Making "Wool" By a Continuous Automatic Process

Modern rock wool plant of Federal Portland Cement Co. designed for efficient material handling, ventilation and storage facilities

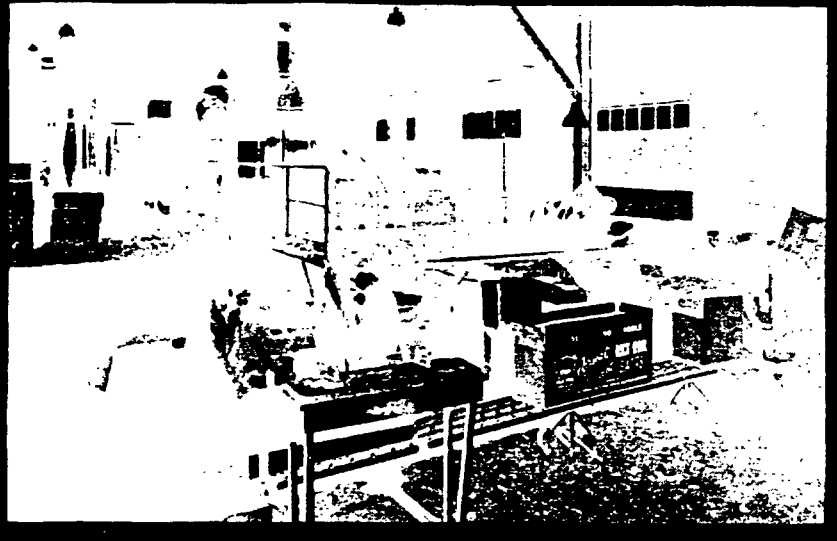
By BROR NORDBERG

Blowing mineral wool. Cupola on left has six molten streams for loose wool; cupola on right (four streams) is for batt manufacturing

ADVANCED TECHNOLOGY and the latest in improved machinery for the manufacture of mineral wool have been incorporated by the Federal Portland Cement Co., Inc., Buffalo, N. Y., into a new plant that represents advanced practice, particularly in methods to manufacture mineral wool batts. Federal's Insulation Division started the production of batts by a continuous and automatic process October 15, 1946, having manufactured loose wool and granulated wool for approximately two years at the same location.

Located on the shore of Lake Erie adjacent to the parent portland cement plant, the mineral wool plant has rail and trucking facilities and is housed in a 85- x 200-ft. fireproof building of concrete masonry and steel construction that, in itself, far outstrips plant standards for the industry. Material handling, ventilation, storage and the efficient interrelation of manufacturing and related processing were all designed into this plant.

Slag and coke are the basic raw materials for wool manufacture and the vertical cupola process of melting and blowing is employed. Essentially, there are two parallel production lines. One cupola is for the manufacture of loose wool and granulated wool, while a second, of identical size and capacity, blows wool fibers into a collecting chamber for the manufacture of batts. Capacity of the plant is potentially two-and-one-half tons of wool per hour. The cupolas are the conventional, water-jacketed, vertical blast furnace type, located side by side on a common firing floor, so that the plant could conveniently be expanded sidewise.



Batt production line taken from packing end. Note crosscut saw and on left, background, chute for packing loose wool. Workers to the left are compressing resilient batts into boxes

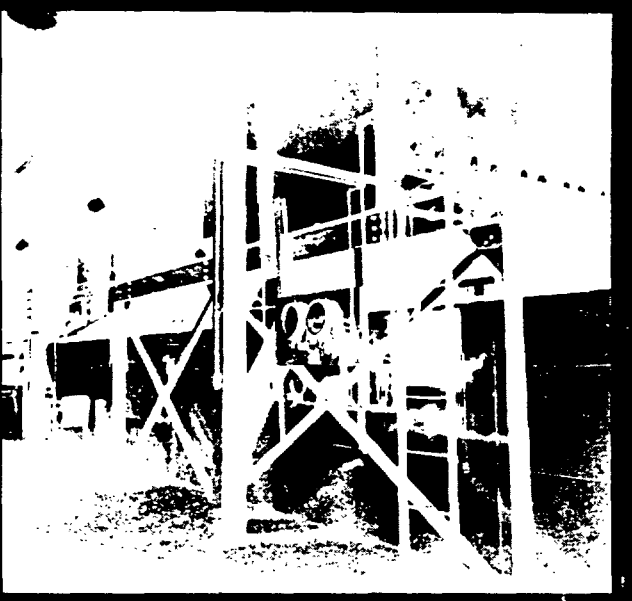
Raw Materials

Air cooled blast furnace slag sized from 1¾ to 4 in., without any additive raw materials, comprises the cupola feed, in alternate layers with 3½-4½-in. high grade foundry coke. Overhead bins for slag and coke have capacity sufficient for 24-hr. operation. Both materials are weighed on a hopper scale, in the approximate fuel ratio of 5.6:1, a skip hoist transferring to an overhead reversible belt conveyor charging into the top of either cupola. An average charge of slag plus coke weighs 1500 lb.

