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LIME & LIMESTONE PRODUCTION, PRODUCTS AND TRENDS IN INDUSTRY – A MINING COMPANY'S PERSPECTIVE

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Agenda

- **Lime and Limestone**
  - Nomenclature
  - Lime Products
  - How Lime Products are Produced
- **CCE and Fineness Factor**
- **Product Descriptions**
- **Graymont Activities**
- **Conclusion**

Dan Orchard – Canola Council of Canada with crops treated with lime

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Lime and Limestone Nomenclature

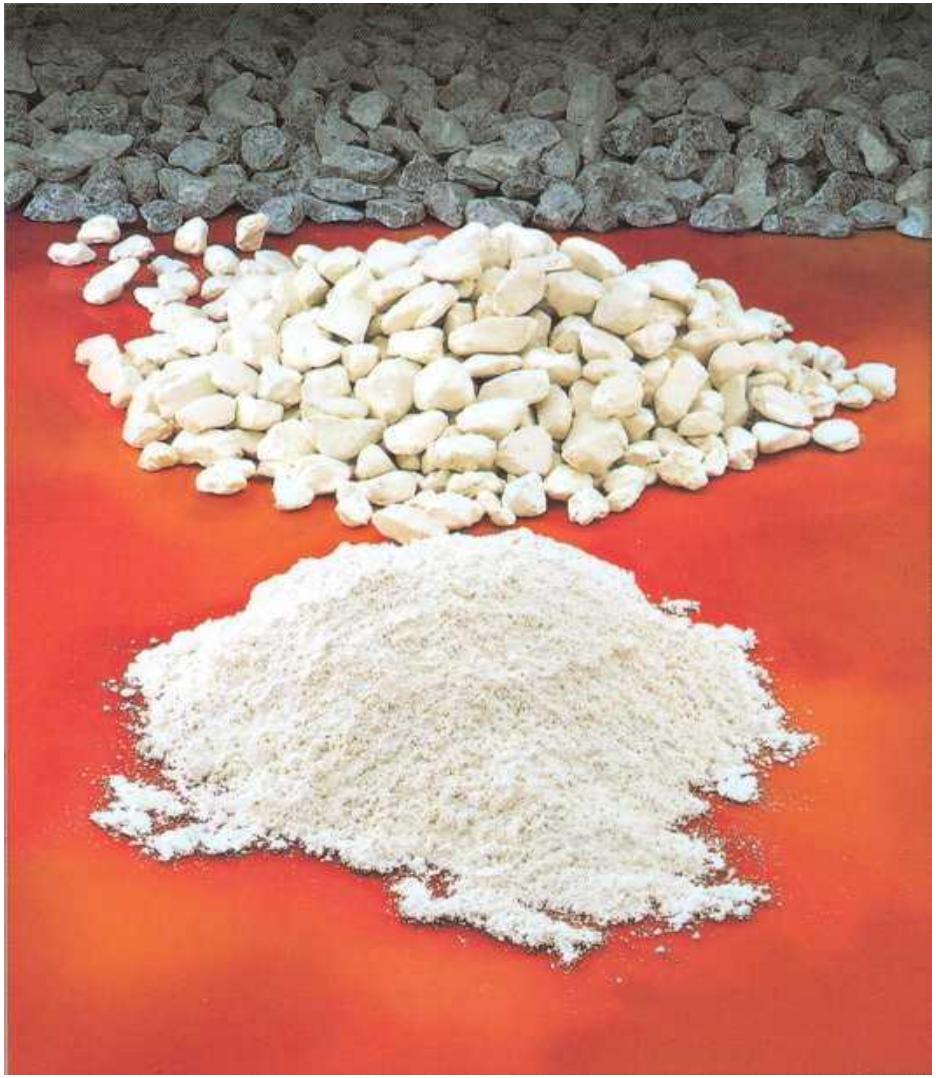
- **Aglime – Agricultural Limestone**
- **Limestone – *CaCO3* – Calcium Carbonate**
- **Quicklime – Lime – *CaO* – Calcium Oxide**
- **Hydrated Lime – *CaOH* – Calcium Hydroxide**

Lime and Limestone Products

Limestone

Quicklime

Hydrated Lime



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How are Lime and Limestone products Produced?

Residual Fine Limestone (By-Product)

Gas (CO_2)

PCC ($CaCO_3$)

Heat

Quarry/Mine Limestone ($CaCO_3$)

Crushed/Sized Coarse Limestone

Kiln

Hydrated Lime ($Ca(OH)_2$)

Heat +1100^{0}C

Quicklime (CaO)

Water (H_2O)

Calcium Carbonate ($CaCO_3$) Equivalent (CCE)

- CCE describes the neutralizing power per weight of material compared to pure $CaCO_3$

Table 6-5. Liming materials and their calcium carbonate ($CaCO_3$) equivalent

Liming material	Neutralizing agent	$CaCO_3$ equivalent of pure material (%)
Dolomitic limestone	$CaCO_3 \cdot MgCO_3$	110–118
Papermill lime sludge	Mainly $CaCO_3$	*
Marl	Mainly $CaCO_3$	variable
Calcitic limestone	$CaCO_3$	100
Water treatment lime waste	$CaCO_3$	variable
Wood ash	K_2CO_3, $CaCO_3$, $MgCO_3$	20–90
Fly ash	CaO, $Ca(OH)_2$, $CaCO_3$	variable
Hydrated lime	$Ca(OH)_2$	135
Air-slaked lime	$Ca(OH)_2 + CaCO_3$	100–135

