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ADDITIONAL

310 Facility Chemical Specifications

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Abstract: This document provides the basis for the chemical specifications for the ~~and the~~ 310 facility.

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310 FACILITY CHEMICAL SPECIFICATIONS

MAY 20, 1997

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CHEMICAL SPECIFICATIONS

FOR THE

300 AREA TREATED EFFLUENT DISPOSAL FACILITY

Reference 1: ENGINEERING SUMMARY REPORT, WHC-SD-L045H-ER-002

1.0 PURPOSE

The 300 area Treated Effluent Disposal Facility (TEDF) was designed and built to treat the waste water from the 300 area process sewer system. Several treatment technologies are employed to remove the trace quantities of contaminants in the stream, including iron coprecipitation, clarification, filtration, ion exchange, and ultra violet light/hydrogen peroxide oxidation of organics. The chemicals that will be utilized in the treatment process are hydrogen peroxide, sulfuric acid, sodium hydroxide, and ferric chloride.

This document annotates the required chemical characteristics of TEDF bulk chemicals as well as the criteria that were used to establish these criteria. The chemical specifications in appendix B are generated from this information.

2.0 CHEMICAL SPECIFICATION CRITERIA

The essential materials must meet the following basic criteria:

Concentration range - The chemicals must adhere to certain concentration limits in order to maintain proper process control in the treatment train. The facility was designed for the chemical concentrations as specified in ref. 1.

Contaminant limits - Concentrations of impurities must remain below specified levels, as the contaminants in the essential materials have the potential to also contaminate the TEDF waste stream. Use of relatively high quality chemicals at TEDF has shown that there is minimal deleterious effect on TEDF effluent water quality. The co-precipitation process is efficient in removing heavy metal contaminants from the ferric chloride, and sodium hydroxide.

The sulfuric acid and caustic #2 systems run at minimal feed rates, and also have no discernable effect on effluent water quality. Hydrogen peroxide contains no contaminants affecting the TEDF NPDES permit.

3.0 DISCUSSION

The Run Plan Report (WHC-SD-LEF-RPT-002) established the fact that the precipitation process was capable of removing contaminants in excess of the permit limits, with the possible exception of beryllium and selenium. Acceptable levels of these impurities in the essential materials are determined by performing a simple mass balance over the process streams. This mass balance will evaluate the amount of dilution taking place as the chemicals are utilized in the treatment process. If any contaminant contributed to the TEDF waste stream is in excess of the permit Average Monthly Limit (AML), the contaminant will be evaluated individually to determine deleterious effects. Use of chemicals as outlined in the following pages will provide adequate assurance that the chemicals will not contribute excessively to overall waste stream contaminant levels. For each of the chemicals, contributions to the TEDF waste stream (prior to treatment) are developed in appendix A. Chemical specifications are contained in App. B.

When procuring chemicals from a new vendor, the "typical" analysis of the chemical should be evaluated for impacts to facility operations, and this document should be revised if required. This will ensure that the chemicals in use at TEDF have little or no impact to effluent quality.

4.0 Sulfuric Acid

There are two common grades of sulfuric acid, those being "commercial" or "technical" grade and "electrolyte" grade. The commercial grade is a by-product of several heavy manufacturing industries, while the electrolyte grade is made by absorption of sulfur gases in water. The electrolyte grade is much more pure, and has been used in the TEDF processes since the plant began operations. The electrolyte grade sulfuric acid will, however, contribute contaminants to the facility effluent as follows:

MATERIAL PARAMETERS FOR ELECTROLYTE GRADE SULFURIC ACID

CONTAMINANT	PERMIT LIMIT (ug/l)	ELECTROLYTE GRADE SULFURIC ACID TYPICAL ANALYSIS (mg/l)	CONTRIBUTION TO EFFLUENT CONTAMINANT LOADING (ug/l)
Aluminum	215	<0.5	<0.02
Arsenic	3	<0.1	<0.004
Beryllium	2	<5	<0.2
Cadmium	2	<5	<0.2
Copper	3	<1	<0.04
Iron	846	<5	<0.2
Lead	2	<0.09	<0.003
Manganese	10	<0.05	<0.002
Nickel	35	<0.8	<0.03
Selenium	5	<0.5	<0.02
Silver	6	<5	<0.2
Zinc	25	<0.5	<0.02

Contributions to the TEDF effluent stream contaminant loading due to the use of electrolyte grade sulfuric acid are minimal, with the possible exceptions of cadmium and beryllium. No significantly elevated levels of these two elements have been detected in the TEDF effluent, in more than two years of operation with this grade of acid.

