Trace Elements in Agricultural Slags

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The slags most commonly used in agriculture are blast-furnace slag, basic slag, and phosphorus-furnace slag. These slags are the byproducts, respectively, of iron production in the blast furnace, pig iron refining by the basic Bessemer or open hearth processes, and of phosphorus production by the electrothermal process. Gathered in the slags are most of the unwanted or auxiliary constituents of the iron ore, pig iron, phosphate rock, limestone, silica, and other raw materials, that are completely or partially nonvolatile under process conditions. Included among such constituents are silicon, calcium, magnesium, sulfur, and aluminum. These combine in the slags to form complex silicates, alumino-silicates and lesser amounts of other compounds. Trace elements occurring in the raw materials also tend to accumulate in the slags which thus become a repository of certain trace and secondary plant nutrient elements.

Slags as Soil Amendments

The main agricultural use of blast-furnace and phosphorus-furnace slags is for liming the soil. The latter is nearly all consumed in that manner. Basic slag, however, with its component of available phosphorus, is used mainly as a phosphorus fertilizer. Slags are prepared for use on the land by allowing the molten material as it comes from the furnace to cool in pits followed by crushing and screening to the desired particle size (air-cooled type), or the molten material may be quenched with water. The latter process granulates the material and eliminates or greatly reduces the grinding and screening.

In spite of its recognized liming value, only a small fraction of the annual blast-furnace slag production is used in agriculture: 83,000 tons of a total domestic production of 35,800,000 tons were so used in 1950 (9). Although about 30,000,000 tons were processed for various commercial uses (railroad ballast, mineral wool, roofing, etc.) in 1950, present outlets are not always sources of substantial profit to producers nor do such outlets fully utilize the production. Plants producing this slag are fairly well distributed in the humid regions where soils require liming, and it may be inferred that much more than the roughly 5,800,000 tons not now commercialized would be available to agriculture should the demand arise. This reservoir of soil liming values and of plant nutrients. The total soil-neutralizing power of blastfurnace slag produced in 1950 was much greater than that of all the other liming materials used on that year or any previous year.

Crop response to applications of blast-furnace slag sometimes been more than would be expected from its liming action alone. Davis, Collier, and Cutler, for example, appear to have demonstrated that blastfurnace slag is a good source of boron. This slag produced where boron was deficient, beyond what would be expected from simple correction of soil acidity. Blastfurnace slag is known from spectroscopic studies to contain a number of trace elements in addition to boron but quantitative values for the actual amount except for manganese and boron, have been obtained. Manganese is determined routinely as a means of control and quantitative results for boron have been reported for a few samples (14). Increased yields and other benefits from the trace elements in slags have been inferred but seldom proven, due in part to the lack of definite knowledge of the contents of such elements in the slag. Information on trace elements in slag is of interest to both producer and consumer for a number of reasons. A knowledge of the trace elements in slag may be important in the evaluation of the slag for agricultural use.