

# ARLINGTON COUNTY WATER POLLUTION CONTROL PLANT MASTER PLAN 2001 UPDATE

## TECHNICAL MEMORANDUM IX – MULTI-POINT FERRIC ADDITION FOR PHOSPHORUS REMOVAL

### 1 WASTEWATER PHOSPHORUS CONTENT

The raw influent wastewater phosphorus content was estimated based on the Greeley and Hansen report, dated June 2000 and the historically observed variation in raw wastewater quality – refer to Technical Memorandum II dealing with Wastewater Flow and Properties.

The estimated phosphorus concentrations are summarized below:

Annual average = 6.9 mg/L as P

Maximum month = 8.0 mg/L as P

Maximum week = 9.7 mg/L as P

The raw wastewater orthophosphate fraction of Total Phosphorus is not routinely monitored. The following fraction was assumed for the purposes of this Technical Memorandum

$$\text{PO}_4\text{-P/TP} = 0.5$$

### 2 MULTIPLE-POINT FERRIC ADDITION

The Master Plan 2001 Update caters for multiple point ferric addition to specifically remove the phosphorus. Ferric addition will also have the benefit of enhanced settling and solids removal. Ferric addition is planned for the following points :

- *Raw wastewater, upstream of the primary clarifiers*
- *Primary effluent*
- *Activated sludge upstream of the secondary clarifiers*
- *Activated sludge effluent (ASE), upstream of the LRT's (in the interim) or of the mono-media filters (in future).*

#### 2.1 Raw Wastewater

A number of alternative ferric dosing points could be considered. It is important to have adequate mixing turbulence for effective ferric dispersion.

The following options can be considered :

- *Dosing to the West influent channel (at the Venturi flume) and to the Potomac interceptors (at the box where the flow turns towards the PTB).*
- *Dosing to the common influent channel, immediately outside the PTB, and upstream of the bar screens. This will require installation of a mixer to achieve proper ferric dispersion.*
- *Dosing to the raw wastewater distribution box, which feeds the individual primary clarifiers.*
- *Dosing before the parshall flume and after the primary effluent channel.*

The ferric dosing should be flow-paced, based on the influent flow rate if the dosing point is upstream of the primary tanks and based on the flow to the secondary system, aeration tanks, if the dosing point is after the primary effluent channel and before the parshall flume.

## **2.2 Activated Sludge**

Two alternative ferric dosing points can be considered :

- *The flow distribution boxes (2) which feed mixed liquor to the individual secondary clarifiers.*
- *The RAS pipeline, before it splits between the different aeration tanks.*

Ferric dosing should be flow-paced. Under dry weather operating conditions, the secondary treatment process flow should be equalized and ferric dosing control will be simple.

## **2.3 Tertiary Filters**

Two alternative ferric dosing points can be considered :

- *The ASE pipelines feeding the LRT's (short term) and mono-media filters (long term).*
- *A special mixing chamber with installed mixer(s) to achieve proper ferric dispersion. (preferred option)*

# **3 FERRIC DOSING REQUIREMENTS**

## **3.1 Raw Wastewater**

The objective of the ferric addition to the raw wastewater is orthophosphate removal in the primary clarifiers. Sufficient phosphorus must remain to supply the biological growth requirements of the activated sludge process.

The estimated ferric addition is based on the following assumptions :

- Fe : P mass ratio = 3
- PO<sub>4</sub>-P/TP fraction = 0.5

- Ferric solution (35%) = 4.1 lbs FeCl<sub>3</sub> per gallon.

The ferric dosage requirements are as follows :

	Annual Average	Maximum Month	Maximum Week
<b>Ferric dose</b>			
- mg/L	30	35	42
- lbs/day	10,020	11,620	14,080
- gals/day	2,440	2,830	3,435

### 3.2 Secondary activated sludge

The ferric dosage is based on effective removal of the residual orthophosphate, after satisfying the biosynthesis requirements. The biosynthesis P requirements were estimated on the basis of the following assumptions :

- *Biomass volatile solids content* = 80%
- *P content of biomass* = 2.5% of volatile solids.

The P requirements to satisfy the biosynthesis :

	Annual Average	Maximum Month	Maximum Week
WAS (lbs/day)	23,600	28,200	33,280
P for biosynthesis (mg/L)	1.4	1.7	2.0

The ferric dosage requirements to remove the residual phosphate are summarized below based on the following assumptions:

- *Fe : P mass ratio* = 3
- *PO<sub>4</sub>-P/TP fraction* = 0.9
- *Ferric solution (35 %)* = 4.1 lbs FeCl<sub>3</sub> per gallon

	Annual Average	Maximum Month	Maximum Week
<b>Ferric dose</b>			
- mg/L	16	19	24
- lbs/day	5,320	6,200	7,900
- gals/day	1,300	1,510	1,930

### 3.3 Tertiary filters

A nominal allowance for ferric dosing of 10 mg/L is proposed for the tertiary filters. The ferric dosage is then as follows :

mg/L	=	10
lbs/day	=	3,390
gals/day	=	830

#### **4 FERRIC STORAGE**

If centralized ferric storage with distributed day tanks and associated dosing pumps are considered, then centralized storage should cater for :

- *delivery interval* = 14 days
- *storage capacity* = 72,000 gals