GRAYMONT

Innovations with Lime:

A Faster Path to Tailings Reclamation

To eliminate the risks associated with large fluid tailings inventories, the oil sands industry is seeking to create solid, stackable deposits with the strength to be self-supporting without conventional containment. Historically, this has been technically challenging, and no suitable solution has been found, particularly for clay-containing tailings.

Lime treatment improves dewatering of clay-containing tailings and can enhance the strength of resultant solid surfaces.

PRIMARY BENEFIT: FASTER PATH TO TAILINGS RECLAMATION

- Lime treated tailings show improved dewatering.
- Addition of lime creates a solid product with geotechnical strengths of 40 kPa, although strengths can exceed 100 kPa under certain treatment conditions. This increased strength significantly accelerates reclamation and enhances remediation.
- Treated tailings continue to gain strength over a period of weeks. For centrifuge dewatered tailings, this can allow treated tailings to be pumpable after treatment while developing enough strength over time to benefit reclamation activities.

WHAT'S NEW?

Research by Graymont has identified a method to modify the surface of clay minerals in fluid tailings when subjected to treatment with a 5-10% hydrated lime slurry at an elevated pH, transforming the structure into new mineral phases with improved geotechnical characteristics.

The COSIA clay challenge seeks solutions to modify clay minerals in tailings to reduce reclamation timelines. This can be accomplished through improved mechanical dewatering and strength development of treated tailings. Graymont's innovative lime treatment has shown benefits for both dewatering and strength development and addresses this COSIA Challenge.

COMMON MISCONCEPTIONS ABOUT LIME TREATMENT

Filtrate water, treated using lime, has soluble calcium, which is a barrier to recycling.
Water removed during dewatering has soluble calcium levels; however, unlike calcium from gypsum, the calcium from lime is not stable and quickly attenuates with carbonate in process water or carbon dioxide from the air. The reaction of calcium with carbonates and bicarbonates sequesters carbon dioxide as insoluble limestone, mitigating the risk of recycling.

Lime treated filtrate water has high pH, so it can never be part of the reclaimed environment.
Lime treatment does result in a high pH initially; however, exposure to air results in reactions with carbon dioxide which reduces the process water pH over a period of weeks.

The chemical cost of lime is too high.
Graymont's new lime treatment methods use at least 75wt% less lime than previously studied lime treatment methods. The addition of lime to tailings is expected to generate economic benefits, for example through reduced tailings pond operating costs, faster reclamation at lower cost.

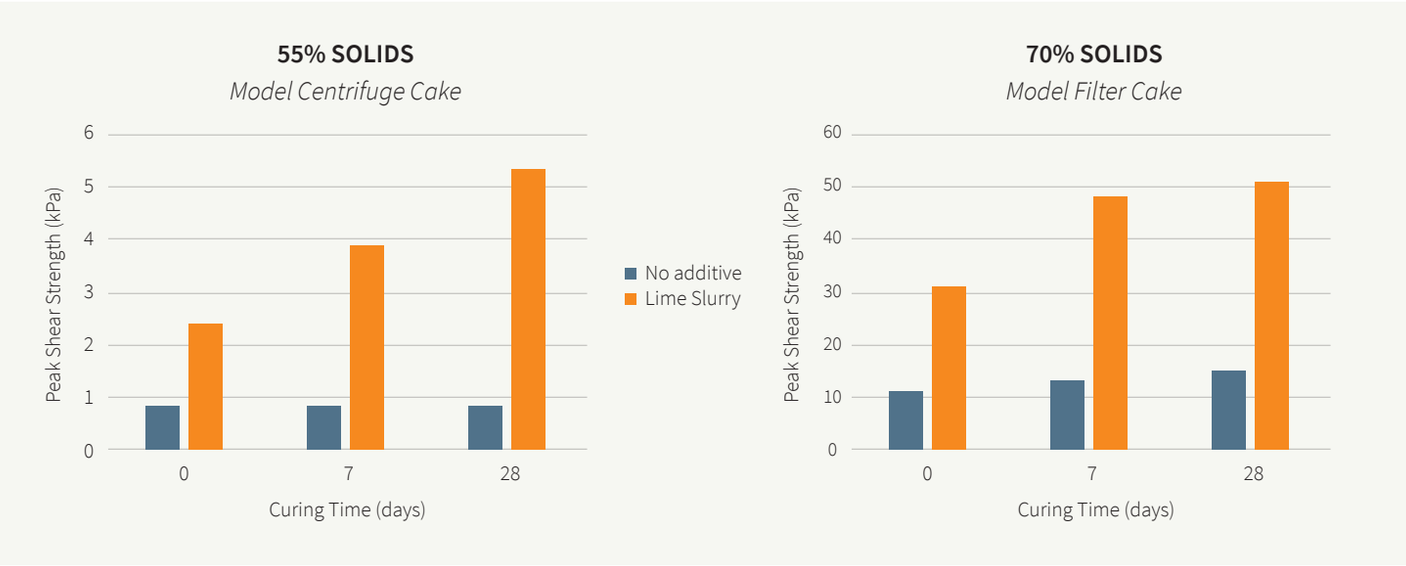
There's no way to supply enough lime to meet demand.
Use of a low solids content lime slurry significantly reduces the amount of lime required for effective treatment. Graymont is uniquely positioned to meet demand in Western Canada, with an established and growing distribution network. Whether 100 or 100,000 tonnes per year are required, we work directly with each client to adapt to their independent supply and shipment needs.

HOW IT WORKS

- Quicklime is slaked to produce a 5 to 10% solids hydrated lime slurry.
- Fluid tailings are pre-treated with a lime slurry to raise the pH. Tailings are then processed into a dewatered cake by filtration or centrifuge.
- Lime initiates reactions that change the structure of the alumina and silica of the clay minerals in the mechanically dewatered tailings. These reactions lead to accelerated dewatering and a significant increase in tailings strength. The restructuring reactions can create solid products with observed strengths well in excess of 40 kPa, and under certain treatment conditions in excess of 100 kPa.

RESULTS HIGHLIGHTS

- Shown are the geotechnical strengths of lime treated tailings with 55wt% and 70wt% solids content.
- The results show lime treated tailings after mechanical dewatering with a geotechnical strength over 50 kPa after 28 days. Consistent strengths can be obtained with a variety of dewatering methods; the ongoing reactions contribute significantly to the strength of the lime treated tailings, so strength is not just dependent on the solids content or dewatering method.
- Initial testing indicates that lime has a beneficial effect on the concentrations of organics in the process water produced from dewatered tailings.



Further reading

Rahal, K., Fox, J., Tate, M., Romaniuk, N., Impact of Calcium Hydroxide on the Equipment and Process of Oil Sands Tailings Treatment, Tailings and Mine Waste 2018, Keystone, CO.

Tate, M., Leikam, J., Romaniuk, N., Use of Calcium Hydroxide as a Coagulant to Improve Dewatering, Strength Development and Water Quality in Oil Sands Tailings Treatment Processes, Tailings and Mine Waste 2017, November 5-8, 2017, Banff, AB, Canada.

Li Y, Kaminsky, H, Romaniuk, N, Tate M. 2018. "Filter Press Modification to Assess Dewatering Performance of Fluid Fine Tailings" Proceedings of the Sixth International Oil Sands Tailings Conference; Edmonton. Edmonton (AB): University of Alberta Geotechnical Centre: 314-323

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

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