



**Wastewater**  
**STANDARD**  
**PARAMETERS**  
**GLOSSARY Excerpt by:**

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## PASS YOUR WASTEWATER OPERATOR EXAMS

What follows is a **Glossary** of **standard operating design** and **operating parameter ranges** for most conventional wastewater plants by process unit.

We'll have to go out on a limb with some of these numbers within this Standard Wastewater Design and Operating Parameters excerpt Glossary, but it's the only way. It goes without saying that every plant is different, so your numbers may not match up with those found within this booklet. Various sources list different ranges, especially temperature ranges, for that concoction known as a "*normal domestic wastewater*" treated in an imaginary "*conventional*" treatment plant.

Number questions pop up quite often on exams. So, you need to know the usual ranges to check your math answers. Also included are many of those little numbers that are hard to remember or find, like the melting point of fusible plugs in chlorine cylinders.

### Principle Data to remember:

An operator has control the following at all times:

1. Dissolved Oxygen Levels:  
There must be a presence of dissolved oxygen (D.O.) at all times within a conventional wastewater plant.
2. Wasting:  
In order to maintain Plant Balance, an operator must waste a calculated amount of sludge solids, or treated liquid, on a daily basis.
3. Range of Standard Organic Loading rates:  
**25 – 35 Organic Loading Rates (Lbs BOD/day/1,000 cubic feet)**
4. Ammonia – nitrogen demands increased chlorine feed rates.

Key Numbers appear in **Bold**.

# STANDARD PARAMETERS

| <u>DOMESTIC / COMMERICAL CHARACTERISTICS</u>  | <u>Typical Range</u>                   |
|-----------------------------------------------|----------------------------------------|
| <b><i>Design Criteria Data</i></b>            |                                        |
| <b><u>PER CAPITA</u></b>                      |                                        |
| <b><i>BOD Produced, Lbs/capita/day</i></b>    | <b>0.17</b>                            |
| <b><i>TSS Produced, Lbs/capita/day</i></b>    | <b>0.20</b>                            |
| <i>Strength (mg/L BOD or TSS):</i>            |                                        |
| <i>Dry Weather</i>                            | 150 – 200                              |
| <i>Wet Weather</i>                            | 50 – 150                               |
| <i>Average Design Value</i>                   | <b>200</b>                             |
| <i>Particulate BOD (1 lb BOD/ lb TSS)</i>     | 0.5 - 0.7                              |
| <i>COD Domestic (mg/L)</i>                    | <b>200 – 500</b>                       |
| <i>COD Commercial</i>                         | 500 – 1,200                            |
| <i>COD:BOD ratio</i>                          |                                        |
| <i>Domestic sewage</i>                        | 2:1                                    |
| <i>Settleable solids (ml/L)</i>               |                                        |
|                                               | 5 – 20                                 |
| <i>Nutrients (mg/L):</i>                      |                                        |
| <i>Ammonia</i>                                | 15 – 30                                |
| <i>Phosphorous</i>                            | 6 – 12                                 |
| <i>pH</i>                                     | <b>6.5 – 8.5</b>                       |
| <i>Dissolved Oxygen (DO) mg/L</i>             |                                        |
| <i>Normal range for wastewater operations</i> | 1.0 – 5.0                              |
| <i>Saturation</i>                             | 9.2 mg/L at 68° F                      |
| <i>Wastewater Temperature (Fahrenheit)</i>    | <b>50<sup>0</sup> – 77<sup>0</sup></b> |
| <i>(Celsius)</i>                              | 10 <sup>0</sup> - 25 <sup>0</sup>      |
| <i>Color:</i>                                 |                                        |
| <i>Fresh</i>                                  | <b>Gray</b>                            |
| <i>Septic / Anaerobic</i>                     | Black                                  |

