RESEARCH IN ROCK WOOL MANUFACTURING POSSIBILITIES IN OKLAHOMA

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About two years ago it was decided that the Oklahoma Geological Survey should stress in its work the development of the lesser known mineral resources of the State which have, in the past, been considered as being of somewhat minor importance in comparison with the major industry of oil production. To further this work the Survey organized and equipped a new laboratory known as the "Industrial Research Laboratory." The equipment is especially designed to facilitate research on the production and treatment of any mineral substances that may be found in commercial quantities in Oklahoma.

One of the first possibilities that occurred to the staff of the Survey was that of producing rock wool from local materials. On investigation it was found that the Illinois Geological Survey had recently completed an extensive study of rock wool possibilities in Illinois and published the results of that study in their very comprehensive and complete Bulletin No. 61. Late in 1936 Robert H. Dott, director of the Oklahoma Geological Survey, with the writer, visited the Illinois survey and discussed the problem in detail. It was decided that the purely scientific phases of the subject had been covered so thoroughly that it would be unnecessary to duplicate any of that work and all efforts should be devoted to the finding of satisfactory deposits of raw materials in this state and the solving of problems of the industry that are peculiar to Oklahoma. It was thought especially necessary to take advantage of the large available supply of natural gas.

During the past two years the Oklahoma Geological Survey, with the assistance of the Works Progress Administration, has located, mapped and sampled mineral deposits in every county of the state and several thousands of those samples have been analyzed and the results filed for record. The work of the Illinois survey definitely established the fact that all natural wool rocks, regardless of exact composition, would contain between 20 and 30 per cent of carbon dioxide. This fact does not mean that all rocks with that characteristic will make wool, but it does permit the elimination from further consideration of many rocks that will not make wool. Using this limiting factor, it was a simple matter to select from the files several hundred samples of rock that might prove to be wool-rock.

In general, a wool-rock is one that will melt at economically possible temperatures and form a slag of rather low viscosity. Roughly the rock should contain from 30 to 45 per cent silica, 40 to 55 per cent calcium carbonate and smaller percentages of alumina, iron and other impurities. These impurities tend to lower the temperature of fusion. A typical analysis of a rock that makes excellent wool is as follows SiO_2, 38.53%; Al_2O_3, 2.01%; Fe_2O_3, 1.27%; MnO, tr.; $CaCO_3$, 45.33%; $MgCO_3$, 9.41%; combined H_2O, 2.02%; excess CaO, 1.82%; total 100.39%. This analysis is computed as a composite of four similar samples. It has been found, however, that to definitely determine whether or not a rock is a true wool-rock an actual blowing test must be made. Whereas some rocks will go into solution at reasonably low temperatures (1425° - 1550°C) other rocks of nearly the same chemical composition will not melt at the highest temperatures attainable when using standard refractories and equipment. The writer believes that the exact mineral composition and crystallization have a direct influence on the melting temperature of the rock and, therefore, a chemical analysis alone is insufficient.

The apparatus used in the laboratory to make rock wool consists of a cylindrical high temperature furnace lined with standard high

alumina fire-clay. Fuel used is natural gas which is pre-mixed with air and blown into the furnace by an electric blower. Temperatures exceeding 1600°C. have been reached without appreciable damage to the furnace lining. A 1½ H. P. vertical tube steam boiler furnishes steam at 100 pounds per square inch, working pressure. A steam blowing nozzle is used. This nozzle has a ¾ inch by 3/32 inch orifice and is equipped with a gauge for the control of nozzle pressure. A structural steel pouring rack and special crucible tongs are provided to facilitate pouring the molten material.

After chemical analysis, rock to be tested is crushed to pass ¼ inch mesh screen and is then completely calcined. A charge of calcined material is weighed into a No. 2 graphite crucible and then heated until completely in solution, unless the melting temperature is too high. Practical temperatures range from 1425° to 1550°C. The molten material, or slag, is transferred in the crucible to the pouring rack and poured evenly througgh a jet of steam, thus forming the mineral fibers. Pouring temperatures average about 1500°C. and steam nozzle pressure about 80 pounds per square inch. Rate of pouring is about 35 seconds per kilogram of slag. When wool is formed it is collected and weighed. Laboratory practice indicates that approximately 60 per cent of the weight of the raw material can be recovered as rock wool.

An impure limestone is generally considered to be type wool-rock, but actually many other varieties of rocks have been found that are suitable for the manufacture of wool. The Verden Channel sandstone of Grady County and caliche deposits of Beaver County both produce rock wool of exceptionally good quality. More than one hundred samples of wool have been produced in the Survey laboratories to date and many more samples are yet to be tested. It is safe to say that almost unlimited quantities of material suitable for commercial exploitation have been found in the entire eastern and southeastern parts of the state and in the Panhandle area. Wools equal in quality to all grades of standard wools now marketed have been produced from Oklahoma materials and in some instances the local products appear to be better than the best of the standard imported varieties.

Most of the rock wool now sold in the southwest is produced in Indiana and Illinois. An expensive blast furnace method involving the use of coke as fuel is in general use. Production costs are high, ranging from $20.00 to $25.00 per ton of finished product. Freight rates are also high and these factors result in a cost to local distributors of $40.00 to $55.00 per ton and a retail cost of $80.00 to $90.00 per ton. In Oklahoma there are large deposits of satisfactory materials that can be mined by the cheapest methods, such as power shovel or open pit quarrying. Favorable freight rates can be obtained for shipment of raw material within the state. An unlimited supply of natural gas is available that can be purchased for about 8 cents per 1,000 cu. ft. The design of a new type gas burning plant is now being completed by the Oklahoma Geological Survey in cooperation with commercial interests, which plant will use from 6,000 to 10,000 cu. ft. of gas per ton of raw material. Considering these economic factors it is safe to say that rock wool can be produced in Oklahoma at not more than one-half the cost now common to the industry.

As a direct result of this study one 40 ton per day factory is now assured and construction will start as soon as the plans are completed. Many inquiries have been received and an important new industry may develop to the benefit of the state.