

FILE NAME: Concrete (CONC)

DATE: 1941 Feb

DOC#: CONC013

DOCUMENT DESCRIPTION: Journal Article - Aim Dust-Abatement Efforts
at Finest Particle Sizes

Concrete

Established 1904

with which has been combined Cement Age,
New York, and Concrete Engineering, Cleveland

CEMENT MILL EDITION
Published monthly by
CONCRETE PUBLISHING CORP.
400 West Madison Street
Chicago, Illinois
Telephone CENTral 8822

For
FEBRUARY • 1941

Volume 49

No. 2

CEMENT MILL SECTION

IN THE INTERESTS OF

Those engaged in the manufacture of portland cement and related products. Its pages are devoted to discussion of plant design, management, operation, production, efficiency, chemical research and control, quarry operation, progress and news of the industry.

The *Cement Mill Edition* also contains all the material published in the *Regular Edition*, thus providing mill operating officials with progressive data on the uses and merchandising of their products and establishing for them valuable points of contact with the users of the materials they produce.

Subscription price is \$3.00 a year in the United States and its possessions and Mexico. One Dollar additional for postage in all other countries. Current copies, 40 cents each.

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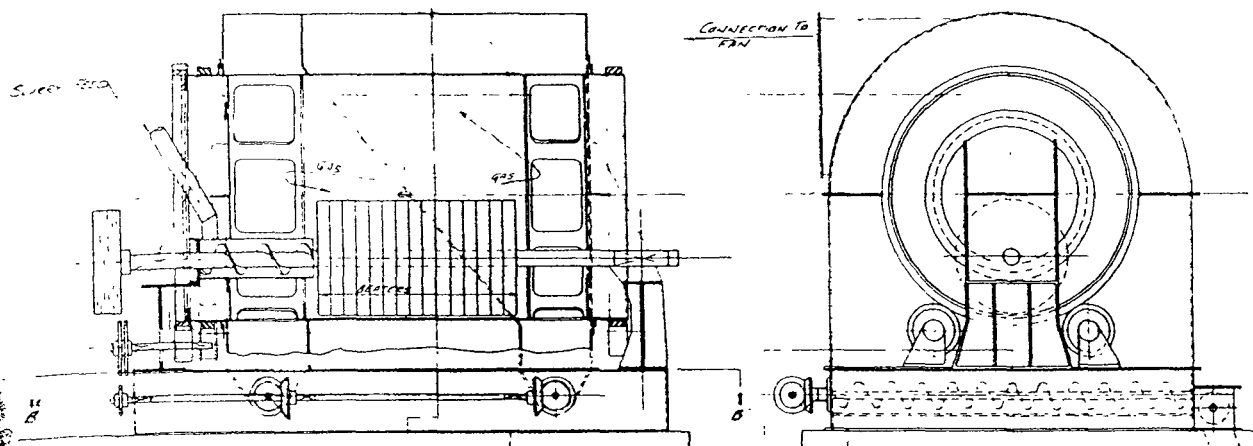
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Indexed in INDUSTRIAL ARTS INDEX

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Showing mechanical details of recuperator

drum, where the slurry is precipitated by paddles mounted on the shaft of the screw conveyor.

This screw conveyor shaft rotates at a speed exceeding 200 r.p.m., with the result that the slurry is atomized and sprayed through the hot kiln gases passing slowly through the drum. The spraying action projects the slurry against the hot shell of the drum, where the slurry is dried very quickly because of the highly heated condition of the shell. The paddles mounted on the shaft of the screw conveyor for the purpose of projecting the slurry, now serve the additional purpose of knocking the dried slurry off the shell.

Moisture Not All Removed

On the average installation, the temperature of the kiln gases passing through the drum and removing moisture from the sprayed slurry will have dropped to about 250 deg. F. by the time these gases pass through the second set of port holes at the far end of the drum.

Not all moisture is removed from the slurry—or the filter cake—as it might more properly be termed at this semi-dry stage. Assuming a case where the raw slurry has a moisture content somewhere around 36 to 40 per cent, the moisture of the semi-dry “cake” will be around 16 to 19 per cent. This “cake” now leaves the drum, having the “feel” of a dried product, but actually, as already indicated, containing around 16 to 19 per cent of moisture.

Inasmuch as this heat recuperator installation is above the discharge end of the kiln, the semi-dry product must be transported to the feed end of the kiln. This is accomplished by means of a screw conveyor.

