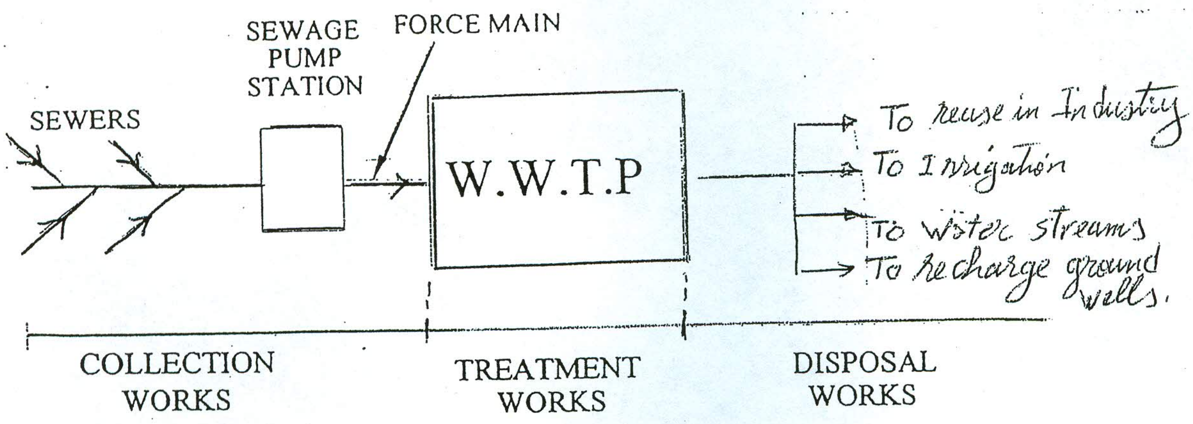
Wastewater Treatment



Wastewater works:

1- Collection works.
2- Treatment works.
3- Disposal works.

* Type of Treatment

1. Physical
2. Chemical
3. Biological.

Sources of sewage:

1- Domestic wastewater.
2- Industrial wastewater.
3- Commercial
4- Public

* Wastewater Flowrates

- Represent 80 to 90% from Water Consumption

* Main Pollutants of Wastewater

- BOD
- TSS

Wastewater Composition:

- Water (99.9%)
- Solids (0.1%) → organic / non-organic

Degree of treatment (Level)

- Preliminary Treatment → Removal of large objects and oil & Grease
- Primary treatment → Removal of 60% SS, 30% BOD
- Secondary treatment → Removal of 80 → 90% SS, 80 → 90% BOD
- Tertiary treatment → Removal of 90 → 99% SS, Removal of 90 → 99% BOD, Removal of Pathogenic Bacteria.

Wastewater Treatment: → • Preliminary Treatment

- Primary Treatment.
- Secondary Treatment.
- Tertiary Treatment.
- Sludge Treatment.

Flow line for Primary Treatment:

Units:	Purpose:
1- Rising main :	To transmit sewage from pump station to deceleration tank under pressure
2-Decceleration tank:	Decrease the velocity of flow before screen to prevent escaping of removed matters
3-Approach Channel:	To transmit sewage to screen with suitable velocity
4- Screen:	Removal of big floating matters
5- Grit Removal Chamber:	Removal of particles of diameter 0.2mm or greater
6- Primary sedimentation Tank:	a)Removal of (40-60)% of suspended solids. b)Removal of (25-35)% of BOD.

