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Experiences with
Long Dry-Process Kilns

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EXPERIENCE WITH LONG DRY-PROCESS KILN AT SPEED PLANT, LOUISVILLE CEMENT CORPORATION

By

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The long dry process kiln installed by the Louisville Cement Corporation at Speed, Ind. is 11 ft in diameter by 390 ft long. This diameter and length were determined by the amount of production desired at an economical fuel figure and by the space available for installation. The ratio of length to inside diameter of previous long dry-process kilns was used. This is the first kiln that the Louisville Cement Corporation has operated without a waste-heat boiler. The relatively high capital cost of boiler and generating equipment, the cost of fuel, and the availability of purchased power at a reasonable cost has changed the desirability of the use of waste-heat boilers in our locality from our viewpoint.

We have now just completed our third year of operation with this kiln. Satisfaction of our management with their decision, and with our success in operation of the long kiln is revealed by the fact that we are now installing another almost identical 11 ft in diameter by 390-ft kiln.

Our kiln is of F. L. Smidth manufacture with a 7/16-in. pitch and is carried on five supports. Each end of the kiln has a tight-fitting, air-cooled seal ring. The kiln is driven by a 125 hp shunt-wound, adjustable-speed d-c motor. The generator for this d-c current also is the source of power for the variable-speed drive on our Fuller clinker cooler grate. For coal firing we have a No. 533 Raymond Bowl Mill. The pulverized-coal-primary-air mixture is blown into the kiln through an 11-in. water-cooled burner pipe. Coal consumption on this kiln is measured by a Richardson coal scale in 200-pound batches. This summer, for the first time, we have used natural gas for fuel. Consumption of natural gas is measured by a Republic flow meter. Some problems with use of natural gas have yet to be worked out.

Exit gases from the kiln, averaging around 1150 degrees F. in temperature, must be tempered to 750 degrees by the addition of cold air, before being drawn through the Multiclone dust collector by the 7-1/2-ft diameter induced-draft fan. Discharge of the fan is to an independent 9x200 ft concrete stack. This Multiclone collects 52 tons of dust per day which is continuously discharged into a mixing conveyor which also receives the new kiln feed from the synchronized kiln feed screw. The mixture is fed directly into the kiln.

Since uniform feed and uniform operation are thought to be more important with longer kilns, some dry-process plants have elaborate feed blending systems. In contrast, our results are interesting because we do not have a particularly elaborate raw department. The feed is pumped from four raw blending silos to a 28-ft diameter steel tank of 450 tons capacity. Fuller Airslides, installed in four radial positions in the conical bottom of this tank aerate the feed which is carried out of the tank to an elevator by an Airslide. If the feed starts to overload this elevator, bindicators in the

