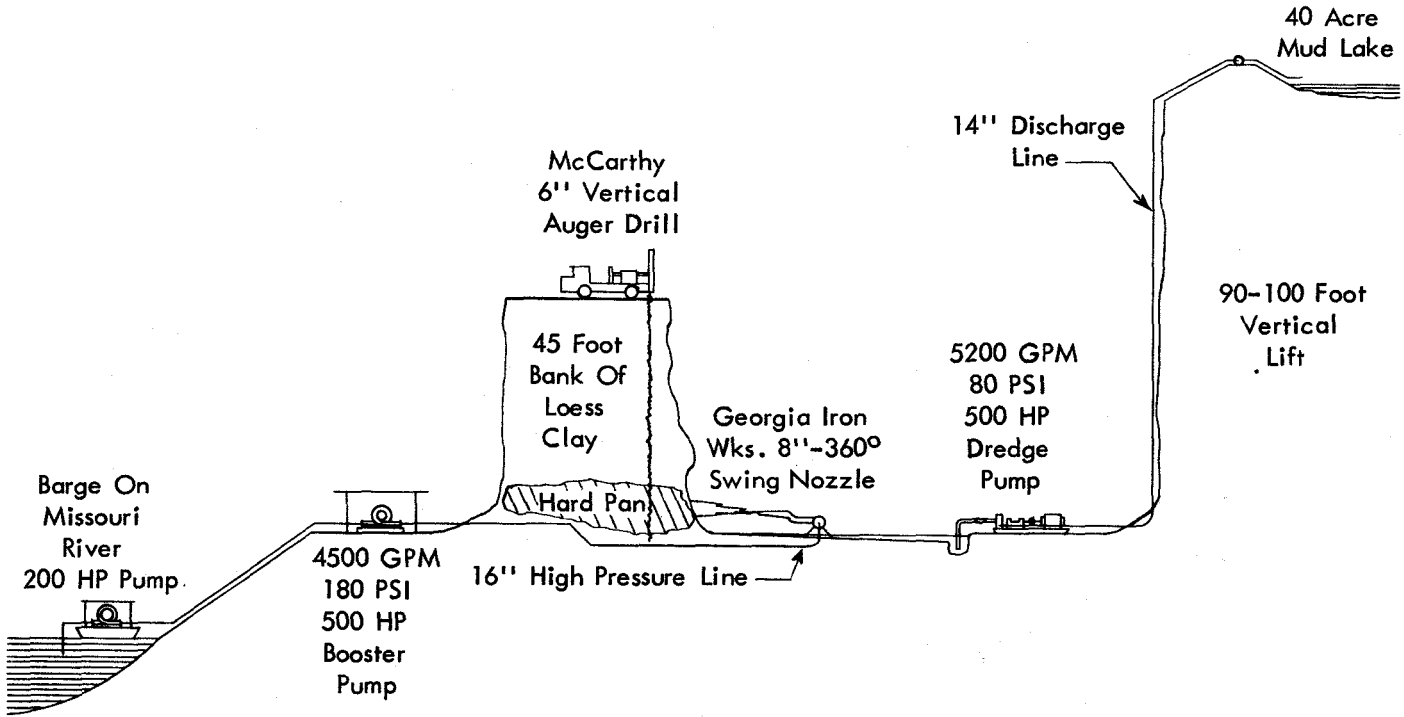

Figure 1. Schematic Diagram of Hydraulic Stripping at the Ft. Bellefontaine Quarry.