## **HYDRAULIC LOADING**

|                                    |                        |
|------------------------------------|------------------------|
| <i>GPCD (Gallons / capita/day)</i> | <b>100 – 200</b>       |
| <i>Diurnal Flow Period:</i>        |                        |
| <i>Day - Peak (2:00 p.m.)</i>      | 9:00 a.m. – 6:00 p.m.  |
| <i>Night – Low (6:00 a.m.)</i>     | 12:00 a.m. – 7:00 a.m. |

## **PRELIMINARY TREATMENT**

### **Grit Channel**

|                                                 |              |
|-------------------------------------------------|--------------|
| <i>Pre-aeration time, minutes</i>               | 10 – 45      |
| <i>Grit Removal, Gravity Flow:</i>              |              |
| <i>Velocity Range, FPS:</i>                     | 0.8 – 1.2    |
| <i>Average Channel velocity, FPS</i>            | <b>1.0</b>   |
| <i>Detention time range, seconds</i>            | 45 – 90      |
| <i>Average, seconds</i>                         | 60           |
| <i>Percentage of channel depth, %</i>           | 30 – 40      |
| <i>Disposal Volume (Cubic feet / MG/D)</i>      |              |
| <i>Average day</i>                              | <b>1 – 7</b> |
| <i>Maximum Peak day</i>                         | 10 – 25      |
| <i>Aerated Grit Removal:</i>                    |              |
| <i>Detention time, minutes</i>                  | 2 – 5        |
| <i>Air Supply (CFM / foot of Length)</i>        | 2.0 – 5.0    |
| <i>Disposal Volume (Cubic feet / MG or MGD)</i> |              |
| <i>Average day</i>                              | 0.5 – 2.0    |
| <i>Peak day</i>                                 | 2.0 - 27     |
| <i>Vortex-type grit chambers:</i>               |              |
| <i>Detention time, seconds</i>                  | 30           |
| <i>Removal Rates, %</i>                         | 65 – 95      |

## Bar Racks

|                            |                         |
|----------------------------|-------------------------|
| <i>Openings (fine)</i>     | 1 to 2 inches           |
| <i>Openings (course)</i>   | 2 to 6 inches           |
| <i>Approach velocity</i>   | 2 to 4 FPS              |
| <i>Screenings (fine)</i>   | 5 to 10 cubic feet / MG |
| <i>Screenings (course)</i> | 1 to 2 cubic feet / MG  |

## Parshall Flume Capacity (MGD)

|                 |            |
|-----------------|------------|
| <i>3 Inch</i>   | 0.02 – 0.7 |
| <i>6 inch</i>   | 0.04 – 1.8 |
| <i>9 inch</i>   | 0.07 – 3.6 |
| <i>1.0 feet</i> | 0.30 - 10  |
| <i>1.5 feet</i> | 0.40 - 16  |
| <i>2.0 feet</i> | 0.5 - 21   |

## Comminutor(s)

|                 |                     |
|-----------------|---------------------|
| <i>Openings</i> | 0.25 to 0.75 inches |
|-----------------|---------------------|

## Screens

|                             |                     |
|-----------------------------|---------------------|
| <i>Openings (static)</i>    | 0.10 to 0.25 inches |
| <i>Openings (traveling)</i> | 0.02 to 0.30 inches |

## SETTLING TANKS

### Primary Clarifiers

*Detention time\*:*

|                       |                 |
|-----------------------|-----------------|
| <i>Range, hours</i>   | <b>1.5 to 3</b> |
| <i>Average, hours</i> | <b>1.5</b>      |

\*Is based on the retention of DO in a basin which is *Temperature variable*.

