Full Scale Demonstration Studies of Recalcinated Lime

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Treatment Supervisor
Greater Cincinnati Water Works
Lime solids disposal alternatives

- New Monofill
- Land Application
- Recalcinating
- Other beneficial uses
  - Regional power plant (scrubbers)
City of Dayton Lime Recovery Facility

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David Cornwell, President, EET, Inc.

City of Dayton water plants use calcium oxide (quick lime) to soften extremely hard well water. Dayton is one of two water utilities in the U.S. that creates calcium oxide from recovered lime softening residuals. The Lime Recovery Facility, aka Lime Plant, reclaims calcium carbonate from the lime softening residuals of both water treatment plants and produces more lime for softening. Because calcium from Dayton’s well water precipitates into the lime softening residuals, more lime is produced than is consumed.

There are advantages and disadvantages related to operating the Lime Recovery Facility (LRF). Operating the LRF normally eliminates the need for purchasing lime for softening, it produces excess lime that can be sold, and it eliminates the need and associated costs for disposing of over 700,000 gallons of lime softening residuals produced by Dayton’s water plants on an average day. The disadvantages include the high labor costs for running the Lime Plant 24/7, the cost of natural gas to heat the kiln, costs for maintenance and capital improvement projects, and the large water usage for cooling water.

The Lime Recovery Facility has operators that work on shifts 24 hours per day. The Operator I position has overall responsibility for operating the plant. The Operator I is responsible for the feed end of the kiln and minor maintenance. The plant has a maintenance employee and an electrician on staff during the day. The plant supervisor oversees 24/7 operations, ensures that Dayton’s water plants receive sufficient lime for water softening, sells excess lime to other water systems, and coordinates importation of lime sludge.

Both of the City of Dayton’s water treatment plants pump calcium carbonate/magnesium hydroxide lime softening residuals to our Lime Recovery Facility (LRF). The LRF is located next to the Ottawa Water Treatment Plant. At the LRF, carbon dioxide produced by the lime recalcination process selectively dissolves and separates magnesium from the lime softening residuals. Then, relatively pure calcium carbonate is dewatered in centrifuges and pumped into a rotary lime kiln.

During the recalcination process in the kiln, heat at approximately 2000 degrees F converts the calcium carbonate into calcium oxide and carbon dioxide. The carbon dioxide is used for carbonation of lime softening residuals. The final product of the recalcination process is calcium oxide. The Lime Recovery Facility produced over 23,000 tons of lime in 2012.

Calcium oxide, in a pebble form, is conveyed pneumatically from the LRF to the adjacent Ottawa Water Plant. Because lime is easily conveyed to the plant, the Ottawa Water plant has only approximately 80 tons of calcium oxide storage capacity. An LRF employee drives a dedicated truck to the Miami Water Plant on a daily basis during the week and on weekends as needed. The Miami plant has a storage capacity of approximately 740 tons of calcium oxide. At the water plants, the calcium oxide is mixed with water in slaking machines to create calcium hydroxide for water softening.

To prepare for Ohio EPAs adoption of NSF/ANSI Standard 60 requirements for water additives, Dayton completed all NSF International requirements to allow Standard 60 certification of Dayton Lime (calcium oxide). To comply with certification requirements, Dayton submitted a Lime Plant Quality Control Plan, a complete description of the recalcination process, NSF certification paperwork, and made arrangements for audits, sampling and NSF testing of the calcium oxide. After testing and toxicological evaluation, Dayton Lime received Standard 60 approval for lime softening.
Recalcinated Lime

Quick Lime
Study Background
Study Results
Study 1 Filter Turbidity

![Graph showing turbidity levels over time for Filter 2 and Filter 2 Recal between specified dates.](image-url)
Study 3 Filter Turbidity

![Graph showing filter turbidity over time with two curves representing different filter runs.](image-url)
Filter Backwash Profile Comparison

Turbidity (NTU) vs. Backwash Time (Minutes)

- 2005
- 2008
- 2010
- 2014-Recal 6/8
- 2014-Recal 6/23
Metals in Lime Comparison

- **Sr**
  - Regular Lime: 0 ppb
  - Recalcinated Lime: 1500 ppb

- **Ba**
  - Regular Lime: 1000 ppb
  - Recalcinated Lime: 3000 ppb

Legend:
- Blue: Regular Lime
- Red: Recalcinated Lime
## Metals in Plant Samples

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Lime Dose Comparison

![Graph showing lime dose comparison over time](image-url)
Lime Costs per Ton

The graph shows the cost of lime per ton from 2000 to 2013. The cost generally increased over the years, with a notable rise after 2007, peaking in 2013.
Maintenance
Conclusions

- Recalcinated Lime is a good alternative to regular quicklime for softening.

- Although turbidity did increase, it was still within our target range.
  - Sludge blanket operation in the future?
Benefits

- Using recalcinated lime completes the lime cycle
- Less grit is produced during the slaking process
- Decrease in transportation costs
- Keeping business in the Region
Next Steps

- Use Recalcinated lime as Dayton has inventory
- Evaluate operating with a sludge blanket
- Continue to evaluate lime disposal alternatives
BIG THANKS TO...

- City of Dayton
  - Shannon Zell
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