Extension Service
West Virginia University

The Value of Agricultural Limestone

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Different agricultural liming materials have different values. The value of agricultural limestone varies with the geological source of the limestone and how the limestone is processed. The geological source of the limestone determines how much calcium carbonate and magnesium carbonate is in a ton of lime. The amount of these two carbonates determines the total neutralizing value (TNV) of the limestone. The processing of the limestone determines the fineness of the particles in the finished product. The lime's fineness determines how fast the limestone will react with the acids in the soil to increase the soil pH. The combination of TNV and reaction rate is the effective neutralizing value (ENV) of the lime.

By law, all agricultural liming materials sold in West Virginia must include a tag on the bag or truck weight slip that describes the liming material. This tag must give the TNV of the material in calcium carbonate equivalent (CCE), the amount of material that passes different sieve sizes, and the percent of magnesium carbonate in the material.

The TNV is the percentage of the limestone capable of neutralizing an acid and is expressed as CCE. If a limestone has a TNV of 80 percent it means that 1 pound of it will neutralize the same amount of acid as 0.8 pounds of pure calcium carbonate. Limestones differ in TNV since they all contain impurities which do not react with acid; the more impurities the lower the TNV. Also some limestones contain magnesium carbonate, which has a greater neutralizing value than calcium carbonate per unit of weight. One pound of pure magnesium carbonate will neutralize the same amount of acid as 1.2 pounds of calcium carbonate. Therefore, dolomite limestone (also called high magnesium lime) often has a higher TNV than calcium limestone. Since limestone never has more magnesium than calcium carbonate, the highest purity of dolomite limestone has a TNV of about 108 percent. Hydrated and slaked lime are heated to drive off carbon dioxide, leaving oxide forms of calcium and magnesium. These have higher TNVs than ground limestone.

When a soil tests low to medium in magnesium the use of high magnesium limestone is recommended to meet the needs of plants for magnesium.

Fineness of a ground limestone (sieve size) determines how fast the lime reacts with an acid. As a ton of limestone is ground finer there is more surface area. This increased surface area gives more places where the lime can react with the acids in the soil. The fineness of limestone is measured by how much will pass through different mesh screens or sieves. The screen mesh or sieve size is the number of wires in a 1-inch/length of screen. The larger the number of the mesh means the more wires per inch which results in smaller holes in the sieve. Soil and management conditions will affect how fast the different particle sizes react with your soil. However, based on plant response and laboratory studies we can expect the following to occur when lime is worked into the soil:

1. particles that pass a 100-mesh sieve react 100 percent with the soil in six months or less;
2. particles that pass a 60-mesh or finer sieve react 100 percent within the first year;
3. particles that pass a 20-mesh but not a 60-mesh sieve react about 50 percent in the first year;
4. particles not passing a 20-mesh sieve have little liming value and are not generally credited when evaluating lime materials.

Effective neutralizing value (ENV) is a way of combining TNV and fineness to estimate how much of a liming material will be available to change the soil pH within one year. The worksheet "Comparing the Effective Neutralizing Value of Agricultural Limestone" is available at the end of this fact sheet for making these calculations. An Excel spread sheet "Lime Value Work Sheet.xls" is also available for calculating the ENV of ground limestone materials.

Three pieces of information are needed to calculate a ground limestone's ENV; these are its TNV in percent CCE, the percent of the limestone that passes a 20-mesh sieve, and the percent that passes a 60-mesh sieve. All of this information is available on the label provided with the sale of

ground agricultural limestone in West Virginia. Enter the TNV and the percent passing the 20- and 60-mesh sieve in the blanks on the appropriate lines of the worksheet. The percent of limestone that passes a 60-mesh sieve is given a weighting value of 1.0 since it is considered to be completely available within one year. The amount passing a 20-mesh sieve but not a 60-mesh sieve (subtract that passing a 60-mesh sieve from that passing a 20-mesh sieve) is given a weighting value of 0.5 since only half of it is available in the first year. Multiply these weighting values by the percent material in the respective sieve class and enter the result to the right of the equal sign. Next add these values to get the "% Effectiveness of liming material". Divide this value by 100 to convert the number to a decimal fraction. This decimal is then multiplied by the "Calcium Carbonate Equivalent" to get the "Effective Neutralizing Value (ENV) of the liming material" or "% ENV."

Lime requirement are given in terms of 100% CCE limestone. To determine the tons of lime needed to get one ton of CCE, divide one by the "% CCE" and multiply by 100 (to adjust for using a percent and not a fraction). This is the tons of this liming material to provide one ton of 100 % CCE limestone.

To compare limes based on their ENV divide 1 by the respective limes %ENV and multiply by 100. This is the tons of lime required per ton of lime requirement needed to obtain the same change in soil pH within 12 months.

When investing money in lime the manager needs to determine which source of lime will provide the needed change in soil pH at the lowest cost. Soil testing and evaluating ground limestones based on their TNV and ENV enable the manager to do this with confidence.

Example

Limestone #1							
Total neutralizing value as Calcium Carbonate Equivalent (CCE)							105.6% CCE
% Passing a 20-mesh sieve	100%						
% Passing a 60-mesh sieve	85%	x	1.0	=		85.0	
% 20- to 60-mesh (subtract 60-mesh from 20-mesh)	15%	x	0.5	=	+	7.5	
% Effectiveness of liming material						92.5	
(to convert percentages to decimal)						/ 100 =	x 0.925
Effective Neutralizing Value (ENV)							97.68% ENV

Tons of lime required per ton lime requirement = 1.0 / 97.68 x 100 = 1.02 tons of lime
To equal 1 ton of 100% ENV lime (%ENV)

Limestone #2							
Total neutralizing value as Calcium Carbonate Equivalent (CCE)							87.0% CCE
% Passing a 20-mesh sieve	45%						
% Passing a 60-mesh sieve	26%	x	1.0	=		26.0	
% 20- to 60-mesh (subtract 60-mesh from 20 mesh)	19%	x	0.5	=	+	9.5	
% Effectiveness of liming material						35.5	
(to convert percentages to decimal)						/ 100 =	x 0.355
Effective Neutralizing Value (ENV)							30.88% ENV

Tons of lime required per ton lime requirement = 1.0 / 30.88 x 100 = 3.24 tons of this lime
To equal 1 ton of 100% ENV lime (%ENV)

To calculate the effective neutralizing value (ENV) of agricultural limestone enter the information from the label describing the limestone and perform the indicated calculation.

Limestone #1

Percent Calcium Carbonate Equivalent							_____%
% Passing a 20-mesh sieve	_____%						
% Passing a 60-mesh sieve (substract 60 from 20 mesh)	_____%	x	1.0	=		_____	
% 20- to 60-mesh	_____%	x	0.5	=	+	_____	
% Effectiveness of liming material						_____	
(to convert percentages to decimal)						/100=	x_____
Effective Neutralizing Value (ENV)							_____% ENV

1 / _____ x 100 = _____ tons of this lime equals 1 ton of 100% ENV lime.

Limestone #2

Percent Calcium Carbonate Equivalent							_____%
% Passing a 20-mesh sieve	_____%						
% Passing a 60-mesh sieve (subtract 60 from 20 mesh)	_____%	x	1.0	=		_____	
% 20- to 60-mesh sieve	_____%	x	0.5	=	+	_____	
% Effectiveness of liming material						/100=	x_____
(to convert percentages to decimal)							_____% ENV
Effective Neutralizing Value (ENV)							

1 / _____ x 100 = tons of this lime equals 1 ton of 100% ENV lime.