Adjusting Lime Rates

FACT SHEET

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Lime applications should be made when a soil's acidity gets to a level that is detrimental to plant growth. The amount of lime recommended is based on using a good quality limestone source that will efficiently raise the soils pH level. Adjustments need to be made to the recommended amount based on two factors; the purity and the fineness of the lime material's particles. If these adjustments are not made, correcting the soil's low pH condition cannot be assured. This Fact Sheet provides information regarding terminology used to describe lime quality and how to adjust a lime recommendation based on its' quality.

PURITY

Liming materials will vary in their percentage of calcium and/or magnesium as well as impurities such as silt and clay. The purity of lime is expressed as it's *calcium carbonate equivalent* (CCE). Pure calcium carbonate has a CCE of 100%. Liming materials such as dolomite or hydrated lime may have a CCE greater than 100%. Other liming materials such as wastewater treatment lime tend to have a lower CCE, sometimes only 65 - 75%. With this wide variability, it is essential to adjust a lime recommendation according to the CCE.

FINENESS

Particle size varies greatly among lime sources. Agricultural limestone has a mixture of different size particles. The distribution of these particles is determined by passing the mix through various mesh sizes of sieves. Lime quality improves when a greater percentage of the particles pass through finer mesh sieves, such as a U.S. 60 or U.S. 100 mesh. Finely ground lime reacts quickly with the soil. Large particles may not react at all within a reasonable length of time. The effectiveness of the reaction is limited to a small area around each particle. Increasing the surface area exposes more lime and increases its solubility. Finer grades of lime have a significantly larger surface area per unit weight of material than coarser grades.

Some liming sources are comprised of very fine particles, even smaller than a U.S. 100 mesh sieve. Liquid lime is made from particles this small and suspended in water or fluid fertilizer. Pelletized lime is also made from very fine particles of lime and, once dissolved by soil moisture, becomes quickly available for neutralizing acidity. Liquid and pelletized lime, though, should not be used as a substitute for timely applications of agricultural limestone. Since they do not contain coarser particles, they do not provide the residual effect of agricultural limestone.

REGULATING LIME QUALITY

When dealing with lime quality, state agencies do not always agree. Different terms are used in different states as well as philosophies for adjusting lime recommendations. Because of this, it is important to become acquainted with these differences, especially when comparing lime sources between states.

All of the states in the Great Lakes Region recognize the fact that a lime's purity (CCE or TNV) needs to be taken into account when adjusting for lime quality. Differences of opinion occur in how each state factors in the availability of the various size particles.

ILLINOIS

The state of Illinois refers to a limestone's *Effective Neutralizing Value* (ENV). It is based on a material's CCE and *Efficiency Factor* established from particle size distribution of the lime. Illinois recognizes the fact that applying lime prior to seeding alfalfa requires highly reactive particles, while liming for a corn/soybean rotation, a less reactive lime can be used. Because of this, lime is evaluated on both a one year after application basis and a four year after application basis.

The 1-year efficiency factor is calculated by adding up 5% of particles greater than an 8 mesh sieve, 20% of particles between a 30 mesh and 8 mesh, 50% of particles between a 60 mesh and 30 mesh, and 100% of the particles that pass a 60 mesh sieve. This result is then multiplied by the percent CCE of the material to arrive at the ENV. To correct for quality of a lime source, divide the 1-year ENV into 46.35 and multiply this result by the tons of lime recommended from a soil test report.

Efficiency Factor = (5% x (% Particles > 8 mesh) + 20% x (% Particles between 30 & 8 mesh)
+ 50% x (% Particles between 60 & 30 mesh) + 100% x (% Particles Passing 60 mesh)

Effective Neutralizing Value (ENV) = Efficiency Factor x (% CCE / 100)

1-Year Correction Factor = 46.35 / ENV of sampled limestone

The 4-year efficiency factor is calculated by adding up 15% of particles greater than an 8 mesh sieve, 45% of particles between a 30 mesh and 8 mesh, 100% of particles between a 60 mesh and 30 mesh, and 100% of the particles that pass a 60 mesh sieve. This result is then multiplied by the percent CCE of the material to arrive at the ENV. To correct for quality of a lime source, divide the 4-year ENV into 67.5 and multiply this result by the tons of lime recommended from a soil test report.

Efficiency Factor = (15% x (% Particles > 8 mesh) + 45% x (% Particles between 30 & 8 mesh)
+100% x (% Particles between 60 & 30 mesh) + 100% x (% Particles Passing 60 mesh)

Effective Neutralizing Value (ENV) = Efficiency Factor x (% CCE / 100)

4-Year Correction Factor = 67.5 / ENV of sampled limestone

Source of Information: Illinois Agronomy Handbook, 1999-2000, pgs. 83-87

INDIANA

Indiana uses the term *Neutralizing Value* (NV) interchangeably with calcium carbonate equivalent (CCE). The fineness of a lime is evaluated by summing the percent of particles passing an 8 mesh sieve with the percent passing a 60 mesh sieve and dividing the result by 2. This number is then multiplied by the percent CCE of the material to arrive at the *Relative Neutralizing Value* (RNV).

