Mineral Wool

Interesting Technical Data Compiled From Field Survey

MINERAL WOOL

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INTERESTING TECHNICAL DATA on mineral wool has been compiled as a result of a field survey recently completed by the Bureau of Mines. Certain general conclusions and data were published in the report of the American Institute of Mining Engineers' meeting appearing in ROCK PRODUCTS, November, 1937, page 48, but the complete report of the survey is now available.

The report classifies mineral wools into three groups; rock wool, slag wool, and glass wool, and describes the various marketable forms and uses. Due to the confidential character of the information, names of producers are not given; but the plants are designated by number. Under each plant are listed the following data: raw material, but not the proportions, although the methods of proportioning and the manner in which it is fed are given in some cases; recovery of loose wool as compared with raw material fed into the cupola; fuel ratio; plant capacity; cupola dimensions and specifications; slag stream length; steam jet; type and steam pressure; wool rooms; type of granulator; and methods of removing shot.

Although the manufacture of mineral wool is a comparatively simple process and requires a relatively small amount of capital, (estimated at $50,000 to $60,000 for a plant producing 1000-lb. per hour) demands for specification products will necessitate more technical knowledge and closer control of operations. However, as mineral wool is a bulky material (usually not more than 12 tons can be packed in a freight car), it is expensive to ship long distances and for that reason, and the wide distribution of raw materials, the manufacture of mineral wool will continue to be a so-called decentralized industry.

Items in the manufacturing process that require careful technical study and control by an established producer and that hold potential trouble for the prospective producer are, as follows:

1. Chemical and physical composition of raw materials.
2. Type of melting furnace.
3. Melting and blowing temperature.
4. Blowing technique.
5. Shot prevention or removal.
6. Consumer's specification requirements.

Raw materials for the manufacture of mineral wool present an extended list today, and include the natural "wool rock" of Indiana, classed as a calcareous shale or argillaceous limestone; common shale, clay; combinations of calcareous and silicious materials, including waste glass, waste china, and even soil; and iron, copper, and lead blast furnace slags. The Illinois Geological Survey also suggests the possibility of manufacturing wool from charges containing sand and gravel, common clay, or other unconsolidated materials. Unconsolidated fine materials, however, cannot be used in water-jacketed or brick-lined cupolas because of the difficulty of forcing a draft through them. This confines the selection of raw materials for cupola melting to products in sizes large enough to permit free passage of furnace gases. In addition, it is necessary that the material retain its shape to the melting zone.

The greatest variation, however, lies in the chemical composition of the raw material. Some operators attempt to achieve and maintain a chemical balance between acids and bases in the cupola charge. Others contend that this is not necessary and that better wool results when there is a definitely greater percentage of acids over bases, or vice versa. While neither contention is supported in the report, it is pointed out that similar chemical compositions in the cupola charge may be obtained by combining two, three, four, or more of a large number of natural or waste materials and that the chemical composition of the charge is reflected in the chemical composition of the wool.

Practically all mineral wool is made in water-jacketed cupolas, the original brick-lined cupola having almost disappeared. While cupolas require raw material to be in lump form to permit the passage of furnace gases, one manufacturer has been successful in briquetting fine unconsolidated materials so that they may be melted in a cupola. Another operator is using a conical cupola instead of the cylindrical type.

The reverberatory type of furnace has been used in the manufacture of mineral wool, and glass wool is being made in a similar type of furnace. Finely divided unconsolidated materials can be handled in this type of furnace as it is not necessary to pass furnace gases through them. With cupolas there is considerable waste in the form of shot, but with the reverberatory type furnace the shot can be remelted to make more wool.

It is difficult to determine the temperatures maintained in the melting zone and the blowing temperature or temperature of the issuing slag stream. Thermocouples have been placed in the furnace wall or near the melting zone from which actual melting temperatures are calculated. The blowing temperature is gauged by the color. Both melting and blowing temperatures are important in mineral wool manufacture as the physical characteristics of the wool (shot content, fiber diameter, fiber length, etc.), with the same raw materials, will vary with different temperatures. A change in chemical composition or physical characteristics of the furnace charge may require a radical difference in melting temperature, whereas better wool may result without change in the original blowing temperature.

The length of drop of the slag stream from tap hole to steam jet has a very appreciable effect on the characteristics of the wool. Melting and blowing temperatures as well as chemical composition affect the viscosity of the slag which is an important factor in the shearing action of the steam or air jet and its ability to produce fine or coarse fiber and a minimum or maximum of shot. The diameter of the descending slag stream also is an important factor in evaluating the ability of the steam jet to shear or break it into globules. One experimenter found that the farther he could drop the slag to the steam jet without cooling or destroying the continuity of the stream, the better wool he could make.