*Hydraulic Surface Loading rate, GPD/sq. ft.*

|                 |                    |
|-----------------|--------------------|
| <i>Average:</i> | <b>800 - 1,200</b> |
| <i>Peak:</i>    | 2,000 – 3,000      |

*Weir overflow rate, GPD / Linear foot*

|                 |                        |
|-----------------|------------------------|
| <i>Range:</i>   | <b>10,000 - 40,000</b> |
| <i>Average:</i> | 15,000 - 20,000        |

|                                                               |                    |
|---------------------------------------------------------------|--------------------|
| <i>Blanket depth, feet</i>                                    | 1 to 3             |
| <b><i>BOD removal, %</i></b>                                  | <b>30 - 40</b>     |
| <b><i>TSS removal, %</i></b>                                  | <b>40 - 60</b>     |
| <i>Total Solids removed, %</i>                                | 10 – 15            |
| <i>Settleable Solids removed, %</i>                           | 90 – 95            |
| <i>Bacteria, %</i>                                            | 25 – 75            |
| <i>Pumped Sludge concentration, %</i>                         |                    |
| <i>Range:</i>                                                 | 3.0 – 7.0          |
| <i>Average concentration:</i>                                 | <b>5.0</b>         |
| Hydraulic head available for sludge withdrawal,<br>In inches: | 30                 |
| Sludge Removal ability:                                       | Automatic / Manual |
| Effluent Water quality, mg/L                                  |                    |
| TSS                                                           | 50 – 80            |
| BOD                                                           | 100 – 150          |
| NH <sub>4</sub> – Ammonia                                     | Variable - -       |
| Total Phosphorous, ortho PO <sup>3,4</sup>                    | Variable - -       |

## **BIOLOGICAL FILTERS**

### **Hydraulic Loading Rate, GPD/Sq. ft.**

*Standard rate*

25 to 250

*High rate*

250 to 2,500

*Roughing*

1,000 to 4,000

## **SECONDARY TREATMENT**

### **Ponds and Lagoons – Design Criteria**

|                      | <u>Anaerobic</u> | <u>Facultative</u> |            | <u>Aerobic</u> |
|----------------------|------------------|--------------------|------------|----------------|
| Mechanical Aeration  | <b>No</b>        | <b>No</b>          | <b>Yes</b> | <b>No</b>      |
| Detention Time, days | 10 – 40          | 7-30               | 7– 20      | 3 - 40         |
| Depth, feet          | 10 – 20          | 3-6                | 8 – 12     | 1 – 3          |

### **Organic Loading**

Rates, (1 lb/BOD/day/acre)

|              |           |                      |           |         |
|--------------|-----------|----------------------|-----------|---------|
| Total System | 60 – 120  | 15 – 50              | 20 – 100  | 5 – 20  |
| Average:     |           | <b>35 lbs/ac/day</b> |           |         |
| Primary Pond | 120 – 200 | 50 – 75              | 100 – 200 | 70 - 30 |

### **Typical Effluent Quality**

|           |                 |                  |              |              |
|-----------|-----------------|------------------|--------------|--------------|
| BOD, mg/L | 30 – 50         | 30 – 50          | 20 – 30      | 15 - 20      |
| TSS, mg/L | 25 – 50         | 25 – 50          | 20 – 30      | 15 - 20      |
| pH Range  | <b>6.8 – 11</b> | <b>7.5 - 9.5</b> | <b>7 - 8</b> | <b>7 – 9</b> |

### **Water Depth, ft.**

*Oxidation ponds*

3 to 4 feet

*Facultative ponds*

3 to 5 feet

*Aerated ponds*

10 to 15 feet

## Trickling Filters - Organic Loading Rate

### Rock Media:

#### Organic Loading Rates (Lbs BOD/day/1,000 cubic feet)

|                                  |           |
|----------------------------------|-----------|
| <i>Standard rate</i>             | 5 - 25    |
| Intermediate rate                | 15 – 30   |
| <i>High rate</i>                 | 25 - 300  |
| <i>Super High rate (Plastic)</i> | Up to 300 |
| <i>Roughing</i>                  | over 100  |

#### Hydraulic Wetting Rate, GPD / Sq. ft.

|                           |             |
|---------------------------|-------------|
| Standard rate             | 25 – 100    |
| Intermediate or High rate | 100 – 1,000 |

#### Average Recirculation Ratio:

|               |            |
|---------------|------------|
| Standard rate | None - 1:1 |
| High Rate     | 1:1 – 4:1  |