* *According to the Wisconsin Lime Law, one cubic yard of papermill lime sludge is equivalent to one ton of aglime having a neutralizing index of 60–69.*

Source: Slide 4 http://www.soils.wisc.edu/extension/materials/Liming_Terms.pdf

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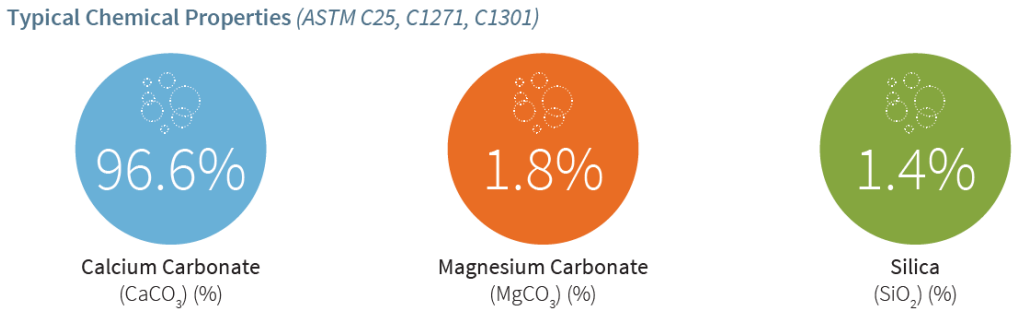
Calcium Carbonate ($CaCO_3$) Equivalent (CCE)

TYPICAL CHEMICAL PROPERTIES (ASTM C25, C1271, C1301)	
Calcium Carbonate ($CaCO_3$) (%)	96.6
Calcium (Ca) (%)	38.7
Magnesium Carbonate ($MgCO_3$) (%)	1.8
Magnesium (Mg) (%)	0.5
Silica (SiO_2) (%)	1.4
Ferric Oxide (Fe_2O_3) (%)	0.1
Alumina (Al_2O_3) (%)	0.2
Manganese Oxide (MnO) (ppm)	< 50
Total Sulfur (S) (%)	0.03
Loss on ignition (%)	43.3



CCE = % CaCO3 + % MgCO3 * (molar mass CaCO3 / molar mass MgCO3)

CCE = 96.6% + 1.8% (100g/mol / 84g/mol)

CCE = 98.8%

- **The CCE number is used in conjunction with the fineness factor to calculate the Effective Neutralizing Value (ENV) which Alberta Agriculture defines as a quality index used to express the effectiveness of liming materials for neutralizing soil acidity**

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Fineness Factors

- **Different Jurisdictions use different mesh sizes for calculation for amount of limestone to use**
- **Iowa -** 4, 8, 60
- **Illinois –** 8, 30, 60
- **Minnesota & Wisconsin –** 8, 20, 60
- **Michigan –** 8, 60
- **Oregon –** 10, 20, 40
- **Alberta –** 10, 30, 60

Table 3. Efficiency factor of various limestone size fractions

Limestone size fraction	Efficiency factor
passing 60 mesh	100
30 to 60 mesh	50
10 to 30 mesh	20
retained on 10 mesh	5

Using the efficiency factors shown above, total fineness efficiency is calculated

Source: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex3684

Source: http://www.ticomindia.com/test-sieves-4376464.html

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Fineness Efficiency and Effective Neutralization Value (ENV) at Exshaw

- **325** 90% min passing 325 Mesh (0.045 mm minus)
  - Fineness Efficiency = 100
  - ENV = 98.8%
- **0** 0.160 mm minus
  - Fineness Efficiency = 100
  - ENV = 98.8 %
- **Supercal** 0.160 mm minus
  - Fineness Efficiency = 57
  - ENV = 56.8%
- **Hydrated Lime** 0.010 mm Average
  - CCE=130
  - ENV = 127%
- **Feed Grit** 0.630 – 2.0mm
  - Fineness efficiency = 24.5
  - ENV = 24.2%
- **Poultry Grit** 1.25 - 3.15 mm
  - Fineness efficiency = 17.75
  - ENV = 17.5%
- **LKD**
  - CCE = 113
  - Fineness efficiency = 100
  - ENV = 113%

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Granulime

- Derivative of a limestone product
- 0.200 – 0.400 mm
- 5% lignosulfonate
- Used as a carrier

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Quicklime

- Quicklime AKA Lime is ***NOT*** the same as Aglime
- Chemical Formula = CaO
- Reacts with water in an exothermic reaction (heat generating)

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Hydrated lime

- Chemical formula = $Ca(OH)_2$
- Created by Slaking lime
- Very useful for it's high neutralizing value compared to limestone
- CCE = 130
- Product is very "fluffy" which translates to as hard to spread
- ENV = 127 %
- A "right now" solution due to higher reactivity (pH 8 vs pH 12 in saturated solution) as well as higher solubility in water over limestone (1.65g/l versus 0.014g/l)

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Graymont Activities

- Support the research at Alberta Agriculture;
- Work with the Canola Council of Canada and participate in their sessions on clubroot;
- Conduct liming field trials with agriculture experts

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Conclusions

- Dealing with proper nomenclature and getting away from the trade names is a big deal!! Deal with the technical specs
- Creating lime and limestone products is a multi-step process
- Different sizes of limestone affects the effective neutralization value which changes the amount of lime that should be spread
- Do NOT use lime (quicklime) for liming of fields
- Hydrated lime has a lot of potential and reacts quickly for a “right now” solution

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Questions

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