

Date: April 2, 2015

Prepared For: Clean Water 2020
City of Columbia

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Re: Magnesium Hydroxide Demonstration Results
Metropolitan Wastewater Treatment Plant
City Project No. SS7153

Introduction

In February 2014, the City of Columbia (City) received bids from three (3) suppliers for the delivery of magnesium hydroxide to the Metropolitan Wastewater Treatment Plant (Metro WWTP) for alkalinity addition in Liquid Treatment Train 2 to ensure complete nitrification. The City awarded the Contract to the lowest responsible bidder (Premier Magnesia). Garrison Minerals and their authorized representative (Evoqua Water Technologies) protested the bid on the premise that their cost was lower and that they met the majority of the requirements of the technical specifications. Garrison Minerals / Evoqua Water Technology agreed to rescind their bid protest in exchange for the opportunity to conduct a product demonstration test. Hazen and Sawyer (H&S) was tasked with developing and implementing a testing protocol. This technical memorandum summarizes the results of the laboratory bench scale and full scale field demonstration tests.

Laboratory Bench Scale Tests

Results of the bench scale jar tests were inconclusive. Accurate dosing of magnesium hydroxide solution could not be confirmed for the low volumes required by jar testing. Uniform distribution of solids in the diluted magnesium hydroxide solution could not be confirmed due to the lack of solution transparency. Quantitative analysis must be observed through full scale testing.

Full Scale Field Demonstration Tests

Full scale field demonstration testing of each product included the following requirements:

- 30-day test period for alkalinity supplementation.
- Product dosed to provide a residual alkalinity of 40-50 mg/L at the effluent of the aeration basin.
- Alkalinity monitored four times throughout the day with test strips for process control.
- Primary and Secondary effluent composite samples collected and analyzed for ammonia, nitrate, and alkalinity.

The Premier product average feed rate over the 30-day test period was 900 gal/day for a plant flow of approximately 11 mgd, yielding a typical magnesium hydroxide dose of 80 mg/L to achieve a secondary clarifier effluent alkalinity concentration of 40 to 50 mg/L.

The Evoqua product had numerous operational challenges and excessive dosage requirements which impacted performance and could not be further evaluated quantitatively. The manufacturer voluntarily withdrew from the product trial. Timeline details were as follows:

- Oct 23 – Evoqua product trial start.
- Oct 28 – Product clogging feed pumps; switch back to Premier product.
- Nov 3 – Evoqua modifications to feed equipment.
- Nov 13 – Resume Evoqua product trial.
- Nov 16 – Evoqua experienced issues with consistency and volume required over the weekend (without leachate being fed to the plant).
- Nov 18 – Evoqua withdraws from the trial.

The data gathered comparing the two products is shown below. In addition to the operational challenges the Evoqua product presented, the feed rate was in excess of three times the Premier product's feed rate and still was not able to meet the target required alkalinity.

Date	Premier Magnesia				
	Liquid Process Train 2 Flow (mgd)	Influent Ammonia (lbs/day)	Influent Alkalinity (mg/L)	Alkalinity Addition (gpd)	Secondary Clarifier Effluent Alkalinity (mg/L)
11-Sep	11.22	2,246	160	900	49
12-Sep	11.00 ¹	2,385	160	900	50
15-Sep	10.37	1,730	140	900	45
16-Sep	10.83	2,348	160	900	51
17-Sep	11.86	2,374	160	900	45
18-Sep	11.64	2,330	160	900	41
19-Sep	11.50 ¹	2,302	160	900	37
22-Sep	11.85	1,977	130	900	35
23-Sep	11.34	2,554	160	900	39
24-Sep	11.10	2,592	170	900	50
25-Sep	11.18	2,611	160	900	57
29-Sep	7.71	1,415	150	900	45
30-Sep	9.04	2,262	180	900	40
1-Oct	9.81	2,127	170	900	32
2-Oct	10.21	2,299	170	900	37
3-Oct	9.39	2,271	180	900	43
Average:	10.63	2,239	161	900	44

¹ Flow rate to Liquid Process Train 2 estimated.

Date	Evoqua Water Technologies/Garrison Minerals				
	Liquid Process Train 2 Flow (mgd)	Influent Ammonia (lbs/day)	Influent Alkalinity (mg/L)	Alkalinity Addition (gpd)	Secondary Clarifier Effluent Alkalinity (mg/L)
14-Nov	8.51	2,335	181	1,370	40
15-Nov	7.93	2,262	191	3,470	28
16-Nov	8.04	1,810	167	4,159	32
Average:	8.16	2,136	180	3,000	34

Recommendations

The full scale field demonstration test indicates acceptable performance of the Premier product. The Premier product had a typical dose of 80 mg/L that resulted in an average of approximately 520 lbs/MG alkalinity addition to the Train 2 liquid treatment process. The Evoqua product did not complete the test and reliable data was not collected. Before considering a bid from Evoqua or any other supplier with a similar product specification (but outside the proven acceptable specifications), a 30-day full scale field demonstration test is to be successfully completed at the sole expense of the supplier. Data obtained from the demonstration test would then be used to compare products based on both cost and product performance.

Based upon the successful results of the Premier Magnesia product, the magnesium hydroxide solution for supplemental alkalinity shall be produced and manufactured from seawater or magnesium chloride brine utilizing a wet milling process for consistent product sizing and uniformity conforming to the following chemical specifications:

Parameter	Maximum Value	Minimum Value
Slurry Basis		
Mg(OH) ₂ contained lb/gal	8.0	6.9
Dry Solids Basis		
Mg(OH) ₂ , wt%		98.0
CaO, wt%	1.5	
SiO ₂ , wt%	0.35	
Fe ₂ O ₃ , wt%	0.21	
Median Particle Size, Micron	5.0	1.0
Specific Surface Area, m ² /g	20	10
Lbs. Alkalinity/Gallon	13.1	12.8
% Passing 325 Mesh Sieve	100	99.0
Stabilized Residual Test, Grams*	4.0	
NaOH Equivalent	1 lb Equivalent to 0.73 lb Mg(OH) ₂	
Na ₂ CO ₃ Equivalent	1 lb Equivalent to 0.55 lb Mg(OH) ₂	
Physical Properties of Slurry		
Density, lb/gal		12.20
Solids, Weight Percent %	60	54
Viscosity, cps*	500	100
*TP-112 14 Hour Stability Residual Test		
*Brookfield RVT Viscometer #3 spindle @ 100 rpm, 60 seconds at 70°F		