INTRODUCTION

THIOGUARD® TST offers responsible process solutions to problems related with acid neutralization, biological treatment and biosolids disposal and handling.

Premier Magnesia is proud to offer the THIOGUARD® family of products and services to control odor, corrosion, FOG, and enhanced treatment for municipal wastewater systems.

THIOGUARD® is a safe and superior technical grade magnesium hydroxide, similar to milk of magnesia. Think of it as industrial-strength milk of mag-nesia for your sanitary system.

HYDROGEN SULFIDE CAUSES ODOR

SULFURIC ACID CAUSES CORROSION

DIRECT ADDITION FOR ODOR CONTROL

Added directly to wastewater collection systems, THIOGUARD® stops odors by preventing the formation of H₂S, hydrogen sulfide gas.

CROWN SPRAY FOR CORROSION CONTROL

Surfaces periodically sprayed with THIOGUARD® are gently neutralized and protected from corrosion.

SULFUR COMPOUNDS ARE THE PRIMARY SOURCE OF ODOR, WHETHER IN THE INORGANIC FORM, H₂S, OR IN ONE OF MANY ORGANIC FORMS (VOSCS), SUCH AS MERCAPTANS, DMS OR DMDS.
At pH levels < 7.0, the equilibrium reaction favors hydrogen sulfide (H\textsubscript{2}S) and odorous gas evolution. At pH > 7.0, the reaction favors hydrosulfide (HS\textsuperscript{-}). Unlike other alkali choices, THIOGUARD\textsuperscript{®} contains slowly dissolving magnesium hydroxide particles. These particles have high surface pH and high surface area, applying additional physical adsorption and chemical bonding properties to make THIOGUARD\textsuperscript{®} more effective, even when wastewater pH returns to neutral, 7.0.

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In the absence of metals, bacterial activity increases. At dissolved oxygen concentrations above 1 mg/L, aerobes reduce organic matter via oxidation. Very little sulfide is produced at this stage.

**FIGURE 1**

Odors occur when wastewater pH allows (H\textsubscript{2}S) hydrogen sulfide to evolve from liquid phase hydrosulfide (HS\textsuperscript{-}). THIOGUARD\textsuperscript{®} prevents the formation and release of H\textsubscript{2}S gas in several important ways:

- **Longer retention times caused by urban sprawl and centralized treatment strategies**
- **Low flow plumbing fixtures and other water conservation measures**
- **Legislative changes impacting wastewater chemistry and biochemistry**

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Although reducing metals was necessary to protect public health, pretreatment has contributed significantly to increased odors and accelerated sulfide related corrosion. Sewage has changed. Odor complaints have increased and infrastructure failures have become prevalent.

**GRAPHIC**

At < 0.1 mg/L dissolved oxygen, anaerobic bacteria reduce sulfates to sulfides.
**SURFACE pH CORROSION**

H₂S gas generated in the sewer system is converted by Thiobacillus bacteria residing on concrete and metal surfaces above the waterline to corrosive sulfuric acid. This acid attacks exposed concrete and metal surfaces.

A simple method to measure relative strength of the sulfuric acid and rate of decay of the infrastructure is surface pH testing, conducted with contact pH paper on the wetted surfaces inside wetwells, manholes and sewer lines.

When **THIOGUARD®** is injected into a wastewater stream, it enters in 3 distinct phases. These phases are a result of technical grade magnesium hydroxide’s unique solubility and reactivity properties and the way it reacts to other qualities of the wastewater (i.e. pH, CO₂ concentration, free acid H⁺, biological activity, etc.).

**Phase I (Mg(OH)₂):** Technical grade magnesium hydroxide as a particle has a solubility of 9 mg/L. While the solubility is considered relatively low, the particle, having a surface area of nearly 1 acre per gallon, is reactive and/or absorptive to acids, H₂S, CO₂, and some organics. The particle has a positive surface potential and is capable of improving flocculation and settling. In the collection system, it slowly dissolves as it reacts with H₂S, CO₂, acids, FOG, etc. At the plant, it usually enters the biosolids stream through Primary settling. That which passes through to Secondary processing is typically fully consumed by biogenic acids and CO₂ produced during secondary treatment.

**Phase II (MgOH⁺ + OH⁻):** This ionic phase is transitional from the particle phase to soluble phase and is indicative of technical grade magnesium hydroxide’s unique abilities to “buffer” both acids and bases. This species also explains why pH’s in a magnesium hydroxide supplemented stream do not accurately reflect the total amount of hydroxide present (neutralizing capability), since only the first ionized OH⁻ contributes to the pH values. This is why pH, OH⁻ and total alkalinity are critical measurements collectively rather than individually.