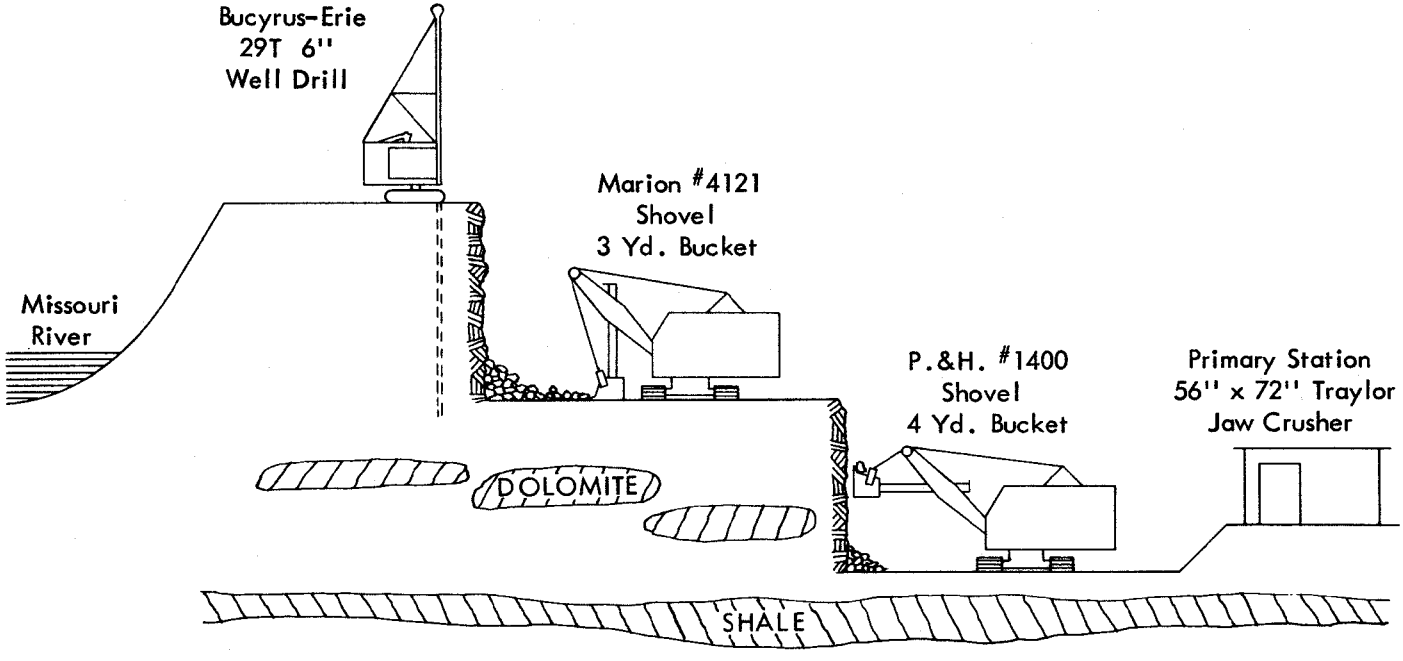

Figure 2. Schematic Diagram of Operation at the Ft. Bellefontaine Quarry.

The lower level of the quarry is approximately 67 feet below the adjacent Missouri River. It is planned in the very near future to use the worked out portion of the quarry as a dumping space for the clay overburden. Earth dikes will be constructed similar to the present lake, and the water re-used or pumped back into the river.

After visiting the quarry we will proceed to the Prospect Hill plant. You will see that the 216 acres of plant property is gradually being surrounded by residential communities. A natural question is, "Why wasn't the new plant located on the quarry property to get away from this situation?" The reason that the present selection of site was made, was due to the fact that the Prospect Hill plant is located within the St. Louis switching district, which means better service for our customers. The freight bill for moving the rock to the plant is less than it would be to move cement into the city if the plant were located at the quarry.

Because the plant is located in this residential area, we are constantly striving to get along with our neighbors. Dust collecting equipment must be functioning properly, or the unit it is serving must not operate. The amount of explosives used at the shale quarry must be kept at a minimum to reduce noise and vibration.

The shale located adjacent to the plant is also covered by 30 to 40 feet of loess clay. At present the removal of this clay is accomplished with shovel and trucks, wasting it at our river front property. In the near future we plan to use a portion in our raw mix. The 70-foot shale face, part of the Des Moines deposit, is overbedded by a thin strata of sandstone. The shooting is done with vertical auger blast holes. Only two holes are shot at a time to minimize vibration. The shovel loading, truck hauling, crushing, and belt conveying to the storage building is conventional, and is performed by three men. This crushing station is operated by one operator and his principle duties are inspection, lubrication and cleanup of the station. An interesting feature of the hopper is the rolled plate ends that were fabricated to minimize choke-ups at the inlet of the crusher.

Since shipments are made by rail and the bulk of the raw materials are received by rail, this plant can be classified as a "railroad plant"; consequently you will see a railroad hopper car unloading station that is designed for quick removal of loads. A large circle track around the plant is provided and a small locomotive is used to move cars over the unloading hopper. A 70-ton car is spotted, opened, unloaded and closed in five minutes.

You will find that all of the materials used in the process are stored in a large totally enclosed storage building, and conveyed by bridge crane to feed bins. Concrete partition walls have been constructed to separate materials stored in this building, and our operating instructions are designed to prevent contamination of one material with another.

