Soil
FACTSHEET

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Evaluation of Agricultural Limestone

The efficiency of agricultural limestone for neutralizing soil acidity is influenced by four principal factors: degree of fineness, neutralizing capacity, solubility and magnesium content.

1. Degree of Fineness

The relationship between increasing limestone fineness and reactivity is caused by having a larger surface area exposed to chemical reaction. The surface area of liming material increases proportionately with decreasing particle size, for example, the exposed area of a cube of 1 cm is 6 cm^2: decreasing the particle size to 2 mm (10 mesh), or 0.05 mm (300 mesh) increases the exposed area to 30 and 1200 cm^2, respectively. A practical way of adjusting for limestone reactivity due to differential particle sizes is the method developed in Ohio: This method assigns different liming efficiencies to various particle sizes determined by sieve analysis.

SIEVE	EFFICIENCY RATING (E.R.)
Material passing through a 60 mesh sieve	100%
Material passing through a 20 but not a 60 mesh sieve	60%
Material passing through an 8 but not a 20 mesh sieve	20%
Material not passing through an 8 mesh sieve	0%

For example, using the above criteria, two limestones with different sieve fractions would be rated as follows using the Ohio method:

SIEVE FRACTIONS	LIMESTONE A	LIMESTONE B
Passing through a 60 mesh sieve	78.8%	90.0%
Passing through a 20, but not a 60 mesh sieve	10.0%	6.0%
Passing through an 8, but not a 20 mesh sieve	2.4%	4.0%
Not passing through an 8 mesh sieve	7.8%	0%

A = (78.8 X 1.00) + (10 X 0.60) + (2.4 X 0.20)
= 78.8 + 6 + 0.48
= 85.28%

B = (90.0 X 1.00) + (6 X 0.60) + (4.0 X 0.20)
= 90 + 3.6 + 0.8
= 94.46%

This rating suggests that limestone A would be about 10% less efficient than limestone B. This calculation implies that roughly 10% more of limestone A would be required to achieve the same change in soil pH as would be obtained with a given quantity of limestone B.

2. Neutralizing Capacity

Another factor which influences the efficiency of a limestone is its neutralizing capacity. This is determined by reacting limestone with strong acids, either hydrochloric or sulphuric acid. The limestone's neutralizing capacity is expressed as a percentage value of pure calcium carbonate, which has a neutralizing value of 100%. Commercial limestones may have neutralizing capacities greater or lesser than pure $CaCO_3$. Dolomitic limestone (a mixture of magnesium and calcium carbonates) has a theoretical neutralizing value of 108%. Generally, limestones have neutralizing values below 100%. Impurities such as clays in limestone reduce their relative neutralizing capacities.

To determine the agricultural value (A.V.) of limestones, the particle size efficiency rating (E.R.) has to be adjusted by the neutralizing value (N.V.) (synomonous with neutralizing capacity), plus an adjustment for limestone moisture content (M.C.). For example, a limestone having an efficiency rating (E.R.) of 85%, a neutralizing value (N.V.) of 95%, and a moisture content of (M.C.) 13%, has an agricultural value of:

AV = 85% (E.R.) X 0.95 (N.V.) X [1.00 – 0.13 M.C.]
AV = 70.25%

3. Solubility and Magnesium Content

Limestone solubility is not frequently evaluated by routine tests, but it also influences the neutralizing rate of soil acidity. The crystaline structure and chemical composition of limestones vary due to their geological formation. Dolomitic limestones, having a combination of magnesium and calcium carbonates, are less soluble than either calcitic limestones ($CaCO_3$) or magnesium carbonate. Dolomite is, however, useful on acidic soils low in magnesium.

Limestone analysis may include a determination of neutralizing value, calcium and magnesium content, particle size classification, agricultural value rating, and an interpretation of results.

4. Other Liming Materials

At low liming rates, around 2 tonnes/ha (1 ton/acre), calcium hydroxide (slaked lime) can be substituted for limestone by multiplying the recommended rates by 0.84. The main advantage in using calcium hydroxide [$Ca(OH)_2$] is its quick neutralizing capacity, which is due to being very finely pulverized. The disadvantages are that it costs substantially more, may cause overliming problems, and is unpleasant to handle in large quantities due to its caustic nature.

FOR FURTHER INFORMATION CONTACT
Phone: 604.556.3001
Toll Free: 1.888.221.7141

MINISTRY OF AGRICULTURE
1767 Angus Campbell Road
Abbotsford, B.C. V3G 2M