While it would be possible to drive practically all the moisture out of the

slurry, there are several reasons why this is not done. Experience has shown that no slurry-drying or slurry-filtering operations should go too far in the matter of driving out the moisture. As a matter of fact, 15 per cent is about the lowest allowable limit. If drying is carried to a point where the moisture content is less than the limit just named, the dried product acts like cement rock or other kinds of raw materials.

Good Performance

In contrast, when the semi-dry product still contains from 15 to 19 per cent of moisture it enters the kiln in a somewhat puffed condition, due to the action of the carbon dioxide in the effluent gases. Under this condition the heat in the kiln penetrates the product readily, and CO₂ gas escapes without difficulty, and the burning activities are aided.

A typical installation of the heat recuperator here illustrated is that hooked

up with a kiln 240 ft. long and having diameters of 10 ft. and 11 ft. 3 in., located in a Western cement plant. Before the recuperator was installed the kiln turned out a daily production of around 1,650 bbl. of clinker, operating with slurry containing 41 per cent of moisture. The same kiln, after being equipped with this recuperator and having the moisture content of the product reduced to 19 per cent, had an average daily production of 1,825 bbl.

Fuel consumption, prior to the installation, was 11.4 gallons of oil per barrel. After the installation was put in operation the average was 3.6 gallons per barrel.

Acknowledgment: The heat recuperator here described and illustrated is known as the Colton-Lang recuperator, manufactured by Travlor Engineering & Manufacturing Co., Allentown, Pennsylvania.

Permanent Plant to Produce By-Products

THE new 12,000-barrel-per-day plant of the Permanente Corporation near Los Altos, Calif., has set what is probably an all-time low in raw-grinding cost, says Oliver Bowles, in a report to the U. S. Bureau of Mines. Grinding is done in two stages, the first consisting of ball mills in closed circuit with Dorr classifiers, giving a minus 48-mesh product. The second stage consists of ball mills in closed circuit with Dorr bowl classifiers, giving a product of which 96 per cent is minus 200-mesh. The power consumption is said to be 10 to 11 kilowatt-hours per barrel of cement.

Most cement plants make nothing except cement, or cement and lime, at the most. The Permanente Corporation is pioneering in the field of by-products, which eventually may include limestone for beet-sugar factories and concrete aggregate, lime, stone sand, solid carbon dioxide, and potash. The stone for beet-sugar use must be chert-free. The cherty limestone is similar in appearance to the pure stone, but under a fluorescent light the chert assumes such a distinctive coloration that it can be removed by hand on a picking belt, and in this way the work is greatly simplified.

Aim Dust-Abatement Efforts at Finest Particle Sizes

THE Report of the Preventive Engineering Committee of the Air Hygiene Foundation was presented by Prof. Philip Drinker, of Harvard, Committee Chairman, at the fifth annual meeting of the Foundation, held at Pittsburgh on November 12, 1940. An abstract of the report is given here. The report deals with fumes from welding operations as well as with the elimination of fine particles of stone dust.—Editor.

DURING the past fiscal year of the Air Hygiene Foundation, one fellowship has been maintained at the Harvard School of Public Health. The incumbent is Bernard D. Tebbens, who is a candidate for the Doctorate of Science Degree at Harvard. He has worked on two problems, one involving a study of particle size in relation to silicosis, and the other comprising a study of the gases and visible fume evolved in arc welding with coated rods.

Study of Particle Size

For the studies on particle size and silicosis, dust samples of finely-ground flint, 99.3 per cent SiO_2 were prepared in fractions of 3.3, 1.7, 1.0, and 0.6 microns.

As stated in our 1939 report, the object of Mr. Tebbens' work with sized particles was to study the relationship of size to potency (with respect to silicosis). It was generally admitted that the potency increased as the size decreased; but, so far as we knew, no studies had been made (and certainly none published) which attempted to answer this question with pathological proof. We are indebted to Dr. R. Z. Schulz, of the Department of Pathology, Harvard Medical School, for his co-operation in this work.

Engineers are concerned with particle size in the causation of silicosis, because we, and not the physicians, are responsible for dust control and for making estimates or counts of dust concentrations. From the results of Tebbens and Schulz, it is evident that methods and apparatus designed to abate dustiness or to estimate dust concentrations should be directed especially against the particles

well below (and not above) 1 micron in size.