Discharge

Q_{peak} = Peak factor x Qav
Q_{min} = min factor x Qav

Q_{max} = 1.5 x Qav
Q_{min} =0.5 x Qav

- SF (sewage flow) =(0.7-0.9) x Av. W.C
- Qav = pop x SF

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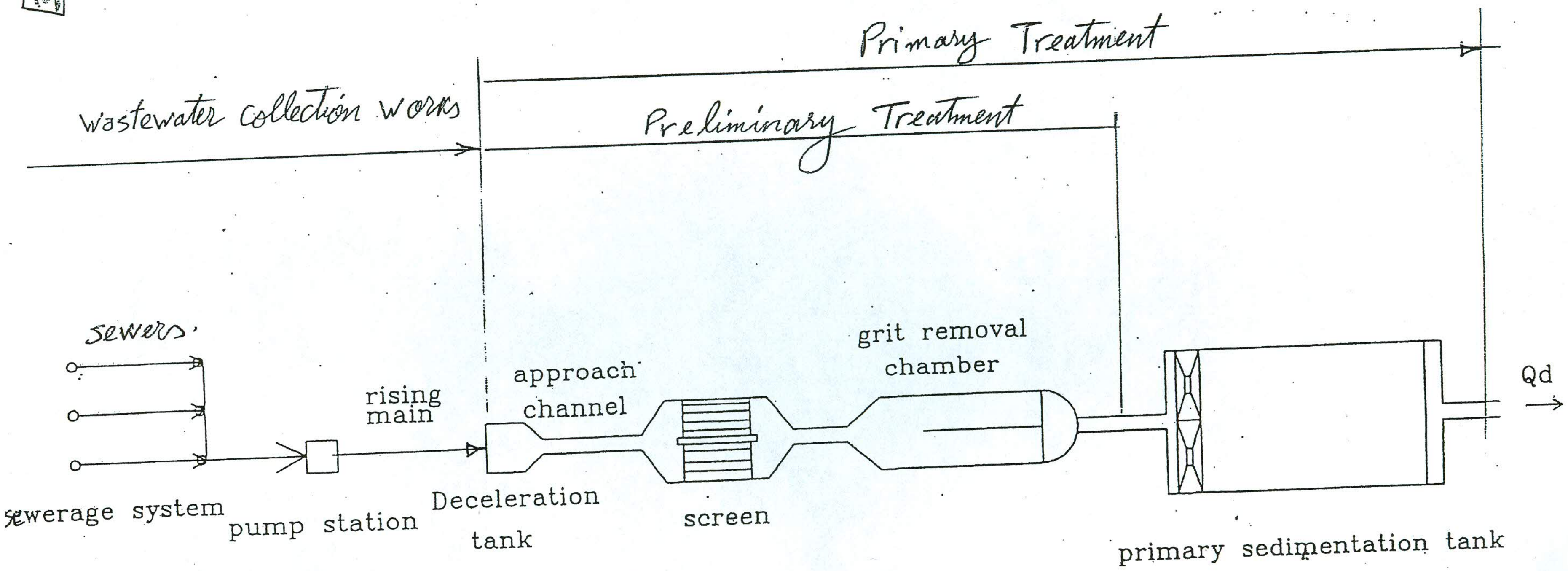


Flow line for primary sewage treatment

Preliminary Treatment

Purpose of Preliminary Treatment:

- To remove large solids and big floating matter.
- To remove sand, gravel and silt.
- To remove oil & Grease.

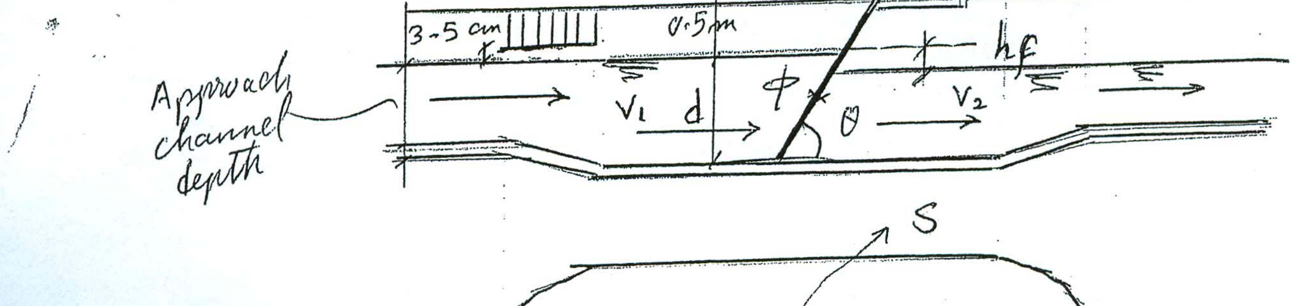
Preliminary Treatment Units:

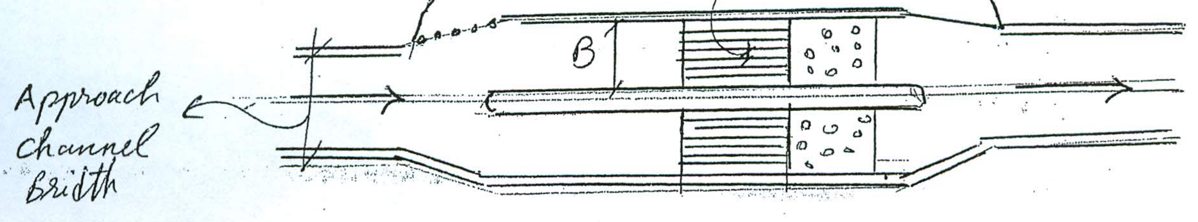
- Screens.
- Grit Removal Chambers.
- Oil & Grease Removal Tanks.