Fusion-Blowing

Each cupola is 48-in. inside diameter and is water-jacketed from the bottom of the fusion zone to a height of 8 ft. Fusion takes place in a zone 42 in. high, starting at a level 8 in. below tuyeres through which induced draft is introduced to burn the coke. Individual induced draft fans serve each cupola. High pressure steam, at 90 p.s.i., for fiberizing the melt is supplied both cupolas by a stoker-fired boiler rated at 125 p.s.i. and 150-hp. capacity. Heat taken up by the circulating cooling water is recovered, part of the steam being utilized as preheated feed water to the boiler.

The only difference in the two cupolas is in the number of streams of melt that are blown into fibers by the high pressure steam. Water-cooled divider plates split the stream flowing from one cupola into six streams of equal size, each subjected to a blast of steam through V-orifice blow caps. The other cupola, for batt manufac-



Left: Oven to set binder, showing arrangement to bag loose wool in foreground. Right: Close-up of oil-fired oven where binder is set or "cured" as blanket of wool passes through

ture, has four streams. Production of wool from each cupola is about the same. This matter of the practicable optimum number of stream divisions, a subject of industry-wide research, is under careful consideration.

Under present operating conditions, consumption of blowing steam for the long, uniform fiber produced is approximately one pound for each pound of slag melted per hour, or 3000 lb. per hour per cupola. The control of induced draft, important for its effect on viscosity of the melt and the fusion rate, is regulated at the fan in each case. Consumption of air is 160 c.f.m. per lb. of coke burned per hour, introduced into the cupola through seven tuyeres equally spaced radially.

Cooling water at 150 deg. F. is circulated by pump through the water jacket of each cupola at the rate of 175 g.p.m., returning to a sump at 200 deg. F. There is an excess of heated water over the boiler requirement (for 90 p.s.i. steam at 340 deg. F.), requiring the addition of makeup cold water to the balance for the recirculation through the cupola water jackets.

Temperature of the melt flowing from the cupolas is 2600 deg. F., which reduces to 2450 deg. F. at the blow caps. Temperature being an important factor for its influence on viscosity of the melt, it is checked at regular intervals by portable optical pyrometers. Observation ports and poke holes are located at each of the seven tuyeres. Normal practice is to charge 1500 lb. of slag plus coke twice each hour into each cupola and to regulate the speed of the conveyor inside each collecting chamber to conform with the highest output of the cupolas that can be maintained.

Annealing oil, for waterproofing and to allay dust, is coated over the fibers from which granulated wool and loose wool are to be processed. Application is at the rate of ¾ of 1 per cent by weight, the incandescent fibers being blown through an atomized stream of oil in front of the blow cap.

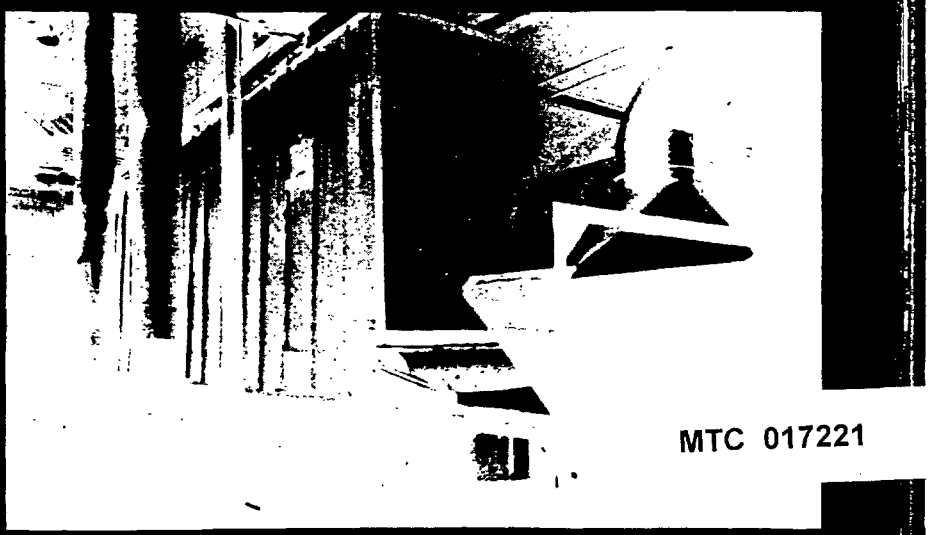
Loose-Granulated Wool

Fiberized wool from the 6-stream cupola is blown into its collecting chamber at a rate requiring that the continuous conveyor, 60 in. wide by 33 ft., on which it comes to rest, travel at seven lineal ft. per minute. The conveyor has high temperature steel woven wire mesh, carrying the wool blanket out of the collecting chamber for the picking and shredding processes.