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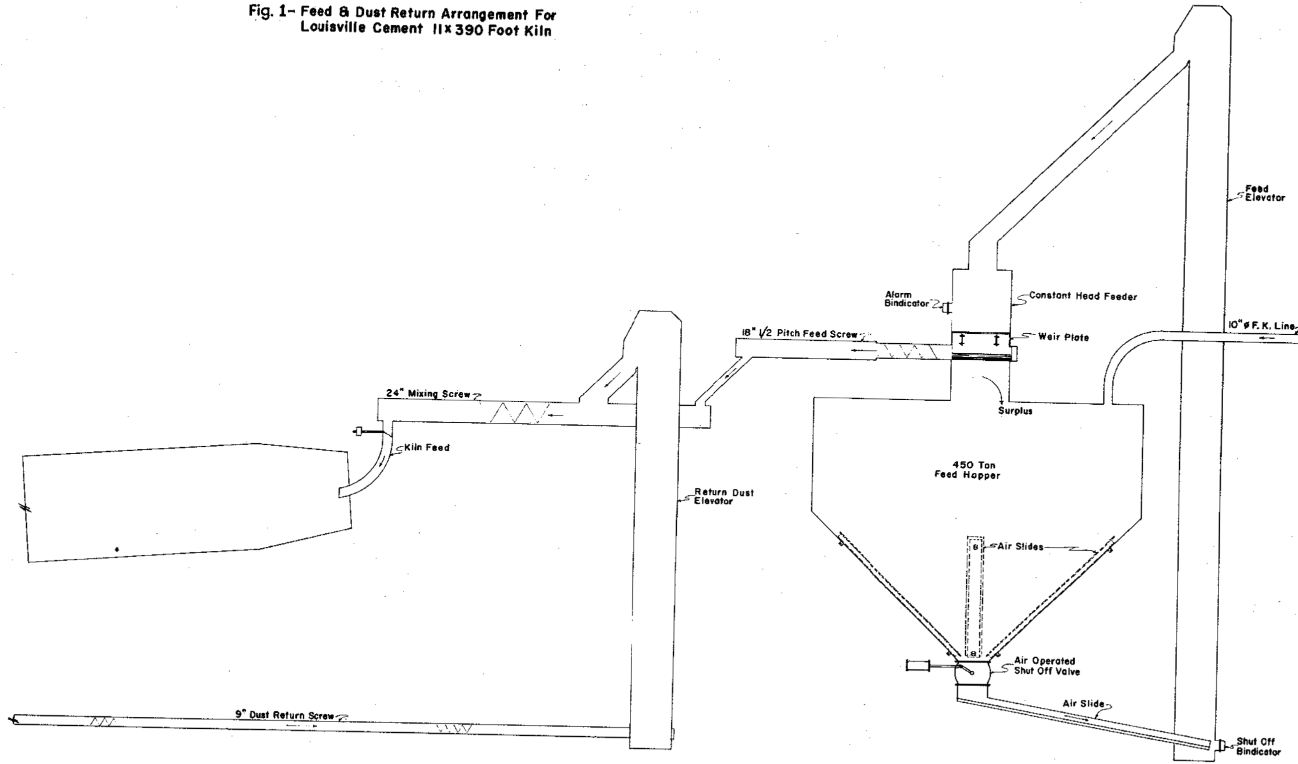
elevator cause shut-off valves to be closed automatically until the overloaded condition is eliminated. This elevator, normally carrying up a surplus of feed, discharges into the Fuller constant head feeder. That part of the feed that is surplus overflows a Weir plate and returns to the steel tank. A more or less constant head of 8-12 in. is thereby maintained above the 18-in. feed screw which has a pitch of 1/2 in. per foot. If this head drops appreciably, a bindicator automatically causes an alarm horn to be blown. An operator stationed nearby is expected to investigate and remedy the trouble. This feed screw is synchronized with the kiln speed by means of an F. L. Smidth alternator which is coupled to an extension of the kiln drive motor shaft and generates a-c power of varying frequency for energizing the feed-screw motor. This synchronized feed is discharged into the previously mentioned mixing conveyor where it is mixed with the long kiln's own dust before being fed into the kiln. Fig. 1 is a schematic diagram of the feed and dust return arrangement.

In recent months, the kiln has operated as continuously as practical at 70 rphr. It discharges its clinker to a Fuller No. 733 air quenching inclined-grate cooler. An inclined-pan conveyor discharges the cooled clinker to a separate storage pit. Each of our kiln's production goes to such a pit. An overhead crane rehandles the clinker from all kiln pits and keeps an accurate tally of the number of level-full clamshell bucket loads from each kiln. Each kiln is then credited with that share of our total scale-measured production which its share of the total bucket load tally earns. This method gives us fairly accurate production figures on individual kilns for longer elements of time.