As your booklet states this is a wet-process plant. The varying composition of our rock makes it so. The raw grind mills are close circuited with bowl and rake classifiers for higher efficiency and better control of particle size. This system has given almost double the amount of slurry production per horsepower as the old open-circuit raw grinding equipment. At present

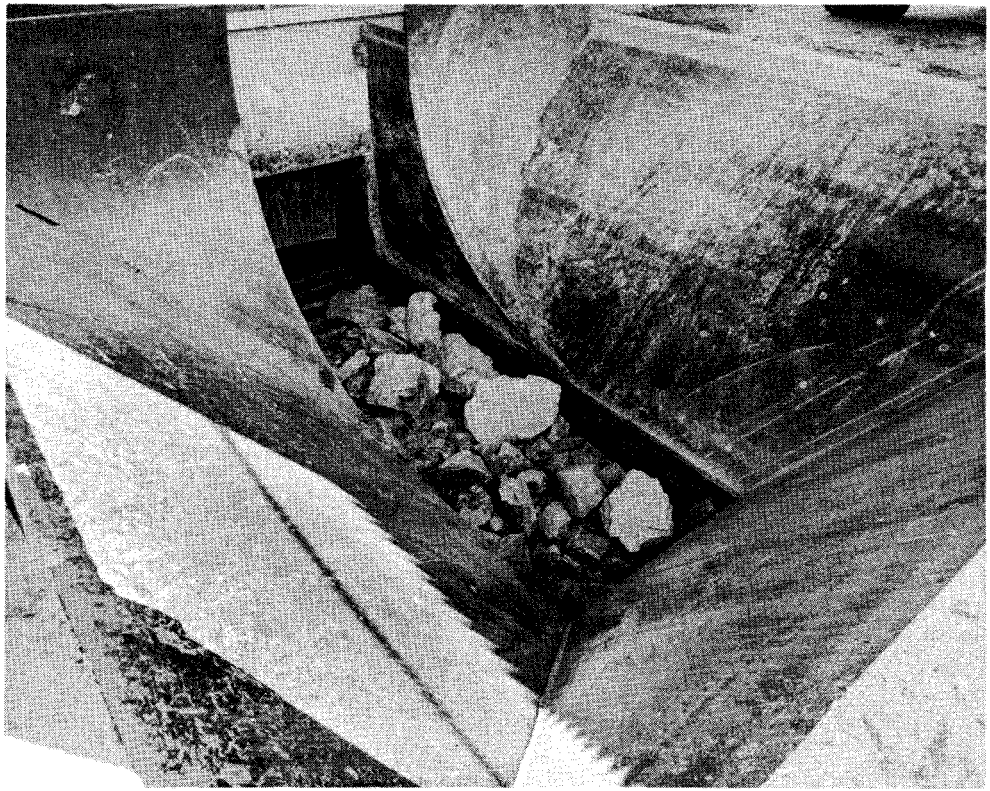

Figure 3. Crusher Hopper - showing rolled plate ends, fabricated to minimize choke-ups.