#### Media Depth, feet

|                            |               |
|----------------------------|---------------|
| <i>Standard rate</i>       | 6 to 8 feet   |
| <i>High rate (stone)</i>   | 3 to 8 feet   |
| <i>High rate (plastic)</i> | up to 40 feet |
| <i>Roughing</i>            | 3 to 20 feet  |

#### BOD Removal, %

|                      |         |
|----------------------|---------|
| <i>Standard rate</i> | 80 - 85 |
| Intermediate rate    | 50 - 70 |
| <i>High rate</i>     | 65 - 80 |
| <i>Roughing</i>      | 40 - 65 |

**Underflow**

Dissolved Oxygen (DO), mg/L 3 – 6

Soluble BOD, mg/L 1 – 10

pH 6 – 8

**High Rate media (Plastic)****Organic Loading Rates (Lbs BOD/day/1,000 cubic feet)**

*Standard rate* 5 - 25

Intermediate rate 20 - 40

*High rate* 40 - 60

Trickling filter (TF)

Trickling filter / solids contact ( TF / SC )

Biofilter / Activated sludge (BF / AS )

Average Recirculation Ratio:

High rate 0.5:1 - 2:1

**Super High Rate**

Trickling filter / Activated sludge (TF / AS )

Roughing filter / Activated sludge (RF / AS)

Biofilter / Activated sludge (BF / AS )

**Hydraulic Wetting Rate, GPD / Sq. ft.**

High rate 1,000 – 7,000

**Underflow**

Dissolved Oxygen (DO), mg/L 4 – 8

Soluble BOD, mg/L  
High rate 1 – 10

Super rate 30 - 200

pH 6 – 8

## Rotating Biological Contactors (RBC's)

*Total Organic Loading, (Lbs BOD/Day/1,000 cubic feet)*

*1<sup>st</sup> Stage*

Less than 0.5

*Total*

Less than 2.0

*Soluble Organic Loading, (Lbs BOD/Day/1,000 cubic feet)*

*1<sup>st</sup> stage*

Less than 2.5

*Total*

Less than 1.1

*Peak Hour Organic Loading, (Lbs BOD/Day/1,000 cubic feet)*

*Total*

6 – 7

*Solids production (Lbs / Lb BOD removed)*

0.5

*Hydraulic Loading Rate, (GPD/Sq. foot)*

*Average*

1.0 – 2.0

*Peak*

2.0 – 4.0

*Peak to Daily Flow Ratio:*

*Q, Peak*

Less than 2.5

*Q, Average*

*Dissolved Oxygen Level, mg/L*

*BOD Removal*

*Nitrification*

*1<sup>st</sup> Stage Effluent*

0.5 – 1.0

1.0

*2<sup>nd</sup> Stage Effluent*

1 – 3

4 – 8

*Disk diameter, feet*

10 to 12

*Shaft length, feet*

up to 25 feet

*Shaft speed*

1 to 2 rpm

## **OXIDATION DITCHES**

|                                              |                     |
|----------------------------------------------|---------------------|
| <b>Plant flow, Range</b>                     | 0.2 to 20.0 MGD     |
| COD Loading / Day/ 1,000 cubic feet of ditch | 10 – 50 lbs.        |
| Primary Clarifier                            | None                |
| Secondary Clarifier                          | Yes, required.      |
| <b>F/M Ratio, (lbs BOD / Day/lb MLVSS)</b>   | <b>0.03 to 0.1</b>  |
| MLSS, concentration, mg/L                    | 2,000 to 5,000      |
| Sludge Age                                   | <b>20 – 35 Days</b> |
| Detention time, hours                        | 3 – 24 hours        |
| Minimum velocity, FPS                        | <b>1.0</b>          |
| D.O. Levels required, mg/L                   | 0.5 – 3.0           |
| Liquid level, feet                           | 3.0 to 7.0          |