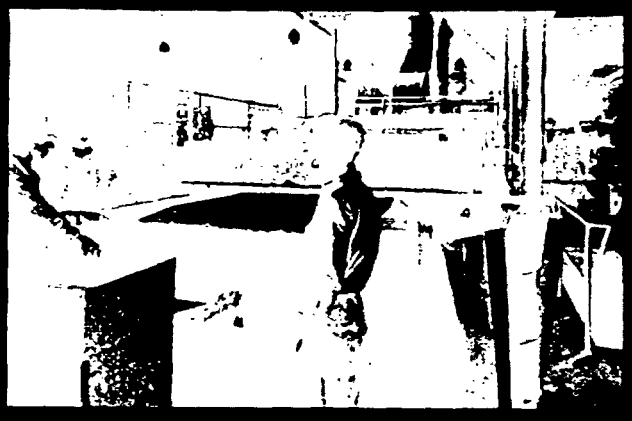
Pre-shedding takes place at the end of this conveyor, where the blanket of wool is passed under a picker, consisting essentially of a horizontal transverse shaft with a series of protruding arms. An inclined cleated belt conveyor followed by two overhead belt conveyors in succession elevates the wool to the shredder. A chute and downspout, where conveyor No. 2 transfers to conveyor No. 3, are provided for bagging loose wool on the main floor.

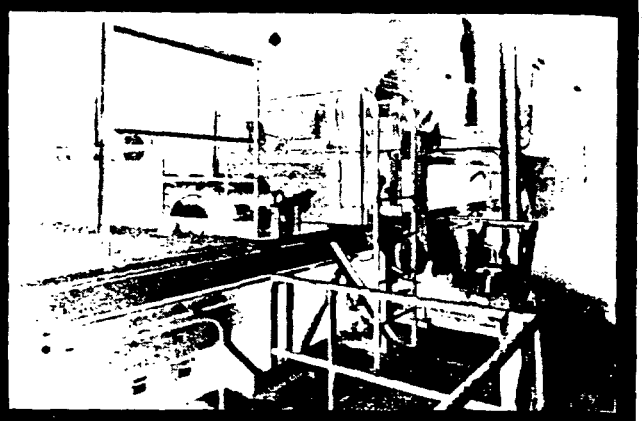
A rotary cage with numerable extending teeth, much like a hammer mill, shreds the wool into ½-in. pieces. Shot and fiber loss are screened through 7-mesh cloth on a revolving screen which also serves to pelletize the wool.

Granulated wool discharges into a chute with separating plate, in circuit with a cyclone separator which,



Collecting chamber on batt line has "floating" sides to settle wool on conveyor





Left: Workers loading batts into cartons from continuous conveyor. Oven to set binder and cooler fan visible in background. Right: Continuous batt conveyor showing longitudinal saw and close-up of cooling fan

while serving as a collecting bin, also separates further, shot and clinker or slugs of coke or slag. The product is packed, 40 lb. by weight, in 50-lb., double-wall stock paper bags. Reject granulated wool is bagged for disposal or for sale at great discount.

Dust, fumes and steam are effectively dispersed from the plant through a downdraft system in the wool collection chamber. For the purpose, a ventilating fan of 40,000 c.f.m. capacity receives its suction through an intake box spanning the complete underside of the conveyor inside the collecting chamber.

Batt Manufacture

Insulating batts are manufactured over a continuous and automatic production line of entirely new equipment. The process consists of melting and blowing of fibers into a collecting chamber, the coating of the fibers with plastic binder, heat treating to cure or "set" the binder, cooling, the application of paper backing, cutting and packaging.

An uninterrupted flow through these processes is effected over a single, endless, wire mesh conveyor on 120-ft. centers, of variable speed that is geared to the output of the cupola.