We have provided the long kiln with rather complete instrumentation. There is a centralized control cubicle from which station any of the 17 motors which drive the long chain of machinery may be started or stopped. Each motor has a green running light and all of the more important motors have indicating ammeters. Alarm horns and lights are provided to signal dangerous temperatures or feed failure or the occurrence of combustible gases at the kiln exit. All of the usual temperatures and drafts are recorded. The cooler bed speed and also the cooler draft is automatically controlled. The tempering with cold air of gases going to our induced-draft fan is automatically controlled. This is a tough problem as too high a temperature is dangerous to the fan, too low a temperature is wasteful of fan capacity, and every change in tempering damper setting also changes combustion air quantities in the kiln. This cold tempering air must be introduced into the main stream in such a way as not to cause too much disruption of the stream with resultant loss of velocity head and fan capacity and complete mixing must be accomplished before the gases reach the fan.

An instrument which we consider especially important is our kiln exit gas analyzer, particularly on this long kiln where fuel economy is so essential and also where secondary combustion is feared. We have spared little expense in installing the Bailey oxygen and combustible gas analyzer and recorder. As with any important and intricate piece of equipment we believe it is necessary to locate our analyzers under tolerable operating conditions and where attention will be easily obtained. Therefore by enclosing the hollow space under our rear-most kiln support pier, we have

Fig. 1– Feed & Dust Return Arrangement For Louisville Cement 11x390 Foot Kiln



made a cozy room for the rear operator and the gas analyzer. In winter the heating of this room is thermostatically controlled and year around the analyzed gases must be exhausted by a vent fan. This room is an operating station for the rear man. Here are several alarms and signals and here is a telephone to the front end and also to the foreman's office. We feel that we have had a great success with instrumentation on this long kiln. Rightly or not, the kiln operators feel that they can hardly operate without any one of several of the instruments. Our instrument men therefore are called out at all hours.

Our company does not advocate pushing kilns for maximum production. Instead we stress fuel economy, uniform quality, and protection of the kiln. On our short 10x150 ft kilns we average only 1150 barrels in 24 hours, burning 110 pounds of coal or 1,250,000 Btu per barrel. Our short kilns do not have heat recuperating coolers.

Our long kiln's production has improved each of these first three years from 2610 bbl per 24 hours for the first year to 2655 bbl for the second year, and then to 2700 bbl this third year. F. L. Smith set the rated capacity at 2700 to 3000 bbl per 24 hours. Along with this gradual increase in production has come a very satisfactory decrease in coal consumption. From a beginning figure of 78.5 pounds per barrel the first year, we have reduced to 70.8 pounds the second year and to 68.5 pounds this last year. This last figure is calculated to be 778,000 Btu per barrel of clinker (365 pounds per barrel). This is only 62 per cent of the fuel used per barrel on our short kilns. The long kiln has consistently turned out quality clinker.

In contrasting long kiln with short kiln, it is well to keep in mind that much more fuel per minute is being burned in the long kiln. Our long kiln is one more foot in diameter, but still 30 per cent more Btu per minute per square foot of cross section area are being released in the long kiln compared to our 10x150 ft kiln. Refractory problems are increased and effects of temperature on the kiln shell, hood, etc. are intensified. Our hottest zone is centered directly over the first kiln tire, 25 ft from the discharge end. We have at times been concerned about the high temperature on the tire and its support mechanism. The cantilever section from this tire to the kiln discharge has several times developed some "throw" or eccentricity due to unequal coating and temperature effects. Although no permanent damage has been done, these occurrences have argued for caution in pushing the kiln to a higher production rate. On the next long kiln this first tire is to be located 15 ft from the hood, instead of 25 ft. In the zone from 15 to 35 ft back from the hood, we have learned to use only basic brick. On our short kilns we have not found the extra initial cost of the basic brick justified. In these first three years we have shut down because of hot zone brick failure 21 times, on an average of once every 7-1/2 weeks. In the worst zone, from 22 to 28 ft from the discharge end, the brick has been replaced 9 times. Total brick costs seem high on this kiln but when figured in cents per barrel produced, are equal to and in some cases better than on our short kilns.

In each succeeding year of our first three years, operation of the long kiln has improved in all of its several aspects. This to me signifies two things: First, we are still learning after three years; and second, perhaps in this fourth year further improvement will be realized.