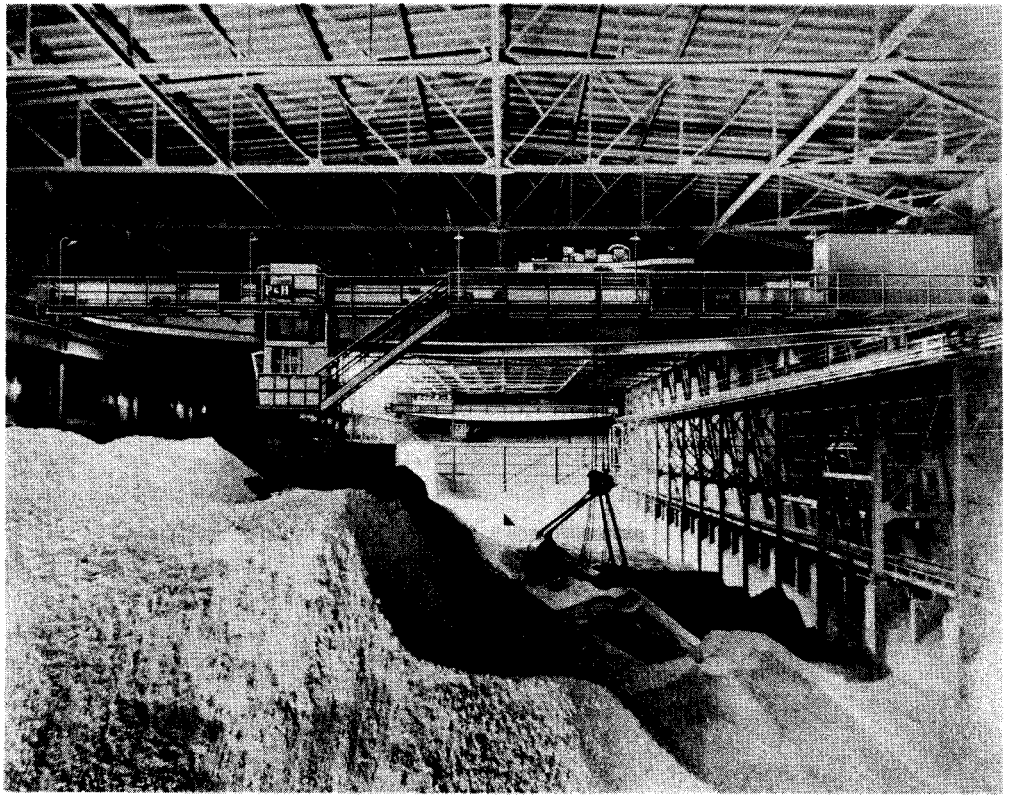

Figure 4. Enclosed Storage Building of the Prospect Hill Plant.

we are using 13.1 kilowatt-hours per ton including all auxiliaries and thickeners. We pump 78 per cent moisture slurry from the overflow of our bowl classifier to our thickeners. The thickeners are pieces of equipment that must be operated anticipating future situations. The small changes you make today do not become a reality in the underflow until 4 or 5 days from now.

The designed mix is blended in our tall blending tanks by proportioning underflow from the thickeners with shale and iron ore slurries that have been open-circuit ground. Ground shale is not processed through the thickeners because it seriously lowers their capacity. All centrifugal pumps handling slurry are equipped with grease seals instead of water seals to minimize the increase of moisture in the slurry.

The kiln operation has always had a goal of maximum output, with a minimum sacrifice of efficiency. To accomplish this, we have all devoted our efforts to attaining as near uniform operation as possible, or as we put it "drawing circles" on the instrument charts. At first the build-up of rings in the chain system of the 450-foot kilns prevented long runs of constant operation. On the 5/8-in diameter stock chain system every imaginable device was tried; different positions of fastener links, sliding fastener links, dense patterns, and thin patterns, but it was not until a 1-in. diameter stock chain was used and the ends fastened every 2 feet along the length of the kiln in a spiral system that results began to come forth. The system in our new 12-foot diameter kiln will have a further modification using 1-in. stock chains, but with the center hole growing larger in diameter as material proceeds from the feed end to the discharge end of the system. The new kilns operate at 70 rph and produce about 3,900 barrels per day each. The helical drive gear has given us good service. You may be interested in the chunk breaker at the end of the air-quenching cooler. This is our own engineering department design which consists of two corrugated fabricated steel rolls driven by two 10 hp 580 rpm motors through Tex-Rope drives that act as clutches in case tramp iron gets in between the rolls. The rolls are set so there is a clearance of 1-in. between the breaker bars. All the clinkers are put through another similar set of rolls that are hard surfaced, and set 1/2-in. apart. These rolls are driven by two 30 hp 580 rpm motors.

The Feedoweights that perform the proportioning on the finish and raw mills have been very successful. Originally, the two double stage finish mills were operated close-circuited around the ball mills with 22 mesh Hummer screens, and open-circuit through the tube mill. Recently a 16-foot air separator was installed for close-circuiting one of the tube mills, and plans are being made to do the same on the second unit. At present we are grinding to a Blaine surface area of 3000-3100 at 6.1 kilowatt hours per barrel on the separator system. This figure includes all auxiliaries up to the cement pump. Future plans are for a third finish mill unit to be installed next year with a 1,500 hp mill close-circuited with an air separator. An auxiliary feature that you may want to see are the "fringe tanks" which allow the changes of different types of cement and changes of pump line routing without shutting down mills or pumps. The system of adding air entraining agents may be of special interest to some of you.