The conveyor in this case is 61 in. wide, allowing 1 in. for trim in cutting four 15-in. wide strips longitudinally. Its length comprises 35 ft. inside the collecting chamber, an 8-ft. section between the forming roll and oven, a

S. J. Drake, superintendent, rock wool division

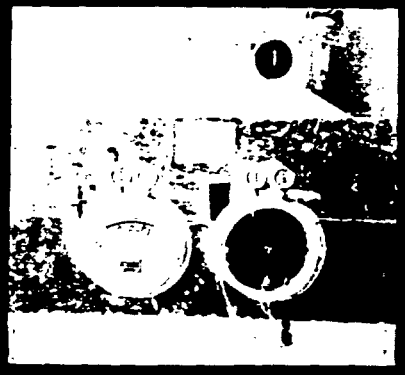
56-ft. oven section, 15 ft. through the cooling section, and the balance for cutting. Speed range is from 7 to 21 lineal ft. per minute, effected through a Reeves variable speed drive. Speed is reset for changes in batt thickness and may be increased or slowed with changes in cupola output in order to maintain uniform density of the product.

Resiliency of the batts is attained by application of a waterproof binder of the "thermo-setting" type. The binder, predominantly of oils and resins, is uniformly dispersed at the blow caps before the cupola, as a water-emulsion, to coat the individual fibers as they are being blown into the collecting chamber. Applied in the ratio of 2½ per cent by weight of wool, through a positive gear pump, the binder is of the class that must be kept moist until the blanket of wool is withdrawn from the blow room, so that the blanket may be handled and shaped into desired thickness. Then the binder is "set" through the application of heat. The result is a batt that is not only resilient, but with increased strength and resistance to moisture and high temperature.

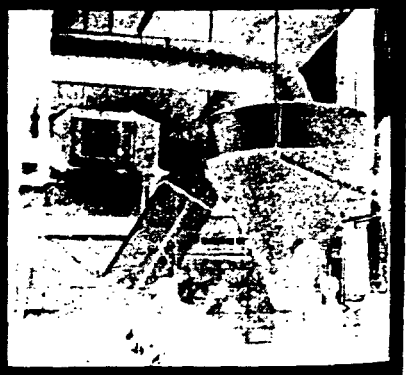
In its moist state the binder is gummy, with the result that coated fibers of wool would have a tendency to stick to the steel sides of the conventional, rigid collecting chamber. To prevent buildup on the inner sides of the chamber and to insure uniform full batt thickness along with reduced trim, the sides of the chamber are

(Continued on page 116)

Arrangement for weigh-batching coke and slag; charging elevator to the right



Instrument controls for oven to "set" batts



Bagging granulated wool from cyclone

screen is available for the production of masons' sand when desired.

Auxiliary Portable Plant

The portable plant, recently installed to produce a crusher run product for secondary roads, is a Cedarapids Junior straight-line tandem plant. The conveyor carrying the product from the primary crusher discharges half its load to the main plant, as previously described, and half to a hopper that serves the portable plant. Under the hopper, a 24- x 48-in. reciprocating feeder discharges to a 24-in. belt conveyor for delivery through a transfer station to another 24-in. belt conveyor. The latter conveyor feeds a 3- x 10-ft. double-deck Nordberg horizontal vibrating screen with 3- and 1½-in. sq. openings on the two decks, respectively. Plus 3-in. gravel is crushed in a 10- x 36-in. jaw crusher; the minus 3-in. plus 1½-in. product is reduced in a 16- x 24-in. roll crusher; and the minus 1½-in. product is delivered by a 24-in. belt conveyor to another 24-in. belt conveyor which fills a 23-ton capacity truck-loading bin. Crushed gravel from the two crushers is conveyed to an elevating wheel, 75-in. in diameter and 22-in. wide. From this wheel a conveyor belt moves the crushed gravel to the horizontal screen, in closed circuit.

Production capacity of both plants is now 100 tons per hour, but with the installation of the new equipment this winter, the main plant will be able to produce 200 tons per hour.

R. Lee Ellis is president of the Grove Stone and Sand Co.; Chas. G. Lee, Jr., secretary; J. G. Northcott, general manager; Paul Warlick, assistant general manager; W. W. White, office manager; L. M. Morgan, superintendent; and George W. "Uncle George" Brandon, assistant superintendent.

In addition, under the same personnel, the company operates a modern Dunbrik plant with a capacity of 18,000 brick per day.

Rock Wool

(Continued from page 112)

built to hang free. A ½-hp. electric motor through an eccentric keeps the sides oscillating, or floating, sidewise continuously, to maintain a square sided felt.