5.0 Ferric Chloride

Ferric chloride is manufactured by the hydrochloric acid digestion of steel mill scrap, producing a "technical" grade Ferric chloride product. This source of iron has a relatively high level of impurities, but the TEDF metal removal processes have been shown to effectively remove these contaminants. The technical grade has been used in the TEDF processes since the plant began operations. The technical grade ferric chloride contributes contaminants to the co-precipitation system as follows:

MATERIAL PARAMETERS FOR TECHNICAL GRADE FERRIC CHLORIDE

CONTAMINANT	PERMIT AML (ug/l)	TECHNICAL GRADE FERRIC CHLORIDE TYPICAL ANALYSIS (mg/l)	FERRIC CHLORIDE CONTRIBUTION TO CO-PRECIP. CONTAMINANT LOADING (ug/l)
Aluminum	215	114	25
Arsenic	3	0.5	0.1
Beryllium	2	<0.14	<0.03
Cadmium	2	<0.14	<0.03
Copper	3	36	8
Lead	2	<14	3
Manganese	10	525	114
Mercury	0.9	<0.014	<0.003
Nickel	35	28	6
Selenium	5	<0.014	<0.003
Silver	6	<0.014	<0.003
Zinc	25	16	3

Contributions to the TEDF effluent stream contaminant loading due to the use of technical grade ferric chloride are minimal, with the possible exceptions of copper, lead, and manganese. Copper added to the co-precipitation system from ferric chloride is (typically) 8 ug/l, which is minimal when compared to the facility influent level of approximately 50 ug/l. The lead added to the co-precipitation system combined with the lead from the normal facility influent totals 3 to 6 ug/l, which is in excess of the permit limit. Treatment processes have been effective in removing this lead, however, and there have been no permit violations for lead. Manganese is effectively

removed in the co-precipitation process, even at the elevated levels contributed by the ferric chloride.

6.0 Hydrogen Peroxide

Technical grade hydrogen peroxide has been used in the TEDF UV/Oxidation system since the facility began operations. The only impurities in the hydrogen peroxide are the stabilizers used to impede peroxide degradation. Vendors that supply hydrogen peroxide to TEDF have used either trace quantities of a tin compound, or acetanilide as a stabilizer. Neither of these compounds are regulated by the NPDES permit, therefore, there is no need to specify limits on them in the Chemical Specification.

7.0 Sodium Hydroxide

TEDF has utilized two grades of sodium hydroxide since the plant began operations. First utilized was "Membrane" grade, which is the purest grade commercially available. "Mercury Cell" or "Rayon" grade also been used, and also has relatively low levels of impurities, but is somewhat less expensive than the membrane grade. The rayon (or mercury cell) grade sodium hydroxide contributes contaminants to the co-precipitation system as follows:

MATERIAL PARAMETERS FOR RAYON GRADE SODIUM HYDROXIDE

CONTAMINANT	PERMIT AML (ug/l)	RAYON GRADE SODIUM HYDROXIDE TYPICAL ANALYSIS (mg/l)	SODIUM HYDROXIDE CONTRIBUTION TO CO-PRECIP. CONTAMINANT LOADING (ug/l)
Aluminum	215	1	0.1
Arsenic	3	<0.4	<0.05
Beryllium	2	<0.0004	<0.00005
Cadmium	2	<0.002	<0.0002
Copper	3	<0.5	<0.06
Lead	2	<0.1	<0.01
Manganese	10	<0.2	<0.02
Mercury	0.9	<0.5	<0.06
Nickel	35	<0.1	<0.01
Selenium	5	<0.002	<0.0002
Silver	6	<5	<0.6
Zinc	25	<20	<2.3

Contributions to the TEDF effluent stream contaminant loading due to the use of rayon (mercury cell) grade sodium hydroxide are minimal. No adverse effects are associated with the use of this grade of chemical.