Welding with Coated Rods

A part of Mr. Tebbens' fellowship work has been devoted to a study of the nature and quantity of the fumes and gases liberated during arc welding with coated rods. Not all electric welding today is done with coated rods, but their use is increasing rapidly. In the case of alloy steels and of non-ferrous metals, coated rods are the rule and not the exception. In general, the primary purpose of the coating is to shield both the arc and the hot metal from reaction with constituents of the air.

Time would not permit studying the full list of the coatings used on modern welding rods, or the products they give off in the arc. With the help of welding experts from the General Electric Company, who supplied all the equipment needed for this study, we selected a number of representative rods, of which the makers generally furnished the approximate analyses. In those few cases where analyses were not available, it was not difficult to determine the essential ingredients and to check them against the products of combustion in the arc. Every effort has been made not to divulge any trade or manufacturing secrets regarding the exact nature of the coatings.

A. Low-Carbon Steel Electrodes:—Seven different electrodes were studied in three sizes, 5/32, 1/4, and 5/16 of an inch. The coatings contained the following:

Ferromanganese, the Mn serving as a deoxidizer.

Various silicates, including asbestos, with small amounts of free silica. Sodium silicate as binder.

Titanium dioxide as an arc stabilizer.

Carbohydrates to furnish a reducing atmosphere.

B. Steel Alloys and Non-Ferrous Alloys:—The coatings of these rods all contain fluorides, usually carbonates, and some silicates. The coating of rods for welding aluminum contained chlorides, while one alloy rod contained borates.

Fumes from Coatings

In general, all rods and all coatings gave off a visible fume or smoke in which the qualitative composition was predictable from the analyses of the rods. In addition, we looked for any volatile fluorine compounds, as well as carbon monoxide, chlorine or hydrochloric acid, and especially oxides of nitrogen.

Welding was done in a gas chamber equipped with a special exhaustor and a hood placed near the welding work. Beads were welded across small metal plates, and the gases and fumes from the arc were drawn into the hood by the exhaustor. Samples of gas and of the visible fume were taken from the flue pipe and analyzed. From a considerable series of such analyses, it was possible to construct a table.

Some Rules for Welding

In general, we believe that modern electric welding is a safe job, providing that the worker observes certain rules.

He must avoid ultra-violet light from the arc. His skin, especially hands, face, and neck, must be protected. We have no fault to find with the conventional safety practices with regard to these items.

He should not weld in confined spaces, like tanks, unless well ventilated, or unless he is supplied with an air mask.

If the concentration of visible fumes is kept within reasonable limits by means of appropriate ventilation, there will be no risk of poisoning from NO_2 . This does not mean that NO_2 gas and visible fumes are given off in any constant ratio. They are not. But low concentrations of visible fumes, such as 20 to 25 mgs. cu.m., preclude any possibility of harm from breathing gaseous impurities.

Ventilation requirements (Q) of unheated tanks with lateral exhausts were found to vary as follows:

Unflanged hoods:

$$Q = 2.3 (\text{width})^{1.17} (\text{length})^{0.85} (\text{velocity})^1$$

Flanged hoods:

$$Q = 1.9 (\text{width})^{1.1} (\text{length})^{0.7} (\text{velocity})^1$$

The optimum height of flange is that equal to tank width, and the optimum flange inclination is the maximum allowable without interference with industrial operations.

Slot velocity or slot width are unsatisfactory criteria of hood performance. The important factor is the quantity of air handled.

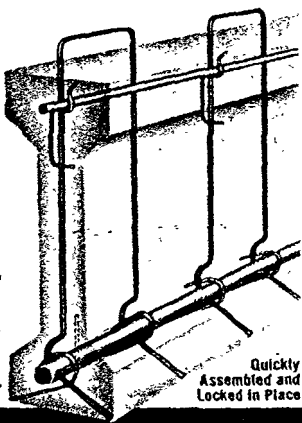
The depth of liquid surface below the slot does not affect greatly the characteristic of hood performance, but may have an important effect on evaporation and entrainment of liquid.

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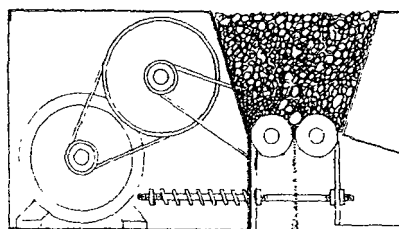
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