Coming from the collecting chamber, the blanket of wool is compressed into desired thickness by a transverse forming roller, then enters the oven where the application of heat sets the binder to retain the established density of the blanket. The oven circulates hot air at 500 deg. F., heated by a 5-section, oil-fired burner, down through the wool blanket and then up through it again—a 2-pass oven—with the heated air re-circulated by fan. Recording and control instruments are the means to regulate oven operation.

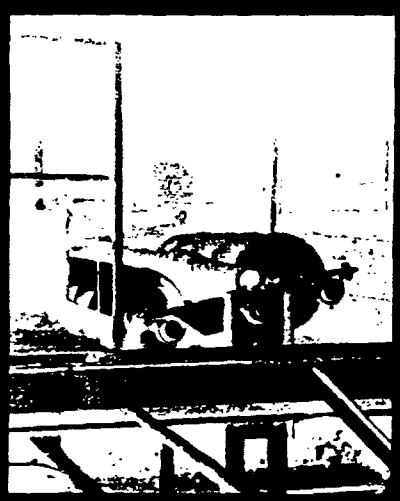
A downdraft created by a fan in the cooling section removes excess heat from the wool blanket to enable early handling and to minimize the likelihood of combustion after the finished product has been loaded into cars for shipment.

Loose wool passing under picker

Cutting-Packaging

Cutting of the batts is accomplished first by continuous longitudinal slicing and then, transversely, by a cross-cut saw. A series of rotary saws mounted on a transverse arbor cuts the blanket into four 15-in. wide strips and trims the edges. Trim is hand-packed into bags for sale. A second series of blades alongside serves as a spare and can be engaged for cutting other-than-standard widths.

Paper backing, or vapor barrier as it is called, is applied automatically from threading rolls before cutting to length. Travel of the cross-cut saw is timed by a timing chain and magnetic switches so that when the saw is engaged it travels forward at the same speed as the wool moves forward, in order to affect a straight cut. Batts are made with a ¼-in. tolerance on length, width and thickness. Full-thick batts are 3¼- to 3½-in. thick and semi-thick sizes measure 2 in. thick. Standard sizes are 15- x 24-in. and 15- x 48-in., with or without the vapor barrier. Capacity is 90 cartons per hour, 40 sq. ft. to the carton, or 88,000 sq. ft. of full thick batts in 24 hr. The production line for batt manufacture, including the collecting chamber, oven, cooler, saws and accessory equipment was designed and manufactured by James Campbell Smith, Inc.



Close-up of longitudinal saws which cut four 15-in. strips continuously

Shipping

Straight line production methods are followed up to include carloading. A density of 2¾ to 3 lb. for batts is maintained by filling cartons on a scale as the batts come off the production line. Ten cubic feet are packed into a box. Cartons are shoved over a Speedway roller conveyor where workers compress the batts to close and seal the cartons. Mineral wool being a bulky commodity and therefor expensive to ship, compressing of resilient batts into cartons to the point where they contain 40 per cent more product than actual volume of the cartons enables a substantial increase in the loading per car. Average loading done by hand-propelled trucks is 18,000 sq. ft. of batts per car and the shipping radius is approximately 500 miles. All products are sold under the tradename "Airseal." Expansion of markets from conventional outlets Among new products to be manufactured will be industrial insulation is contemplated in the near future. materials, metal mesh blankets, industrial felts, insulation for stoves, refrigerators and air-conditioning equipment, pipe covering, acoustical materials, etc.

S. J. Drake, formerly associated with C. W. Poe, Cleveland, Ohio, and at one time superintendent of the American Rock Wool Co. Cleveland plant, is superintendent of the plant. A. A. Oesterle is general superintendent of the Federal Portland Cement Co., Inc., of which the Insulation Division is subsidiary.

Carbon Monoxide Indicator

NATIONAL BUREAU OF STANDARDS, Washington, D. C., has announced the development of a colorimetric indicating gel that will detect and estimate less than one part of carbon monoxide in 500 million parts of air, a sensitivity more than 100 times greater than that attained by former chemical indicators. The indicating material, yellow in color, is a silica gel impregnated with a complex silico-molybdate compound and catalyzed by means of palladium in the form of the sulphate. The yellow indicator turns various shades of green and bluish green on exposure to very low concentrations of carbon monoxide. The color response is a function of time of concentration of carbon monoxide, a direct parallel to the physiological response to this gas. For use, the indicator gel is sealed in a small glass about 5 in. long and the approximate diameter of a lead pencil, with protecting layers of pure silica gel in each end of the tube.

Gypsum Association Moves

GYPSUM ASSOCIATION, Chicago, Ill., has announced that its offices have been moved to 330 S. Wells Street, Chicago 6, Ill.

Rock Product