## **ACTIVATED SLUDGE**

**The lower the F/M number the higher the MLSS, in mg/L.**

### **Food to Microorganisms (Lb BOD / Lb MLVSS basis)**

|                                          |                     |
|------------------------------------------|---------------------|
| <i>Conventional</i> and Tapered Aeration | 0.2 to 0.4          |
| <i>Nitrification</i>                     | <b>0.05 to 0.15</b> |
| Step Aeration                            | 0.2 – 0.4           |
| Contact Stabilization                    | 0.2 – 0.6           |
| Extended Aeration                        | 0.05 – 0.15         |
| Pure Oxygen                              | 0.25 – 1.0          |
| Complete Mix                             | 0.20 – 0.60         |

### **Mixed Liquor Suspended Solids (MLSS), mg/L**

|                                   |               |
|-----------------------------------|---------------|
| Conventional and Tapered Aeration | 1,500 – 3,000 |
| Step Aeration                     | 2,000 – 3,000 |
| Contact stabilization             | 1,000 – 3,000 |
| Extended Aeration                 | 2,000 – 4,000 |
| Pure Oxygen                       | 6,000 – 8,000 |
| Complete Mix                      | 2,500 – 4,000 |

### **Activated Sludge lbs/day BOD loading / 1,000 cu. ft.**

|                       |                |
|-----------------------|----------------|
| <i>Conventional</i>   | <b>30 - 40</b> |
| Step Aeration         | 40 - 60        |
| Contact Stabilization | 60 - 75        |
| Extended Aeration     | 10 – 25        |
| Complete Mix          | 50 - 120       |

### **Sludge Volume Index, ml**

|                         |                |
|-------------------------|----------------|
| <i>Possible pinfloc</i> | lower than 50  |
| <i>Good settling</i>    | 80 to 100      |
| <i>Poor Settling</i>    | 100 - 200      |
| <i>Some filaments</i>   | 100 to 150     |
| Bulking at high flows   | 150 to 200     |
| <i>Bulking</i>          | 200 or greater |

### **Mean Cell Residence Time, Days**

|                                |          |
|--------------------------------|----------|
| <i>No nitrification</i>        | 1 to 3   |
| <i>Possible nitrification</i>  | 4 to 7   |
| <i>Complete nitrification</i>  | 8 to 12  |
| <i>High oxygen consumption</i> | 12 to 20 |
| <i>Extended aeration</i>       | over 20  |
| Complete Mix                   | 5 to 15  |

**Dissolved Oxygen Levels, mg/L***Anoxic Zone***0.0 – 0.2 mg/L***Possible bulking*

under 1 mg/L

*Normal*

1 to 2 mg/L

*Nitrification***2 to 3 mg/L***Wasted energy*

over 3 mg/L

**Oxygen Uptake Rates (mg/L @2,000 mg/L MLSS)**

Normal loads

20 – 40 mg/L

Extended Aeration

10 – 20 mg/L

Heavy Industrial Loads

50 – 100 mg/L

**Diffused Air (SCFM for 14 ft. Sidewall depth (SWD) Basin**

Coarse bubble

4,000 – 8,000

Medium bubble

2,000 – 4,000

Fine bubble

1,000 – 3,000

**Mechanical surface Aerators (Horsepower Requirement)**

Range

100 – 250

**Minimum Mixing:**

Mechanical Horsepower (Hp)

60 – 100

Diffused Air (CFM / MG)

