MOORE & BRUGGINK, INC.
consulting engineers

June 1, 2016

Re: Ferric Chloride Chemical System
Improvements
Project No. 150204.01

Ms. Amy Gilson, P.E.
Director of Public Works
City of Charlotte
111 E Lawrence Avenue
Charlotte, Michigan 48813

Dear Ms. Gilson:

By request, Moore and Bruggink, Inc., is providing additional information to help the City of Charlotte determine the best course of action as pertains to the building enclosure over the proposed chemical storage tanks.

Ferric Chloride is a liquid salt used in the waste water treatment process to remove soluble Phosphorus, a tightly regulated nutrient that can contribute to overgrowth issues in discharge streams. The nature of Ferric Chloride is such that it is highly corrosive, having the ability to deteriorate metals and concrete very quickly. Upon physical contact, it can cause severe skin burns or eye damage, and is highly toxic to the environment. Depending on the concentration of the Ferric Chloride on site (typically 40% FeCl3), it has a relatively high freezing point of 14° F, and can become thicker as it approaches freezing. Deliveries can range slightly in concentration as well, raising the freezing point and causing issues with the pumping of the chemical.

The proposed design includes 2 tanks of 5500 gallons each, 5 feet in diameter and 15 feet high, to meet the requirements for delivery logistics and chemical use at the plant.

State standards for the design of waste water facilities design requires spill containment for the entirety of the storage volume, as well as emergency showers at the fill site, and splash guards on all pumping equipment to protect operators. The emergency containment cannot drain, but must have a sloped floor to a sump for emptying to protect the environment from spills. Precautions must also be taken to prevent chemical storage tanks and feed lines from reaching temperatures likely to result in freezing or chemical crystallization.

The Michigan Department of Environmental Quality (MDEQ) requires, in the case of open containment, the engineers to consider the width of the containment area to provide capture for a

"bullet-hole" leak located high on the tank. This means the containment area needs to be wider in an open area than in an enclosed building where walls can contain the leak.

Having open containment reduces initial capital costs by only a minor amount once all factors are considered. The larger containment area footprint requirement results in more excavation, concrete, and labor that offset some of the costs for masonry and roofing. Tanks and piping would need to be heat-traced and insulated to protect from freezing so as not to damage piping and equipment. Maintenance and service by the operators would increase as precipitation collects in the containment area and must be pumped out, and ice formation could raise safety concerns. Additionally, an enclosure would provide security from the tanks being vandalized or otherwise damaged.

It has also been our experience working with other municipalities in Michigan to design and implement a building-style enclosure over the chemical storage tanks. For example, the City of Grandville, City of Zeeland, and Village of Sparta systems have all been enclosed with good results. The system in the City of Three Rivers, however, was installed outside with no shelter, and the plant was forced to install recirculation equipment to keep the chemical well mixed and to keep it from freezing. They were also required to install an FRP privacy fence attached to the containment to protect from spills and to add security.

It is our recommendation, based on experience, safety, maintenance/operation costs, and low additional capital costs to continue with an enclosed building. The cost savings are a small percentage of the overall estimated project costs, and remove completely the factor of security.

Sincerely,

Brian J. Hannon, P.E.
Project Manager

BJH/jsl

Ferric Chloride:

Freezing Point: 6 – 28 degrees F

St. Johns – Superintendent: John Whitford

Phone: (989) 224-8944 Ext. 230

Utilize Ferrous Chloride

Stored in an enclosed and heated building.

In the future John would be looking into upgrading in the direction we are in.

Portland - Superintendent: Doug Sherman

Phone: (517)647-6926

Utilize Ferrous Chloride

Stored in containment outside

Ran into Ferrous beginning to slush/crystalize in cold temperatures and had to add water to raise freezing point. This required them to increase quantity of solution pumped because of the lower concentration which resulted in higher chemical costs.

Midland – Asst. Superintendent: Bruce Royce

Phone: (989) 615-5801

Utilize Ferric Chloride

Stored in containment outside

Ran into a problem with back feed from day tank and slushing occurred in supply line from bulk tank to the day tank. Integrity of tank can be reduced sooner because of exposure. Had to replace one of the bulk tanks due to failure.

FERRIC CHLORIDE SOLUTION

MATERIAL SAFETY DATA SHEET

Updated 12/96

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Identifier: FERRIC CHLORIDE SOLUTION Additional Names: 30 degree Be' Ferric Chloride, Iron (III) Chloride, 42 degree Be' Ferric Chloride, Iron Trichloride, Zeroing Solution, Ferric Chloride

General Use: Etching solution for engraving copper and brass.

COMPANY: Universal Engraving, Inc.
9090 Nieman Road Overland Park, KS, USA 66214
1-800-821-8864 or 913-599-0244

Emergency Contact: 1-800-424-9300 USA and Canada
01-703-527-3887 International

2. HAZARDOUS INGREDIENTS

	Cas No.	%	OSHA PEL	ACGIH TLV
Ferric Chloride	7705-08-0	20-40	1 mg/m3	1 mg/m3
Hydrochloric Acid	7647-01-0	<1	7.5 mg/m3 *	7.5 mg/m3 * * Ceiling limit in OSHA "Air Contaminants" 29 CFR 1910.1000.

