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
Lime and Limestone Nomenclature

- Aglime – Agricultural Limestone
- Limestone – \( \text{CaCO}_3 \) – Calcium Carbonate
- Quicklime – Lime – \( \text{CaO} \) – Calcium Oxide
- Hydrated Lime – \( \text{CaOH} \) – Calcium Hydroxide
Lime and Limestone Products

- Limestone
- Quicklime
- Hydrated Lime
How are Lime and Limestone products Produced?

Quarry/Mine Limestone (CaCO₃) → Crushed/Sized Coarse Limestone → Kiln → Gas (CO₂) → PCC (CaCO₃) → Heat → Hydrated Lime (Ca(OH)₂) → Quicklime (CaO) → Water (H₂O)

Residual Fine Limestone (By-Product)

Heat +1100°C
CCE describes the neutralizing power per weight of material compared to pure CaCO3

<table>
<thead>
<tr>
<th>Liming Material</th>
<th>Neutralizing Agent</th>
<th>CaCO3 Equivalent of Pure Material (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dolomitic limestone</td>
<td>CaCO₃•MgCO₃</td>
<td>110–118</td>
</tr>
<tr>
<td>Papermill lime sludge</td>
<td>Mainly CaCO₃</td>
<td>*</td>
</tr>
<tr>
<td>Marl</td>
<td>Mainly CaCO₃</td>
<td>variable</td>
</tr>
<tr>
<td>Calcitic limestone</td>
<td>CaCO₃</td>
<td>100–100</td>
</tr>
<tr>
<td>Water treatment lime waste</td>
<td>CaCO₃</td>
<td>variable</td>
</tr>
<tr>
<td>Wood ash</td>
<td>K₂CO₃, CaCO₃, MgCO₃</td>
<td>20–90</td>
</tr>
<tr>
<td>Fly ash</td>
<td>CaO, Ca(OH)₂, CaCO₃</td>
<td>variable</td>
</tr>
<tr>
<td>Hydrated lime</td>
<td>Ca(OH)₂</td>
<td>135</td>
</tr>
<tr>
<td>Air-slaked lime</td>
<td>Ca(OH)₂ + CaCO₃</td>
<td>100–135</td>
</tr>
</tbody>
</table>

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

Source: Slide 4 http://www.soils.wisc.edu/extension/materials/Liming_Terms.pdf
Calcium Carbonate (CaCO3) Equivalent (CCE)

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.
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>
<thead>
<tr>
<th>Limestone size fraction</th>
<th>Efficiency factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>passing 60 mesh</td>
<td>100</td>
</tr>
<tr>
<td>30 to 60 mesh</td>
<td>50</td>
</tr>
<tr>
<td>10 to 30 mesh</td>
<td>20</td>
</tr>
<tr>
<td>retained on 10 mesh</td>
<td>5</td>
</tr>
</tbody>
</table>

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

Using the efficiency factors shown above, total fineness efficiency is calculated.
Source: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex3684
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%
Granulime

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

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

- Chemical formula = Ca(OH)$_2$
- Created by Slaking lime
- Very useful for its 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)
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
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
Questions