Magnesium Hydroxide Liquid for Odour Control
- A catchment dosing approach

ACTI-Mag™
Case Study

Snapshots

CHALLENGES

• Excess odour in sewage network due to high H₂S generation.
• Heavy build up of FOGs in the network leading to restricted flow.
• Frequent need for vacuum truck cleaning leading to an increase in maintenance costs.
• High treatment cost due to excess use of chemical agents such as lime and alum.

SOLUTION

Replace lime and alum with Calix's ACTI-Mag magnesium hydroxide liquid.

BENEFITS

• Reduced H₂S generation within the catchment.
• Significant reduction of FOGs within the catchment.
• Save on multiple chemical purchasing and asset maintenance costs.

Background

LOCATION
Cassowary Coast Region, QLD, Australia

OBJECTIVES
• Manage H₂S odour levels.
• Eliminate fat blockages.
• Save on chemical and maintenance costs.
Dosing your network with ACTI-Mag Magnesium Hydroxide significantly eliminates H₂S odours and saponifies & dissolves fats oils and greases (FOGs).

**BACKGROUND**

Mission Beach is a mixed residential and tourist area and is home to the iconic Cassowary. A sewerage scheme was commissioned by Cassowary Coast Regional Council in 2006 to collect the wastewater from three constituent communities and pumped by two major stations, at Wongaling and North Mission Beach, to the Main Transfer Pump Station (MTPS). The MTPS then pumps 23km to the Tully Sewerage Treatment Plant (STP).

This sewer main suffered significant corrosion due to “rotten egg gas” (H₂S) release in the drained sections. The Tully plant is designed for phosphate removal with liquid alum dosing for phosphate trimming and powered lime dosing for alkalinity and pH correction.

A trial of Calix’s ACTI-Mag Magnesium Hydroxide Liquid (MHL) dosing commenced in December 2017 with the primary objective to control septicity, odour and corrosion issues. Calix proposed additional objectives, i.e. the control of Fat, Oil & Grease (FOG) build-up, elimination of lime dosing at the Tully plant, and partial elimination of alum dosing for phosphate removal.

The trial eliminated odours by maintaining pH between 8.2 and 8.5. Pump station cleaning has been substantially reduced due to decreased FOG accumulation. The lime dosing system was prone to blockage and breakdowns, however dosing of ACTI-Mag has allowed suspension of lime dosing. Also, the dose rate has been reduced by more than 75% whilst still meeting phosphate effluent discharge limits.

Reference

FATS, OILS AND GREASES (FOGs) - A CHALLENGING ISSUE

Fats, oils and grease can build up and become what are called fatbergs.

Fatbergs are caused when oils and fats are tipped down the drain and congeal with other products, including so-called flushable wet wipes.

While each state has their own utility providers, there were at least 360 blockages caused by fatbergs in sewers serviced by QUU – which take in the Brisbane area and four other local councils.

That’s out of a total of 3,500 blockages in QUU sewer pipes that together cost $1.2 million to clear. Fatbergs also caused almost 250 sewage overflows.

But fats, oils and grease also play an important role in wastewater treatment plants, particularly those that capture biogas to generate electrical and thermal energy.

WHAT IS ACTI-Mag MAGNESIUM HYDROXIDE SLURRY (MHL)?

ACTI-Mag is a concentrated and stabilised suspension of magnesium hydroxide also known as milk of magnesia. An inorganic compound with the chemical formula Mg(OH)₂.

Highly fluid, ACTI-Mag has proven to flow easily in most dosing systems. With a higher neutralising value per dry kilo when compared with caustic and lime and being significantly safer than other traditional alkalis, ACTI-Mag is a very cost competitive option for hydrogen sulphide gas (H₂S) control in sewers and industrial waste treatment as well as for several other applications including phosphorus and nitrogen removal from wastewater.

Calix’s ACTI-Mag has several advantages over other generic MHLs.

• Neutralises waste streams 30% faster than generic brands.
• The pH peaks at 10.5 and buffers in the solution between 8.5 and 9.
• The MHL dissolves slowly over time with particles remaining in suspension for as long as needed. (low “GI” alkali)

Reference
- story/idb8b866ac18c3a3e6d04d99a85ae0d

Calcination is an ancient process used to produce lime in a kiln. However, Calix’s unique, patented “Calix Flash Calcination” or “CFC” technology re-invents the kiln. Our CFC process involves grinding magnesium carbonate to around one thousandth of a millimetre in size, and then “flash” heating the particles in a very short time at up to 800°C. As trapped gases in the mineral “bubble out” of the particles, we snap freeze the remaining magnesium oxide in a very high energy state, leaving a very porous, honeycomb-like structure.

