



## Serving Alberta's Oil Producers

For over 70 years, Graymont has produced and supplied innovative lime products that continue to provide long-term solutions for our clients. Whether with well-established applications like soil stabilization, or novel research related to the treatment of oil sands tailings, Graymont is committed to working with Alberta's oil producers to demonstrate how lime can deliver sustainable and cost-effective results. Our local sales account managers, technical support staff and Central Research laboratory serve as resources to show how lime products can benefit your operation.

### Contact Us

Contact our sales staff to learn the detailed ways we can serve you.

#### SERVING WESTERN CANADA

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Creating Value  
in Alberta's Oil Sands  
An Overview of Potential Solutions for Oil Producers

Graymont.com



# Producing a Better Future Together

Graymont is developing lime-based solutions tailored to solving complex surface mining challenges facing Alberta's oil sands mining industry.

## Lime: The Versatile Chemical

Lime is a building block of human industry — an indispensable ingredient to our daily lives. From the production of paper and steel, to road construction and the treatment of environmental pollutants, strategically tailored chemical lime products offer versatile solutions that power human progress. Graymont, a global leader in the production and service of lime resources, is committed to presenting lime's potential solutions to the industries that need them most.

## What is Lime?

Lime is an inorganic chemical derived from limestone, an abundant sedimentary rock with high percentages of calcium carbonate. Limestone is refined for a wide variety of applications by Graymont's worldwide production operations, including facilities in Western Canada.

## The Lime Cycle



## The Lime Cycle: An Overview

The lime cycle is the process of converting limestone ( $\text{CaCO}_3$ ) to various lime-based products through a series of chemical reactions.

Limestone can be calcined in kilns to produce quicklime. This process converts calcium carbonates to calcium oxides that are highly reactive with water. The reaction with water gives off significant heat and breaks coarse quicklime particles into a fine powder called hydrated lime. Quicklime and hydrated lime have a high pH (12.45) which improves their reactivity. As seen in the Lime Cycle diagram, hydrated lime reacts with carbon dioxide to provide a favorable pathway to its original limestone form.

Calcium hydroxide (hydrated lime) performs quite differently than calcium sulfate (gypsum) and calcium chloride in oil sands tailings treatment processes. Only hydrated lime can increase pH to the level needed to modify clays and develop strength. Hydrated lime also reacts with the process water to sequester carbon dioxide by forming insoluble calcium carbonate (limestone) without the formation of soluble calcium bicarbonates.

Applying the properties of the lime cycle to oil sands tailing treatment offers exciting possibilities.

## How Can Lime or Limestone Be Used in Oil Sands Applications?

### ▼ COAGULANT FOR FLUID TAILINGS

Quicklime can be used to produce a fine hydrated lime slurry containing less than 10 percent solids. Research shows that this lime slurry can be used to coagulate fine clay particles in oil sands tailings. Two types of coagulation are possible. Lime slurry addition to a pH just over 11 can provide fast settling and microfines capture, while minimizing soluble calcium (below 60 ppm) in thickener overflow water. If enough lime slurry is added to achieve a pH of approximately 12.5, chemical modification of the clays occurs. This improves dewatering and develops strength over time due to natural pozzolanic reactions.

### ▼ FLUE GAS TREATMENT

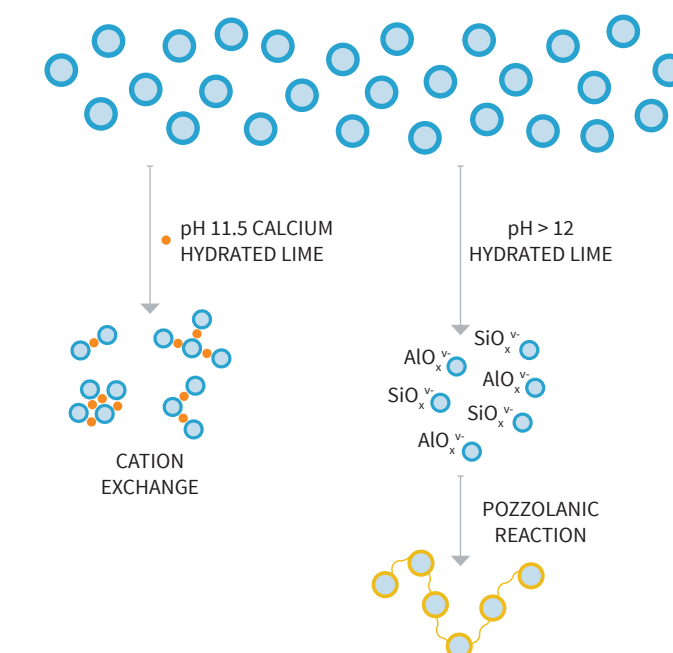
Limestone, quicklime or hydrated lime can be used to remove impurities such as  $\text{SO}_2$  or  $\text{HCl}$  from the flue gas of coal or petroleum coke burning processes.

### ▼ SOIL MODIFICATION

Quicklime and hydrated lime can be blended with highly plastic soils to dewater them by cation exchange and strengthen them through pozzolanic chemical reactions. Adding 1 to 2 percent lime by wet weight of soil can dry wet soils overnight. Stabilized soil provides a stronger foundation for the construction of buildings, pads and roadways.

### ▼ PROCESS WATER TREATMENT

Hydrated lime can be used to remove impurities and increase the pH of process water. Hydrated lime assists in the softening and removal of silica from boiler feed water in Steam Assisted Gravity Drainage (SAGD) processes.



### ▼ SODIUM HYDROXIDE GENERATION

Oil sands mining operations can have high levels of sodium bicarbonate and sodium carbonate in process water. Calcium hydroxide preferentially reacts with these sodium compounds to form insoluble calcium carbonate and sodium hydroxide up to a pH of 11.5. The sodium hydroxide formed provides benefits if process water is recycled back to the extraction process.

### ▼ MINE RECLAMATION

Current research shows that chemical modification of oil sands fine tailings through pozzolanic reactions improves dewatering and strength development. Coupled with mechanical dewatering technologies like centrifuges and pressure filtration, the treated tailings can achieve ready for reclamation status quickly. These treated tailings hold promise for quicker and more cost effective landform development. Lime can also be useful to immobilize harmful contaminants like heavy metals and organic compounds in remediated soils.

Graymont is a global leader in lime and limestone solutions. Our products are essential in addressing today's most pressing environmental issues while supporting vital industrial processes and agricultural needs.