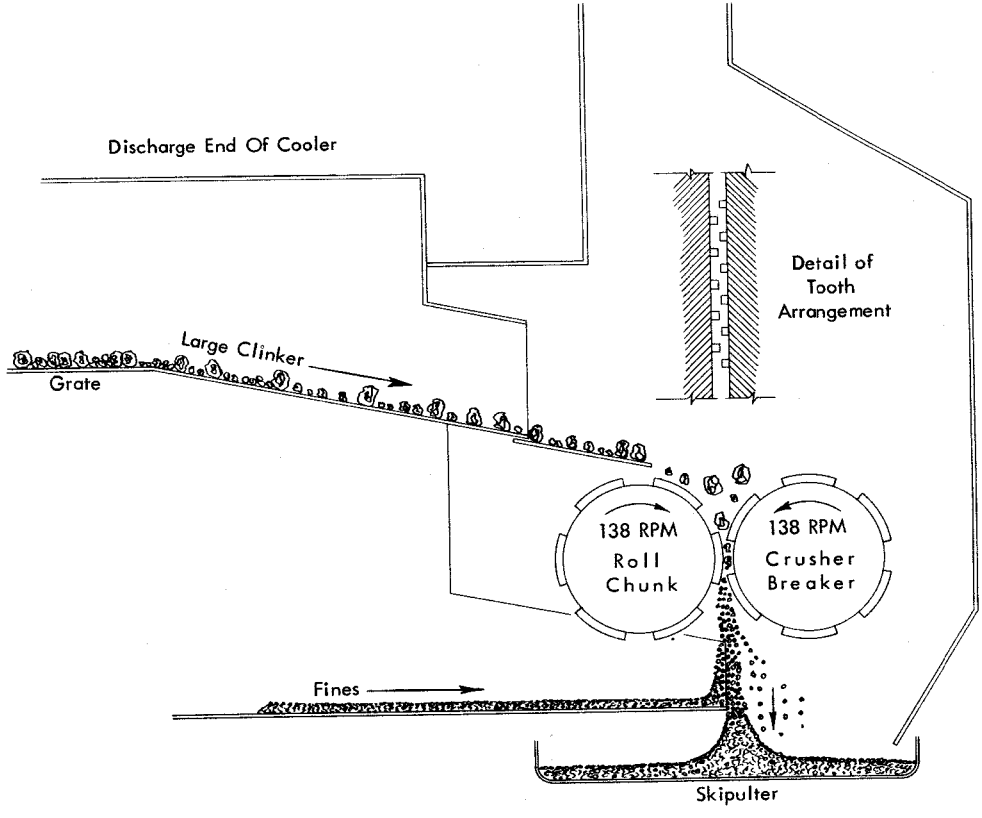

Figure 5. Clinker Breaker at the Prospect Hill Plant.

The storage of cement is conventional with the exception that we are short on silos, and need modern bulk loading facilities. We have adjacent to our property across the Burlington Railroad tracks three asbestos cement manufacturing plants that represent a steady portion of the business.

Our access to water transportation has allowed us to produce a large yearly barrelage. We are now making 13,500 barrels of cement a day with the expectation of 4,500,000 barrels for 1955, and over 5,000,000 barrels in 1956. Our fleet of self-unloading barges is sufficient to keep our Memphis terminal supplied with cement; round trips of tows being made every four days. Supplementing this fleet are barges with side openings for delivering cement to customers on the river. The customers use front-end unloaders to transfer the cement to dump trucks. For a plant to have a fairly large production, water transportation seems to be a necessity.

Our storeroom, toolroom, lunchroom, and shop are available for your inspection. An item that might be of interest is our recent purchase of an International Research and Development Corporation Model 652 Vibration Analyzer. We have made a setup of this electronic balancer to dynamically balance a cement pump screw. We build up, hard surface and grind our pump screws, and have found that a balanced screw gives double the amount of pumped barrels of an unbalanced one. This apparatus can be used on fans, motors and other rotating equipment while this machinery is in operation.

Your visit to the plant will deviate from the normal procedure of conducted tours. When you leave the buses at the plant you will be free to divide into groups of your own choice, and to inspect the portion of the plant according to your desire. For those who wish a planned tour of the plant you will find arrow markers with station numbers to blaze the trail for you. At the different stations you will find individuals who will welcome the opportunity to answer your questions, or direct you to different locations in the plant.

We hope you enjoy your visit to our plant, and we wish to extend to any of you an invitation for a future visit whenever you are in St. Louis.