2,000 – 4,000

**Return Activated Sludge (RAS)**Flow Ratio:  $\frac{Q_{RAS}}{Q_i}$ 

0.25 – 0.75

TSS

6,000 – 12,000 mg/L

**30 Minute Settleability (ml/L)**

Good

**200 – 300**

Average

400 – 600

Poor

Greater than 600

**Hydraulic Retention Time, based on  $Q + Q_r$ , RAS, in hours:**

Average 4 – 8

Peak hour 1 – 2

**Solids Production**

*Conventional* 0.4 to 0.8 lbs solids / lb BOD removed

*Extended aeration* 0.1 to 0.3 lbs solids / lb BOD removed

**Oxygen Consumption**

*Conventional* 0.5 to 1.1 lbs oxygen / lb BOD removed

*Extended aeration* 1.2 to 1.6 lbs oxygen / lb BOD removed

**Air Requirements**

*BOD basis* 500-1500 cu. ft. / lb BOD removed

*Flow basis* 0.5 to 1.5 cu. ft. / gallon

**WAS Sludge Yield for  $Q = 1.0$  MGD @ 8,000 mg/L TSS (1,000 gallon / month )**

Light load (0.4 – 0.6 lb TSS / lb BOD) 10 – 20

Heavy load (0.8 – 1.0 lb TSS / lb BOD) 20 – 40

No Primary Clarifier (1.0 – 1.4 lb TSS / lb BOD) 40 – 50

**Pure Oxygen Capacities**

*Pressure Swing Adsorption* 0.5 to 36 tons/day

*Cryogenic* 10 to 2,000 tons/day

## **Secondary Clarifiers**

### **Normal Basin Parameters**

|                                                                 |                        |
|-----------------------------------------------------------------|------------------------|
| <i>Surface loading (Activated Sludge.), GPD/ Sq. ft.</i>        |                        |
| <i>Average:</i>                                                 | <b>400 – 800</b>       |
| <i>Peak:</i>                                                    | <b>1,000 – 2,000</b>   |
| <i>Surface loading (Trickling Filters), GPD/Sq. ft.</i>         | <b>400 - 600</b>       |
| <i>Weir overflow rate, GPD/Linear foot</i>                      | <b>10,000-30,000</b>   |
| <i>Solids loading (Activated Sludge.), (lb TSS/day/Sq. ft.)</i> |                        |
| <i>Average</i>                                                  | <b>20 – 35</b>         |
| <i>Peak</i>                                                     | <b>30 - 50</b>         |
| <i>Blanket depth</i>                                            | <b>1 to 3 feet</b>     |
| <i>Upflow velocity, Feet / hour</i>                             | <b>12 – 24</b>         |
| <i>Water Depth (Feet):</i>                                      |                        |
| <i>Fixed film (Trickling filter)</i>                            | <b>10 – 12</b>         |
| <i>Activated sludge</i>                                         | <b>12 - 15</b>         |
| <i>Sludge Withdrawal Method:</i>                                |                        |
| <i>Fixed film (RBC or TF)</i>                                   | <b>Scraper or Pump</b> |
| <i>Activated sludge</i>                                         | <b>Pumping</b>         |
| <i>Detention time, in hours</i>                                 | <b>2 - 3</b>           |

## **ANAEROBIC DIGESTERS**

### **Average Digestion Period, Days**

Standard rate **30 – 60**

High rate **15 – 25**

### **Volatile Solids Loading, (lbs VS/day/cubic foot)**

*Standard* **0.03 to 0.1**

*High Rate* **0.1 to 0.3**

### **Volatile Suspended Solids Reduction**

*Range* **55 to 70 percent (%)**

### **Concentration of supernatant Liquor**

Maximum **≤ 5,000 mg/L**

### **Gasification of Solids**

*Good digestion* **90 to 95 percent (%)**

### **Gas Production**

*Range* **10 to 18 cubic feet / lb VS destroyed**

Production required, per capita **4 to 6 cubic feet**

Gas Production per person,  
Per day

**0.6 – 0.8 Primary plants**  
**0.8 – 1.2 Secondary plants**

Gas production / Lb of VS

**12.0 - 15.0 cubic feet**

### **Gas Composition**

*Methane* **65 to 70 percent (%)**

*Carbon dioxide* **30 to 35 percent (%)**

*Hydrogen sulfide* **less than 1.0 percent (%)**

*Other gases* **less than 1.0 percent (%)**

### **Gas Heat Value**

*Range* **500 to 800 BTUs / cubic feet**

Average **600 BTUs / cubic feet**

### **Gas pressure**

*Under cover* **9 to 15 inches water column**

**pH***High volatile acids* lower than 6.7*Normal range* 6.8 to 7.2*High alkalinity* higher than 7.3**Temperature***Cryophilic (Psychrophilic)* lower than 80° degrees F*Mesophilic range* 85° to 100° degrees F***Mesophilic optimum*** **95 deg F** (mimic's human body internal temperature.)*Thermophilic* Higher than 110° degrees F**Temperature Change***Allowable* No more than 1° degree F per day**Temperature Bacteria***Bacterial action stops at low temperature of:* **50° F****Volatile Acids/Alkalinity***Stable operation* 1:10 ratio; Result equal ( ≤ ) to or less than 0.10