**Phase III (Mg²⁺ + 2OH⁻):** This ionic phase is the result of complete dissolution of the Mg(OH)₂ molecule. Complete dissolution occurs as a result of free proton (H⁺) acid neutralization or the formation of bicarbonate (HCO₃⁻) from the reaction of OH⁻ with CO₂. Once dissociated, the divalent magnesium cation (Mg²⁺) aids wastewater treatment by 1) being utilized as a bridging particle for improved flocculation, settling and clarification in both Primaries and Secondaries and improved dewatering and densification in bio-solids processing 2) facilitating the transport and stabilization of P during ADP/ATP conversion and ATP hydrolysis, and 3) supplementing biological nutrients.

Residual OH⁻ is reflected in pH readings. Since the reactive pH is 9, it “buffers” strongly in the pH range between pH 8 and 9, and most preferably near 8.4. As pH rises, magnesium shifts back towards Phases I and II. This is how technical grade magnesium hydroxide is extracted from brines and seawater for commercial production.

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**THIOGUARD**

**3 DISTINCT PHASES MAKE IT UNIQUE AMONG ITS ALKALINE PEERS, AND HIGHLY SUITABLE TO BIOLOGICAL TREATMENT SYSTEMS**

![Image of Thiobacillus bacteria and corrosion attacks on concrete]

**SURFACE pH**

**YEARS OF LIFE**

(2" of sacrificial concrete)

**Surface PH**

**Corrosion Rate**

(in./year)

**Corrosion Range**

200 Years

100

50

20

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**BELOW: GABBS, NEVADA**
TREATMENT PLANTS

Direct addition of THIOGUARD® to a collection system provides the following benefits at the Treatment Plant:

- Odor Control
- Corrosion Control
- Nutrient Addition — Essential Element for Cell Metabolism
- Alkalinity Supplementation
- pH Control

THIOGUARD® improves secondary wastewater treatment for BOD (Biological Oxygen Demand), TSS, Turbidity, ammonia and phosphorus, while enhancing sludge growth and settling characteristics, and improving biosolids treatment, dewatering and disposal.

Nitrogen compounds are the primary cause of pH/alkalinity degradation in treatment plants, with pH depletion being the major cause of activated sludge bulking, high SVI (Sludge Volume Index), and disinfection problems.

DIGESTION, NITRIFICATION, ALKALINITY AND pH CONTROL

Aerobic digestion and nitrification in the activated sludge process depletes natural alkalinity and can cause pH depression. A drop in pH can arrest second-stage nitrification and cause major upset conditions in the secondary clarifiers, resulting in effluent violations for BOD, TSS (Total Suspended Solids), ammonia, etc... Likewise, adequate alkalinity ensures biological process stability and improves methane gas production of anaerobic digesters. THIOGUARD® provides both alkalinity and pH stability for biological processes.

BUFFERING RANGES FOR CAUSTIC, LIME, AND MAG.

SECONDARY CLARIFIERS AND SVI

Periodic pH problems interfere with the growth of floc-forming activated sludge. When this happens, sludge bulking and unwanted denitrification may cause SVI levels to increase. THIOGUARD® provides both pH stability and divalent cations, which improve the Monovalent/Divalent (M/D) Cation Ratio.

BIOSOLIDS

These divalent cations and pH stability provided by THIOGUARD® also improves dewatering/drying performance, polymer use and odor reduction, whether using drying beds, filters, or centrifuges.

CHLORINE DISINFECTION

Incomplete nitrification allows nitrite (NO₂⁻) to pass through the clarifiers and into the chlorine contact tank, consuming chlorine at accelerated rates. Moreover, low pH and inadequate alkalinity can hinder rapid hydrolysis of Cl₂ gas, reducing disinfection efficiency. THIOGUARD® facilitates complete nitrification and provides pH stability for efficient chlorination.

WITH CAUSTIC SODA OR LIME

With Caustic Soda or Lime

WITH THIOGUARD® TST

PH CONTROL

Magnesium hydroxide slurry has long been used to maintain pH during nitrification. Because alkalinity is released slowly, there are no hot spots to kill Nitrosomonas or Nitrobacter bacteria.

And, since the by-products of magnesium hydroxide reactions are soluble salts, THIOGUARD® does not increase the amount of sludge produce in the plant. In fact, studies have shown THIOGUARD® may actually reduce sludge production by 10-20%.

SUMMARY

As sulfide levels have increased, many chemical options become ineffective or too costly. THIOGUARD® offers municipalities a new weapon in the fight against odor, corrosion, FOG and wastewater treatment.

The comparisons presented between THIOGUARD® and some of the most common, competitive chemical products in the market are misunderstood in that THIOGUARD® provides a Total System Treatment approach that many of our competitors cannot. These competitor chemicals fall into the general categories of oxygen providers, metal salts, and pH adjusters. Other common methods for odor control include bacteria addition and air scrubbers, biological, physical, or chemical.

Selection of an appropriate odor control strategy is a complex process that must consider many factors. We believe THIOGUARD® is well suited for applications to safely control odors and acid gases such as hydrogen sulfide, and to enhance biological treatment processes.

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