APPLICATION BRIEF

SafeGuard™ H2O Delivers a Sustainable Phosphate Removal Solution for Wastewater Treatment Facilities

Wastewater treatment facilities traditionally manage phosphate removal by dosing wastewater with ferric chloride or ferrous sulfate. The toxicity and hazardous nature of these bulk chemicals, coupled with supply chain disruptions, inflationary price increases, and a lack of adequate quality controls and certification, are driving utilities to seek alternative, more carbon-neutral, and environmentally sustainable treatment methods.

To reduce dependence on imported bulk chemicals, minimize carbon footprint and ensure final effluent discharges are within regulatory limits, wastewater treatment facilities can benefit from the SafeGuard™ H2O phosphate removal system. The novel technology, manufactured by AMS, generates a ferrous/ferric reagent in-situ via an electrolytic process, providing a sustainable and effective approach to phosphate removal.

Electrogenerated Ferrous/Ferric Reagent

Two of the most significant benefits of SafeGuard H2O's electrogenerated ferrous/ferric reagent over traditional bulk reagents are:

1. It is produced on demand, which avoids high volumes of bulk reagent shipping, storage, and handling; and
2. It offers a flexible treatment reagent dose and pH optimization during the ferrous to ferric conversion, which allows for better pH control of the effluent.

The in-situ electrogenerated ferrous/ferric reagent, produced by the SafeGuard H2O system, as a stand-alone treatment or in a blended ratio with bulk ferric chloride, has been proven in multiple bench-scale demonstrations to have repeated success removing phosphate.

Phosphate Removal Demonstration

A fully automated SafeGuard H2O bench-scale 5.0 mL/min system was installed for demonstration at a wastewater treatment facility that uses bulk ferric chloride to support their phosphate removal needs. The main objectives were to:

- Show the ability of the electrogenerated ferric reagent produced on demand to effectively reduce phosphate levels discharged from the facility;
- Evaluate the performance of the electrogenerated ferric reagent ("as is" and pH adjusted) against the bulk ferric chloride water treatment chemical; and
- Determine the performance and effectiveness of an electrogenerated ferric reagent/bulk ferric chloride reagent blend for phosphate removal.

The SafeGuard H2O system produced a ferrous reagent on demand in a batch manner. Batches of 100 -200 mL of a freshly generated 5,000 ppm ferrous reagent with a pH of 1.3 were treated with a hydrogen peroxide solution (3%) to convert the ferrous species into ferric ones. The resultant 5,000 ppm ferric reagent concentrate was used in the phosphate removal demonstration with and without pH adjustment: as a stand-alone treatment reagent and as part of a blended ratio with bulk ferric chloride.

The demonstration has shown the in-situ electrogenerated ferrous/ferric reagent produced by the SafeGuard H2O system can be used for stand-alone treatment (Table 1) or in a blended ratio with bulk ferric chloride (Table 2) to provide effective phosphate removal.

SafeGuard™ H2O Phosphate Removal Demonstration System

Table 1: pH and Phosphate Residual Levels of Raw Wastewater and Wastewater Treated with Bulk Ferric Chloride or the Equivalent Amount of Electrolytic Ferric Reagent

	pH	PO4	Notes
Raw Wastewater	6.47	3.54	
Control: Bulk Ferric Chloride (80 uL $FeCl_3$)	5.93	0.88	40 min. decanting
Test 1: Electrolytic Ferric Reagent, pH adjusted	4.31	1.14	40 min. decanting
Test 2: Electrolytic Ferric Reagent, pH adjusted	6.52	1.16	40 min. decanting
Test 3: Electrolytic Ferric Reagent, pH 2.76 4.0 mL	6.71	1.73	40 min. decanting

Different electrolytic ferric reagent and bulk ferric chloride blend ratios (using pH-adjusted and no pH-adjusted electrolytic ferric reagents) were tested and demonstrated repeatable and effective phosphate removal. The final water pH was preserved slightly better using a pH-adjusted electrolytic ferric reagent.

Using a 50:50 blend of the electrolytic ferric reagent and the bulk ferric chloride demonstrated phosphate removal ranging from 90% using a pH-adjusted electrolytic ferric reagent. When using a pH-adjusted electrolytic ferric reagent in the 50:50 treatment reagent blend, the pH impact on the treated water was lower than that from the sole use of a bulk ferric chloride reagent. A treatment process using solely bulk ferric chloride causes a significant decrease in pH levels, which requires the use of caustic to readjust pH levels in the treated water.

Table 2: Phosphate Removal Performance of Different Blended Treatment Reagent ($FeCl_3$ / Electrolytic Ferric Reagent) Ratios With and Without pH Adjustment

pH adjusted, Electrolytic Ferric Reagent pH 3.59	pH	PO4	Notes
Raw Wastewater	5.42	2.74	
Control: Bulk Ferric Chloride (80 uL $FeCl_3$)	4.57	0.33	
Blend Ratio (50:50) 20.0 mL Electrolytic Ferric Reagent / 0.4 mL $FeCl_3$	4.86	0.21	Blend pH 1.69
Blend Ratio (40:60) 16.0 mL Electrolytic Ferric Reagent / 0.48 mL $FeCl_3$	4.71	0.23	Blend pH 1.5
Blend Ratio (30:70) 12.0 mLElectrolytic Ferric Reagent / 0.56 mL $FeCl_3$	4.63	0.17	Blend pH 1.38
Blend Ratio (20:80) 8.0 mL Electrolytic Ferric Reagent / 0.64 mL $FeCl_3$	4.6	0.17	Blend pH 1.18

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