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Forage Management

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The Value of Agricultural Limestone

Different agricultural liming materials have different values. How can a manager decide which is the best buy for a given application? 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, capable of neutralizing soil acidity, is in a ton of the material. The amount of these two carbonates determines the total neutralizing value (TNV) of the limestone. The processing of the limestone determines how fine the particles in the finished product are, which determines how fast the limestone will react with the acids in the soil to increase the soil pH.

By law the sale of all agricultural liming materials must include a "tag" on the bag or truck weight slip which describes the material being sold. This tag must give the TNV of the material in calcium carbonate equivalent, the amount of material which 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 calcium carbonate equivalent. 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 pound 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 grater 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 often has a higher TNV than calcium limestone and high-grade magnesium limestone can have a TNV over 100 percent. Hydrated and slaked limestone have been heated to drive off carbon dioxide, leaving oxide forms of calcium and magnesium. These have higher TNV's than limestone.

Fineness of a limestone (sieve size) determines how fast the lime can react 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 which pass a 100-mesh sieve react 100 percent with the soil in six months or less;

2. particles which pass a 60-mesh or finer sieve react 100 percent within the first year;

3. particles which 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 generally are not 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.

The three pieces of information we need to calculate a limestone's ENV are its TNV in percent calcium carbonate equivalent, the percent of the limestone which passes a 20-mesh sieve and the percent which passes a 60-mesh sieve. All of this information is available on the label provided with the sale of all ground agricultural limestone in the state. 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 which 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 (substract that passing a 60 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 that 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". Liming recommendations are given in terms of 100% ENV limestone. To calculate the agronomic value of a liming material, divide its cost by the "% ENV" and multiply by 100 (to adjust for using a percent and not a fraction). This is the cost of this liming material to provide one ton of 100 percent ENV limestone. To find the number of tons of this limestone needed to correct the soil pH, make this same calculation using 1.0 instead of the price of the limestone.

Limestone #1

Percent Calcium Carbonate Equivalent							105.6% TNV
% Passing a 20-mesh sieve	100%						
% Passing a 60-mesh sieve	85%	x	1.0	=		85.0	
% 20- to 60-mesh	15%	x	0.5	=	+	7.5	
% Effectiveness of liming material						92.5	
(to convert percentages to decimal fractions)						÷ 100 =	x 0.925
Effective Neutralizing Value (ENV) of the liming material							97.68% ENV

$ cost per ton / %ENV x 100 = $ cost/ton ENV
$ 26.00 / 97.68 x 100 = $ 26.62/ton ENV
1.0 / 97.68 x 100 = 1.02 tons of this lime equals 1 ton of 100% ENV lime.

Limestone #2

Percent Calcium Carbonate Equivalent							87.0% TNV
% Passing a 20-mesh sieve	45%						
% Passing a 60-mesh sieve	26%	x	1.0	=		26.0	
% 20- to 60-mesh	19%	x	0.5	=	+	9.5	
% Effectiveness of liming material						35.5	
(to convert percentages to decimal fractions)						÷ 100 =	x 0.355
Effective Neutralizing Value (ENV) of the liming material							30.88% ENV

$ cost per ton / %ENV x 100 = $ cost/ton ENV
$ 16.00 / 30.88 x 100 = $ 51.81/ton ENV
1.0 / 30.88 x 100 = 3.24 tons of this lime equals 1 ton of 100% ENV lime.

Comparing the Effective Neutralizing Value of Agricultural Limestone

To calculate the effective neutralizing value of (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 8 (substract 60 from 20 mesh)	_____%	x	1.0	=		_____	
% 20- to 60-mesh	_____%	x	0.5	=	+	_____	
% Effectiveness of liming material						_____	
(to convert percentages to decimal fractions)						÷100=	x_____
Effective Neutralizing Value of (ENV) of the liming material							_____% ENV

$ cost per ton / % ENV x 100 = $ cost/ton ENV
$ _____ / _____ x 100 = $ _____/ton 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 (substract 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 fractions)							_____% ENV
Effective Neutralizing Value (ENV) of the liming material							

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