Range: 0.10 – 0.25

**Example:**

$$\frac{120 \text{ mg/L} - \text{Acids}}{2,400 \text{ mg/L} - \text{Alkalinity}} = 0.05$$

Note(\*) The Volatile Acids / Alkalinity ratio will change before the pH changes.

**To raise and correct pH within a digester, use anhydrous ammonia rather than lime or sodium bicarbonate to avoid sludge build up.****Introduction of Air (oxygen) into a digester**

|                             |       |
|-----------------------------|-------|
| Lower Explosive Limit (LEL) | 5.3%  |
| Upper Explosive Limit (UEL) | 14.0% |

## **AEROBIC DIGESTION**

### **Detention Time, Days**

*Range*

15 to 60 days

### **Volatile Solids Loading,**

*Range*

0.02 to 0.14 lbs VS/day/cuft

### **Oxygen Uptake**

*Range*

1 to 2 mg oxygen/hr/gram VSS

## **GRAVITY THICKENERS**

### **Solids Loading**

*Primary sludge*

20 lbs/day/sq. ft.

*Trickling filter sludge*

8 lbs/day/sq. ft.

*Waste activated sludge*

4 lbs/day/sq. ft.

### **Thickened Sludge**

*Primary or trickling filter*

8 to 10 percent (%) TS

*Activated sludge*

2 to 3 percent (%) TS

## **DAF THICKENERS**

### **Solids Loading**

*WAS without polymer*

10 to 25 lbs/day/sq. ft.

*WAS with polymer*

50 lbs/day/sq. ft.

### **Air to Solids Ratio**

*Range*

0.2 to 0.4

### **Solids Capture**

*Range*

95 to 99 percent (%)

### **Float Solids**

*Range*

3 to 6 percent (%) TS

## **CENTRIFUGE THICKENING**

### **Thickened Solids**

*Range for WAS*

5 to 10 percent (%) TS

### **Solids Capture**

*Range for WAS*

80 to 95 percent (%)

## **HEAT TREATMENT**

### **Reactor Temperature**

*Range*

350° to 450° degrees F

### **Reactor Pressure**

*Range*

100 to 400 PSI

### **Detention Time**

*Range*

15 to 60 minutes

## **VACUUM FILTERS**

### **Solids Yield**

*Activated sludge*

1 to 2 lbs/hour/sq. ft.

*Primary sludge*

5 to 10 lbs/hour/sq. ft.

*Lime sludge*

30 to 40 lbs/hour/sq. ft.

### **Vacuum**

*Average*

15 inches mercury

### **Drum Submergence**

*Range*

15 to 25 percent (%)

### **Cake Solids**

*Range*

20 to 40 percent (%) TS

## **DRYING BEDS**

### **Depth of Application**

*Range on 12 – inches of sand*

4 to 2 inches

### **Application Rate**

*Range*

3 to 40 lbs/year/sq. ft.

### **Dried Sludge Solids**

*Range*

30 to 40 percent (%) TS

## **INCINERATION**

### **Temperatures**

*Hearths*

1,600° to 2,000° degree F

*Afterburner*

1,200° to 1,400° degree F

## **WET AIR OXIDATION**

### **Temperature**

*Range*

500° to 600° degree F

### **Pressure**

*Range*

1,000 to 3,000 PSI

## **SLUDGE CHARACTERISTICS**

### **Terminology**

*"Thickened"*

Less than 15 percent (%) TS

*"Dewatered"*

More than 15 percent (%) TS

### **Volatile Solids**

*Primary or biological*

70 to 80 percent (%)