For blowing, the conventional V-type nozzle is commonly used, but the length and width of the slots and the angle between them is still a matter of preference. Recent improvements of the nozzle include: a curved face nozzle, a recessed nozzle to avoid objectionable air currents, and a newly patented nozzle with an annular steam orifice through the center of which the slag is passed. (Continued on page 40)

*Abstracted from Bureau of Mines Information Circular 6984.

Chain feeder installation ahead of large gyratory crusher

14-ft. long. One of these screens is a new 3½- x 12-ft. horizontal double-deck screen, and the other a 3½- x 12-ft. double-deck screen, made from two 3½- x 6-ft. screens joined together. The top decks of these two screens have either 5/16-, ¼- or ⅜-in. openings, and the bottom decks have three cloth screens, 28-mesh, 10-mesh and ⅛-in., for three dust sizings. The screen openings on the preceding screens, of course, may be varied to meet conditions. For example, a typical screen arrangement will produce, 1½- to 2¼-in., 1- to 1¼-in., 1- to ¾, ¾- to ⅝, ⅝- to ½, ½- to 5/16, ½- to ¼, 5/16- to ⅛, ¼- to ⅛, minus 10 mesh (aglime), minus 28 mesh (aglime in sacks) and minus ⅛-in. plus 10 mesh stone sizes to meet any specification.

The addition of four bins of 1000 tons combined capacity has increased the total live storage capacity of the plant to 2100 tons in 18 bins. Bins are arranged in two rows, with each screen being placed over a bin. Below the bins, the loading-out belt conveyor has been extended under the four additional bins and new chutes installed so that any combination or blending can be done by drawing stone from any of the 18 bins on a single belt conveyor. The 36-in. loading-out belt conveyor on 360-ft. centers, carries stone to the railroad loading tipple and truck loading bins. Stone sizes in the several bins are fed to the loading-out belt conveyor through an accurately calibrated gate feeder so that exact grading specifications may be maintained on the loading-out belt conveyor. A final vibrating screen in the loading-out tower removes any casual dust from materials loaded in cars or sent to retail bins.

This interesting combination of close screen sizing and blending from all bins offers a challenge to any specification.

IRON TRAP ROCK CO. Woonsocket, R. I., has resumed operations after a shut-down of two years. A new corporation, the East Woonsocket Trap Rock Co., Inc., has been formed which holds a lease on the land, buildings, crushing equipment, rock, shovels, and other equipment of the Iron Trap Rock Co. Frederick Pelletier is president.

GRANITE STONE producers in New England have opened a campaign against tariff regulations which they claim permits granite from Finland to compete with domestic stone.

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Various angles of blowing steam jet or compressed air against the slag stream are used, but the conventional angle is always somewhat acute in that the slag drops vertically and the steam jet or air is usually directed upward to as much as 30 deg. above the horizontal.

Shot-free wool is very much desired, but none of the plants are able to entirely eliminate the shot. Glass wool made with a reverberatory furnace is the closest approach to it, but in the manufacture of rock or slag wool in a cupola furnace, shot is a waste product with which all producers have to contend. It is believed that the production of shot is caused by the globule cooling in its passage through the air before it has been entirely converted into fiber. Two remedies are suggested; one to manipulate the blowing operation so smaller globules will be made, and the other to raise the speed of the particle by increased steam pressure. Raw wool contains from 15 to 50 percent shot, ranging from microscopic size to ⅛-in. or more in diameter. It is difficult to remove the shot without breaking the fibers, but experiments are now being made which it is believed will result in the production of relatively shot-free wool. The manufacture of granulated wool eliminates the shot by passing the raw wool through hammer mills, feed threshers, or other types of granulators and then screening, but the fibers are broken up.

Customer Specifications

There is a definite trend toward the manufacture of a product which will meet certain specifications. The following have been mentioned as probable factors to be covered by specification: chemical composition, shot content, fiber size, ductility or softness, waterproofing, and thermal conductivity.

It is reported that mineral wool in which the percentage content of lime is too high, slowly disintegrates under atmospheric conditions. If the sulphur in the wool is in the form of sulphite or sulphate no corrosive action is noticeable, but if sufficient air is present to assure oxidizing conditions in the cupola, sulphur may appear as a sulphide which is unstable in the presence of moisture. Acid formed from the combination of sulphides and moisture is corrosive and harmful. Excessive shot content is not desirable because the shot has no insulating value. Wool of small diameter fiber has greater insulating value, and the longer fiber is desirable because it gives a better supporting bond. Ductility or softness is of value as it makes the wool easier to shape.

Load is divided between two 4- x 8-ft. vibrating screens with 1¼-in. and 1-in. openings. At this point, the ballast is taken out and passed to bins, when larger stone from the scalping screen is allowed to pass to the screening plant, and the 1- to 1¼-in. stone is screened out

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