What's New about Basic Slag

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Basic slag has been around Alabama since it was first ground and bagged at the Ensley plant of U.S. Steel Corporation in 1915. Because of its availability and low cost, this was probably one of the very first soil amendments used on some Alabama cropland.

How it is made
In the process of making steel from iron in the open hearth, iron ore, coke, limestone, and a flux is used. The limestone removes unwanted elements from the steel such as phosphorus and some metals. Some of these elements are essential plant nutrients. The slag is drawn off, cooled, stockpiled, and crushed into what farmers call basic slag. At one time, basic slag made from domestic iron ore could contain as much as 10 percent plant available $P_2O_5$ - a significant amount of phosphate fertilizer considering that very few other fertilizers may have been used on Alabama soils at that time.

Plant nutrients
When fertilizers were low analysis and difficult to transport great distances, basic slag soon became a major fertilizer and soil liming material in Alabama and the Southeast. By the time World War II began, basic slag ranked second only to superphosphate (0-18-0) in the worldwide use of phosphorus fertilizers. Higher grade iron ore is being used in steel making today. As a result, the amount of phosphorus in samples of basic slag today is very low.

Most of today's basic slag contains less than 1 percent $P_2O_5$. It still contains many plant secondary and micronutrients notably magnesium (6.5% Mg), calcium (24% Ca), iron (26% Fe), manganese (1.2% Mn), and zinc (0.1% Zn). The actual amount of secondary and micronutrients can vary from one batch to another.
Neutralizing value
The real value of basic slag is not in the nutrients it contains but in its "basic" soil liming properties. It is a good, alternative soil liming material. Today's basic slag has almost the neutralizing value of minimum quality ground limestone. The source of lime is the crushed limestone used in the steel-making furnace. The intense heat converts the limestone (calcium and magnesium carbonates) to burned or quick lime (calcium and magnesium oxides) that is highly reactive. During cooling and storage, most of the oxides are probably converted to hydroxides and even back to carbonates as the slag reacts with moisture and carbon dioxide in the air. Impurities make the slag black in appearance. Because of the impurities, basic slag is always less than 100% in total neutralizing value. By Alabama law, all commercial, ground limestone must be at least 90% neutralizing value but by-product lime can be any value as long as it is declared on the label. Over the years, neutralizing values for basic slag have ranged from as low as 55% to as high as 90% with 70% about average. Commercial basic slag being sold today is only slight less neutralizing value than minimum quality ground agricultural limestone.

Fineness
Regardless of their total neutralizing value, soil liming materials must be finely ground in order to come into contact with the soil clay surfaces where soil acidity (hydrogen and aluminum cations) are found. Alabama state law requires that ground agricultural limestone be at least fine enough such that 90% will pass a 10-mesh screen (2.5 mm) and 50% will pass a 60-mesh screen (0.4 mm). Particles smaller than a 60-mesh screen are almost 100% reactive. Particles larger than a 10-mesh screen are almost totally unreactive. Those in between are about 50% reactive. Auburn University's limestone recommendations are based on minimum quality ground agricultural limestone. Basic slag is generally much easier to crush into a fine powder than
limestone. Therefore, over the years, part of basic slag's attraction has been its relative reactivity with soil acidity. It has been a very dusty, black powder that reacts relatively quickly with soil particles. Recent samples run by the State Chemical Laboratory, however, indicate that modern basic slag is not ground as finely as older basic slag. Although a coarser product handles, transports, and spreads easier than a fine powder, this could reduce its total reactivity. On the other hand, the total neutralizing value has increased considerably.

Ground limestone or basic slag?
That is the question. It really doesn't matter. The most important value is raising the soil pH to the desirable range for the crops to be grown, generally between 6.0 and 7.0. With basic slag you get calcium and magnesium just as in ground dolomitic limestone. Basic slag also provides a few more micronutrients that you may or may not need. With ground limestone, you get a high quality soil liming material, depending upon fineness, that contains calcium and sometimes magnesium. The cost of hauling, storage and spreading the two should be about the same. Therefore, the bottom line is availability and cost. Theoretically, a grower should apply about 25% more of today's basic slag to get the same effective neutralizing value as ground limestone. That is, if a ton of ground limestone is recommended, a grower needs about 2500 pounds of basic slag. Most producers apply basic slag and ground limestone TON FOR TON and feel comfortable that either product will do the job.