ACTI-Mag is manufactured by hydrating Calix’s high surface area magnesium oxide. This means it has the high reactivity of nano-material, without the potential health and handling issues.
**CALIX ACTI-Mag TRIAL AT MISSION BEACH (MB) SEWERAGE SCHEME**

- 3 sub-catchments – North MB, Wongaling Beach, South MB
- 18 pump stations
- Pumped to Tully STP
- Alum and Lime dosing – Alkalinity and Phosphorus removal
- 2.5 – 3 day retention time in dry weather
- MB ~ 40 – 45% of Tully STP flow (~800 kL/d ADWF)
- Calix ACTI-MAG Trial Started on Dec 12th, 2017

**Primary objectives and success criteria for the network**

- Controlling the odour within the catchment, H₂S < 2 ppm.
- Eliminating blockages and restricted flows by dissolving FOGs.

**Secondary objectives and success criteria for the network and plant**

- Reduce corrosion within the network.
- Demonstrating no detrimental impact on the STP.
- Reducing or eliminating lime dosing at the STP.
- Enhancing the removal of Phosphorus (P) and Nitrogen (N).
- Consequently reducing Alum dose at the STP.

### H₂S Chemistry

H₂S(aq) $\rightarrow$ HS⁻ + H⁺

At high pH HS⁻ predominates
- Limited H₂S release (locked-up)
- Greatly reduced odour & corrosion
THE FIRST DEPLOYMENT OF CALIX “CHARLESTON – BLADDER IN A BOX” DOSING STATION

The Charleston Dosing Station has several benefits;
• It is easily deployable and tamper proof.
• It is SCADA compatible.
• On-board load cells allow users to monitor ACTI-Mag stock levels.

The following metrics were monitored within the network:
• pH logging
• H₂S (Odalog)
• FOGs build-up and SPS cleaning requirements
• The rate of corrosion (long-term assessment)

RESULTS OF PRIMARY OBJECTIVES

1. Reduce H₂S and odours to negligible levels
   - Achieved
2. Eliminate blockages and restricted flows
   - Achieved

Observations show that ACTI-Mag;
• Reduced H₂S and odour to negligible levels within 3-4 days of dosing.
• Eliminated FOGs within the network and allowed dirty rags to be captured by the STP.
• Eliminated the use of costly vacuum trucks to clean out ‘fatbergs.’

![ACTI-Mag Dosing started](image.png)

• MTPS Baseline H₂S, ppm

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<th>MTPS Baseline H₂S level, ppm</th>
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RESULTS OF SECONDARY OBJECTIVES AND OTHER BENEFITS OF ACTI-Mag

- The pH levels the STP were stable and no low pH events occurred.
- Lime dosing was eliminated, leading to significant cost saving; the alkalinity in effluents and in the plant was stabilized.
- Use of Alum dose was reduced by 60%, resulting in cost saving; consistent phosphorus mass content in the effluent was observed regardless of flow.

FOG BREAKDOWN PROCESS

Wastewater has large quantities of low density, long-chain fatty acids.

ACTI-Mag slowly releases hydroxyl ions, which breakdown low-density, large-chain fatty acids into glycerol and various types of soap, both of which are more readily digested by bacteria in wastewater.

The Carboxylate salts that are produced further facilitate the breakdown of other fats.

Slow pH rise – 3 weeks (v/s 3-day retention) – attributed to FOG breakdown and observed the associated release of ‘aged’ rags.
STRUVITE - A TREATABLE NUISANCE

Magnesium Ammonium Phosphate (MAP), commonly known as Struvite, is a crystalline precipitate of Magnesium, Ammonia, and Phosphate.

\[ \text{Mg}^{2+} + \text{NH}_4^+ + \text{PO}_4^{3-} + \text{H}_2\text{O} = \text{Mg(NH}_4\text{PO}_4.6\text{H}_2\text{O (s)} \]

Struvite forms in pipe bends due to pressure differential in the flow. This will lead to a solid precipitate creating blockages and restricting flow.

The advantage of dosing ACTI-Mag is that it precipitates ammonia and phosphate directly in the sludge and stops struvite forming on key infrastructure.
Summary

ACTI-Mag offers the following benefits:
• Manages H₂S odour levels.
• Dissolves and eliminates FOGs.
• Eliminates struvite blockages.
• Saves on chemical and maintenance costs.
Calix is committed to sustainable practices that contribute to saving the planet. This means we try to reduce printing where possible or make sure that when we do print it is on 100% recycled paper.

A Global Company
From our base in Australia, we’ve reached out across the globe. We are now present on four continents and distribute our solutions in many countries.

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