INDIANA (continued)

The average RNV for lime in the state is 60, which is the standard for lime recommendations with no adjustment for quality. Lime rates can be adjusted by dividing 60 by the RNV for the material to be spread and multiplying this by the recommended rate.

Fineness Factor = (% Particles Passing 8 mesh + % Particles Passing 60 mesh) / 2

Relative Neutralizing Value (RNV) = Fineness Factor x (% CCE / 100)

Adjustment Factor = 60 / RNV of sampled limestone

Source: Purdue University Extension Publication AY-274, "Analysis of Agricultural Liming Materials"

OHIO

The state of Ohio has a Liming Material Law which regulates the sales of lime. The term used to evaluate one source with another is the *Effective Neutralizing Power* (ENP). It is based on the fineness of grind (*Fineness Index*) and the calcium carbonate equivalent (CCE), which in Ohio is referred to as the *Total Neutralizing Power* (TNP). Lime is classified into a *Standard of Fineness,* which is one of five different categories (superfine, pulverized, ground, meal, and screened). The Fineness Index is a summation of 20% of the percentage of particles between an 8 and 20 mesh sieve, 60% of the percentage of particles between a 20 and 60 mesh sieve, and 100% of the percentage of particles passing a 60 mesh sieve. The result of this is multiplied by the TNP of the product and then by 2000 to arrive at the ENP per ton of lime. The ENP of a lime material can then be divided into the ENP of standard ag-ground limestone which is 1340 and multiplied by the amount recommended to adjust for the lime's quality.

Fineness Index = 20% x (%Particles between 20 & 8 mesh) + 60% x (% Particles between 60 & 20 mesh) + 100% x (% Particles Passing 60 mesh)

Effective Neutralizing Power (ENP) = Fineness Index x % CCE x 2000

Adjustment Factor = 1340 / ENP of sampled limestone

Source: The Ohio State University Extension Fact Sheet ANR-0-02 & Liming Law 905.51 / 905.66

MICHIGAN

Lime quality in Michigan is evaluated by the *Neutralizing Value* (NV) and the *Effective Calcium Carbonate* (ECC) content. The NV is simply a measure of the ability of a liming material to neutralize acidity relative to pure calcium carbonate, which is also termed the calcium carbonate equivalent (CCE). The ECC takes into consideration the NV and fineness of the liming material. The fineness is assigned a *Fineness Factor* by the sum of 50% of material between an 8 and 60 mesh sieve and 100% of the material passing a 60 mesh sieve. This result is multiplied by the percent NV to arrive at the ECC.

The standard ECC for lime in Michigan is 60. Lime with this ECC would require no adjustments in the amount of lime recommended. Lime rates for materials with an ECC other than this can adjusted by dividing 60 by the ECC of the material to be spread and multiplying the result by the recommended rate.

MICHIGAN (continued)

Fineness Factor = 50% x (% Particles between 60 & 8 mesh) + 100% x (% Particles Passing 60 mesh)

Effective Calcium Carbonate (ECC) = Fineness Factor x (% NV / 100)

Adjustment Factor = 60 / ECC of sampled limestone

Source: Michigan State University Extension Bulletin E-471, "Lime for Michigan Soils"

WISCONSIN

In Wisconsin, the purity (CCE) and fineness, or particle size, are also used to evaluate lime. These two factors are used to calculate the *Neutralizing Index* (NI), a measurement of the relative value of the liming material. A neutralizing index of 60 to 69 is considered typical for Wisconsin lime and no adjustment to the amount recommended is made. The fineness of the lime is the sum of 20% of the particles between an 8 and 20 mesh sieve, 60% of the particles between a 20 and 60 mesh sieve, and 100% of the particles passing a 60 mesh sieve. This result is multiplied by the percent CCE to obtain the NI. Adjustments to the recommended amount of lime can be made by dividing 60 by the NI of the lime material and multiplying this by the recommended amount.

Fineness Index = 20% x (%Particles between 20 & 8 mesh) + 60% x (% Particles between 60 & 20 mesh) + 100% x (% Particles Passing 60 mesh)

Neutralizing Index (NI) = Fineness Factor x (% CCE / 100)

Adjustment Factor = 60 / NI of sampled limestone

Source: University of Wisconsin-Extension Publication A3671, "Choosing Between Liming Materials"

SUMMARY

States in the Great Lakes region use a combination of chemical purity and particle size to rate agricultural lime. There is considerable variation in the terminology used by states when lime recommendations are made. This can lead to confusion, particularly when growers are near state borders and may deal with vendors from different states.

Lime samples tested at our laboratory can be reported out using specific state factors, simplifying the process of comparing a liming material between states. Another means of doing this is available in a spreadsheet developed by A&L Great Lakes Laboratories. When values for test parameters are entered into the spreadsheet for a liming material, all of the various factors used within the Great Lakes region are calculated and can be printed out for review. This spreadsheet is available by contacting the laboratory.

A lime recommendation from our laboratory assumes that no adjustment for lime quality needs to be made. In other words, we assume that the quality of a liming material meets a state's minimum standard. Since this is rarely the case, our lime recommendations need to be adjusted for the quality of the lime that will to be applied.

In summary, be aware of the differences in terminology used between states, but most importantly adjust the amount of lime recommended to compensate for the quality of the material.