* Screens : (Vertical bars type)

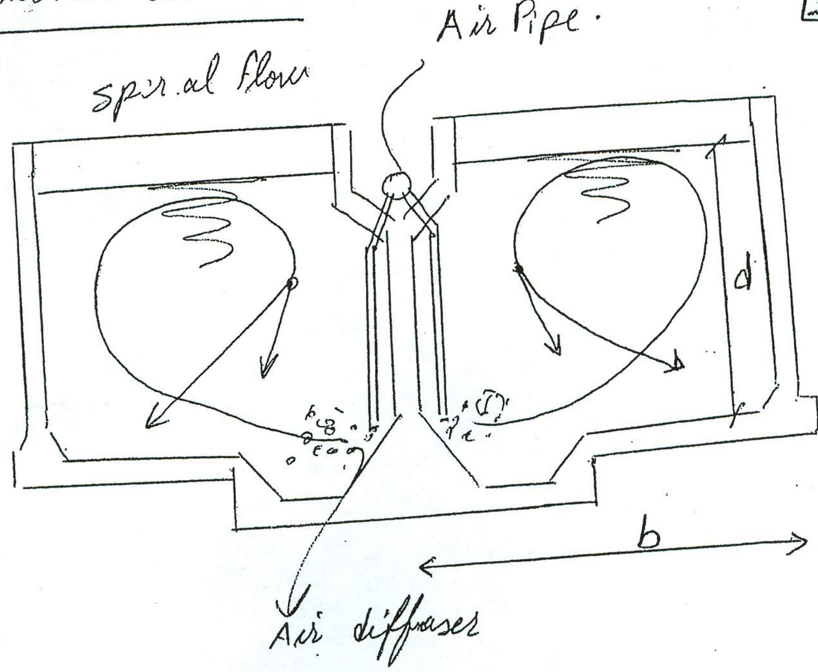
- Coarse Screens: clear spacing between bars from 5 upto 10 cm
- Medium Screens: " " " " ranged from 2 to 5 cm
- Fine Screens: " " " " < 2 cm.

* Screens Design Criteria:





Aerated Grit Removal Chamber



Advantages:

1- The air will refresh the sewage. (Pre-Aeration).
2- Reduce septicity of raw sewage.
3- The air will wash the grit from organics.
4- the air will assist removal of floating oil & Gre.

Disadvantages:

1- Power consumption is high.
2- Release volatile organics compounds VOC that can cause odor problems.

How To Control velocity:

To control velocity:
① through Tank dimensions
② through Quantity of air supply.

Design Data of Aerated Grit Chamber:

1 - Detention Time = 2 → 5 min.

2 - Units Numbers (n) ≥ 2.

3 - Depth (d) = 2 → 5 m.

4 - Bridth (B) = 2.5 → 7 m.

5 - Length (L) = 7 → 20 m.

6 - B = (1 → 5) d —Typical→ B = (1.5 → 2) d

7 - L = (3 → 5) B

8 - Air Supply = 0.2 → 0.5 m^3/m . min.

Example (1): Design of aerated grit chamber

- Design an aerated grit chamber for the treatment of municipal wastewater. The average and Peak flowrates are 0.5 and 2 $m^3/sec.$, respectively?

- Solution:

Assume T = 3 min.

Use TWO chambers

∴ Volume = Q × T

$$= \frac{2}{2}\frac{m^3}{sec} \times 3 \text{ min} \times \frac{60 \text{ sec}}{\text{min}} = 180 \text{ m}^3.$$

Assume water depth = 3 m.

∴ Width = 1.5 depth = 1.5 × 3 = 4.5 m.

$$\therefore \text{Length} = \frac{\text{Volume}}{W \cdot D} = \frac{180}{3 \times 4.5} = 13.5 \text{ m}.$$

∴ Use 2 units each has the following Dimensions:

(3 m × 4.5 m × 13.5 m)

Air requirement,

Assume Air supply is 0.3 $m^3/min.m$

∴ Air required = 13.5 m × 0.3 $m^3/min.m$ = 4.05 m^3/min

Total air required = 4.05 × 2 = 8.1 m^3/min.

Example (2)

Given:

Peak flow = 3 m^3/sec.
Retention Time = 5 min.
Water Depth = 3 m.
Air Supply Rate = 0.3 $m^3/min/m$.

Req.: Design of aerated grit removal Chamber.
L, W, d, n ?

Total Volume = $Q \times T$.

$$= 3 \frac{m^3}{sec} \times 5 \text{ min} \times \frac{60 \text{ sec}}{min} = 900 \text{ m}^3.$$

Use Two chambers

∴ Volume of one unit = 450 m^3.

Water depth = 4 m.

∴ Width = 1.5 depth = 1.5 X 4 = 6 m.

∴ Length = $\frac{Volume}{W.D.} = \frac{450}{4 \times 6} = 18.75$ m.

∴ Use 2 units each has the following Dimensions.

2 (4 m X 6 m X 18.75 m).

Air Requirement:

Air Req. = 18.75 X 0.3 $m^3/min/m$

= 5.625 m^3/min.

Total air Req = 5.625 X 2 = 11.25 m^3/min