APPENDIX A

DILUTION CALCULATIONS

FERRIC CHLORIDE FEED TO FLOCCULATOR

Per ref. 1, the required Ferric dose to the chemical mix tank is 40 mg Fe⁺³/liter, or 3.9 gph of 35 wt% FeCl₃ in a 300 gpm waste water stream.

$$\text{Dilution} = \frac{300 \text{ gpm}}{3.9 \text{ gph}} * \frac{60 \text{ min}}{\text{hour}} = 4,615:1$$

Contaminants present in the essential material will be diluted 4,615:1 in the waste water stream

SULFURIC ACID FEED TO ION EXCHANGE INLET

Per ref. 1, the quantity of sulfuric acid required to reduce pH in the ion exchange feed stream from 9.2 to 7 is 0.5 lb (98 wt%) H₂SO₄/1000 gallons of waste water, or 0.66 gph of 93 wt% H₂SO₄ in a 300 gpm waste water stream.

$$\text{Dilution} = \frac{300 \text{ gpm}}{0.66 \text{ gph}} * \frac{60 \text{ min}}{\text{hour}} = 27,270:1$$

Contaminants present in the essential material will be diluted 27,270:1 in the waste water stream.

HYDROGEN PEROXIDE FEED TO ORGANIC DESTRUCT SYSTEM

Per ref. 1, hydrogen peroxide feed concentration to the UV/OX system is 0.33 lb (50 wt%) hydrogen peroxide/1000 gallons of waste water, or 0.6 gph of 50 wt% H₂O₂ in a 300 gpm waste water stream.

$$\text{Dilution} = \frac{300 \text{ gpm}}{0.6 \text{ gph}} * \frac{60 \text{ min}}{\text{hour}} = 30,000:1$$

Contaminants present in the essential material will be diluted 30,000:1 in the waste water stream.

CAUSTIC FEED SKID NO. 1

Per ref. 1, NaOH required from skid No. 1 is stoichiometrically equivalent to the Fe⁺³ in solution, or 2.1 gph 50 wt% NaOH in a 300 gpm waste water stream.

$$\text{Dilution} = \frac{300 \text{ gpm}}{2.1 \text{ gph}} * \frac{60 \text{ min}}{\text{hour}} = 8,571:1$$

Contaminants present in the essential material will be diluted 8,571:1 in the waste water stream.

APPENDIX A
DILUTION CALCULATIONS

CAUSTIC FEED SKID NO. 2

Per ref. 1, NaOH required from skid No. 2 is the amount to neutralize the pH 6.5 waste water from the UV/OX system, or 0.11 gph 50 wt% NaOH in a 300 gpm waste water stream.

$$\text{Dilution} = \frac{300 \text{ gpm}}{0.11 \text{ gph}} * \frac{60 \text{ min}}{\text{hour}} = 163,600:1$$

Contaminants present in the essential material will be diluted 163,600:1 in the waste water stream.

APPENDIX B
CHEMICAL SPECIFICATIONS

Sulfuric acid Chemical Specification

Concentration: 93% $\pm 1\%$ Sulfuric acid
Grade: Electrolyte grade

Hydrogen Peroxide Chemical Specification

Concentration: 50% $\pm 1\%$ Hydrogen Peroxide
Grade: Technical grade

Ferric Chloride Chemical Specification

Concentration: 40% $\pm 5\%$ Ferric chloride
Grade: Technical grade
Specific Gravity: 1.35 to 1.50

Sodium Hydroxide Chemical Specification

Concentration: 50% $\pm 1\%$ Sodium Hydroxide
Grade: Rayon or Mercury cell grade