*Digested*

40 to 60 percent (%)

### **Heat Value**

*Primary or biological*

10,000 BTU per lb dry

*Digested*

5,000 BTU per lb dry

*Grease*

16,000 BTU per lb dry

## **CHLORINATION**

### **Disinfection Dosage**

*Primary effluent* 17 to 24 mg/L

*Secondary effluent* 6 to 12 mg/L

*Filtered effluent* 5 to 7 mg/L

### **Chlorine Contact Time**

*Detention time* 20 to 60 minutes

### **Gas Cylinders – Do NOT Exceed Gas Withdrawal Rates (Temperature range: between 35° - room temp 68° F)**

*100 or 150 pound Cylinders* **40 lbs/day**

*Ton cylinders* **400 lbs/day**

### **Liquid Withdrawl Rate**

*Tank cars (excess flow valve)* 7,000 lbs/hour

### **Tank Cars**

*Capacities* 16, 30, 55, 90 Tons

### **Container Pressure**

*Room Temp (68°F)* 82 PSI

### **Fusible Plugs**

*Melting temperature* **158 to 165° F**

### **Chlorine Properties**

*Gas color* yellowish - green

*Liquid color* amber

*Gas to liquid volume  
ratio* 460 to 1

*Times heavier than air (gas)* 2.5

*Solubility in water* 60 lbs per 100 gallons

## **DECHLORINATION**

### **Sulfur Dioxide**

*Dosage* 1.0 lb sulfur dioxide per lb of chlorine residual

## **BREAKPOINT CHLORINATION**

### **Chlorine**

*Dosage* 8 to 10 lbs chlorine per lb ammonia

## **POLISHING FILTERS**

### **Hydraulic Loading**

*Rapid sand* 2 to 6 GPM/sq. ft.

*Course deep bed* up to 20 GPM/sq. ft.

### **Surface Wash Rate**

*Average* 1 GPM / sq. ft.

### **Backwash Rate**

*Slow* 2 GPM/sq. ft.

*Fast* 10 GPM/sq. ft.

### **Backwash Time**

*Range* 5 to 8 minutes

### **Backwash Air Rate**

*Range* 2 to 5 CFM/sq. ft.

## **COAGULATION**

### **Dosages (phosphorous and solids removal)**

*Alum* 75 to 250 mg/L

*Lime* 200 to 400 mg/L

*Ferric / Ferrous Chloride* 45 to 90 mg/L

### **Flash Mix Time**

*Range* 15 - 60 seconds

## **POLYELECTROLYTES**

### **Wastewater Dosage**

*Average*

0.1 mg/L

### **Solution Strength**

*Average*

0.5 °

## **CARBON COLUMNS**

### **Contact Time**

*Range*

20 to 40 minutes

### **COD Removal**

*Range*

20 to 40 minutes

## **MISCELLANEOUS**

### **Sewers**

*Minimum Scouring Velocity*

**2.0 FPS**

### **Methane in Air**

*Explosive range*

5 to 15 percent (%)

### **Biological Activity**

*Rates double for every*

10° C rise in temperature

### **Density of Water**

*Maximum density*

1 gram/cc at 4° C / 39.2°F

### **Digester Gas Produced**

*Average Per day / Per day*

1.0 cubic foot

### **Drying Bed Capacity**

*Required area*

1.0 – 1.5 sq. ft. / person

### **Sludge Loading Rate**

*Lbs/day solids / sq. ft. / year*

25 – 30 lbs/day solids

### **Wastewater Flow**

*Per capita per day*

**100 gallons**

## **SECONDARY EFFLUENT REQUIREMENTS \***

### **BOD (5-day)**

*Monthly average*

30 mg/L

### **TSS**

*Monthly average*

30 mg/L

### **Fecal Coliforms**

*Maximum*

200 per 100 ml

### **pH**

*Range*

6.0 to 9.0

\*Based on PL 92-500, The Water Pollution Control Act of 1972

**END**