3. HAZARDS IDENTIFICATION: Brown or greenish liquid, very corrosive, pH below 2.

Routes of Entry: Inhalation, ingestion, skin absorption.
Health Hazards (acute and chronic):
INHALATION: Product mists are irritating to mucous membranes, respiratory tract, and lungs. May cause coughing and difficulty breathing. Excessive exposures have resulted in bronchitis symptoms, chest pain, dyspnea, and pulmonary edema. Onset of respiratory symptoms may be delayed several hours.
SKIN: Contact will cause staining. Prolonged contact may cause irritation, dermatitis, and blistering. Highly toxic by intravenous route.
INGESTION: Low toxicity in small quantities. Doses over 30 mg/kg may cause stomach irritation resulting in nausea, vomiting, and diarrhea. Mucous membranes and gastrointestinal tract may also be burned. Pink urine discoloration indicates iron poisoning. Liver cirrhosis, fibrosis of the pancreas, coma, and death may follow. Oral ingestion may produce mild to moderately severe oral and esophageal burns with severe stomach burns. Vomiting (coffee grounds in appearance), drooling, and pain may occur. Acidosis and hemolysis may occur due to absorption. Probable oral lethal dose in humans ranges from 1 oz. to 1 pint (30ml to 480 ml).
EYES: Exposure results in pain, swelling, lacrimation, corneal erosions, photophobia, and blindness. May cause burns to inner eyelids.
Carcinogenicity: NA
Sign and Symptoms of Exposure: Headache, burning sensation, coughing, wheezing, laryngitis, nausea, vomiting, shortness of breath, albuminuria and hematuria when swallowed.
Medical Conditions: NA

4. FIRST AID MEASURES: In all cases call a physician immediately.

INHALATION: Remove to fresh air. If not breathing give artificial respiration. If breathing is difficult give oxygen.
INGESTION: DO NOT INDUCE VOMITING! Do not give bicarbonate to neutralize. Activated charcoal is of no value. Passing a nasogastric tube into the stomach is controversial at this time. Irrigate all affected areas with copious amounts of water. Immediately dilute with 4 to 8 oz. (120 ml to 240 ml) of milk or water in adults and 2 to 4 oz. (60 ml to 120 ml.) in children. Get immediate medical attention. In severe cases of gastrointestinal necrosis surgical consultation may be required.
EYE CONTACT: Flush eyes with large amounts of water for at least 15 minutes.
SKIN CONTACT: Remove contaminated clothing. Flush skin with large amounts of water for at least 15 minutes. Call a physician only if irritation persists.

5. FIRE FIGHTING MEASURES

Flash Point: > 230 degrees Celsius Flammable Limits: NA Auto-ignition temperature: NA
Extinguishing Media: Water spray, carbon dioxide, dry chemical powder, or appropriate foam
Special Fire Fighting Procedures: Wear self-contained breathing apparatus with full face piece operated in positive pressure mode and full protective clothing to prevent contact with skin and eyes.
Unusual Fire and Explosion Hazards: Irritating hydrogen chloride fumes may be present in fire involving this substance.

6. ACCIDENTAL RELEASE MEASURES: Do not allow ferric chloride to enter sewer system or soil. Dike sewer openings and access to soil. Contain the spill. Ventilate the area and evacuate everyone but clean-up personnel. Neutralize the ferric chloride by pouring soda ash, lime, or Portland cement onto the surface of the spill. Shovel the mixture of ferric chloride and neutralizer into suitable waste containers and dispose of by approved method. Wash area with dilute soda ash solution and dispose of by approved method. Notify proper government authorities. Ensure compliance with local, state, and federal regulations.

Persons in charge of vessels or facilities are required to notify the National Response Center (NRC) immediately as required under 40CFR 302.6 when there is a release of this hazardous substance in an amount equal to or greater than its reportable quantity of 1000 lbs. (454 kg), approximately 80 gallons. The toll free telephone number of the NRC is (800) 424-8802. Serious penalties are prescribed for failing to make the required notifications. Calling CHEMTREC does not constitute compliance with this requirement. Only a phone call to the NRC satisfies these reporting requirements.

7. HANDLING AND STORAGE: See Section 8 for personal protection information. Store at room temperature. Keep container closed. Store in polyolefin, fiberglass, or rubber-lined containers only. A secondary containment system is recommended around the storage area. It is recommended to keep on hand in handling and storage areas a supply of soda ash, lime, or Portland cement for diking and neutralization purposes in case of spill.

8. EXPOSURE CONTROLS AND PERSONAL PROTECTION: Use only in a well-ventilated area. Wear chemical resistant ru bber gloves, chemical safety goggles, chemical resistant body covering, and boots. Do not wear contact lenses when handling this product. If splashing can occur wear full face shield. Emergency shower and eye wash station should be located in the work area.

9. PHYSICAL AND CHEMICAL PROPERTIES

Boiling Point: 225-250 degrees F (104-121 degrees C)
Freezing Point: 6-28 degrees F (-14 to -2 degrees C)
Vapor Density (Air=1): NA
pH: <2
Viscosity: NA
Appearance and odor: Reddish brown to greenish liquid with slight odor.

Melting Point: NA
Vapor Pressure: NA
Solubility in Water: Very
Specific Gravity (Water=1): 1.25 to 1.41
Evaporation Rate (Ether =1): > 1

10. STABILITY AND REACTIVITY:

Stability: Stable Conditions to avoid: Open flames. Avoid forming product mists.
Incompatibility: Strong bases and oxidizers, metals, nitric acid, fluoride potassium nitrate, and diketene.
Hazardous Decomposition/By-Products: Oxides of carbon, hydrogen gas, hydrochloric gas, and fumes of acetic acid.

Hazardous Polymerization: Does NOT polymerize.

11. OTHER INFORMATION: UEI™ Systems provides the information contained herein in good faith. The information is believed to be correct. However it is not all inclusive and should be used only as a guide. Individuals receiving the information must exercise their independent judgement in determining its appropriateness for a particular purpose. UEI ™ Systems shall not be held liable for any damage resulting from handling or from contact with the product listed herein.

Abbreviations: PEL: Permissible Exposure Limit TLV: Threshold Limit Value NA: Not Applicable