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Program : **B.Tech**

Subject Name: **Environmental Engineering I**

Subject Code: **CE-602**

Semester: **6<sup>th</sup>**



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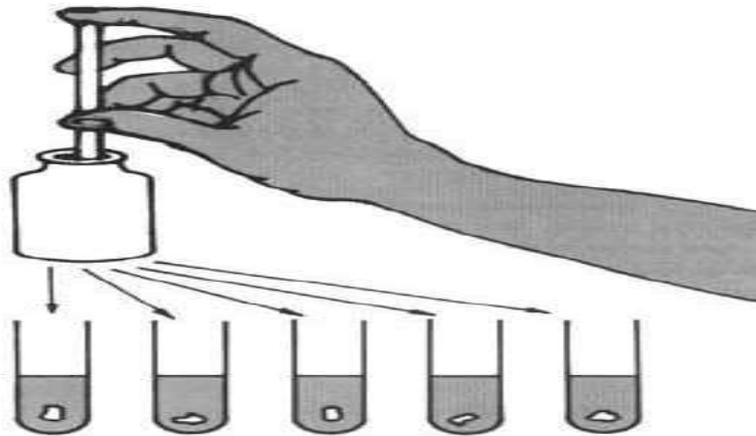
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## Environmental Engineering-I (CE-602)

### Unit – II

Impurities of water and their significance, water-borne diseases, physical, chemical and bacteriological analysis of water, water standards for different uses. Intake structure, conveyance of water, pipe materials, pumps - operation & pumping stations.

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Qualitative and quantitative measurements are needed from time to time to constantly monitor the quality of water from the various sources of supply. The harbour-master should then ensure appropriate water treatment within the fishery harbour complex as well as initiate remedial measures with the suppliers when water supply from outside is polluted.

#### 2.1.1 Borewells

Contamination may arise from pollutants entering the water table some distance from the port or from sewage entering the borehole itself in the port area through cracked or corroded casings. In cases where overdrawn is evident (water is brackish), tests should be conducted at least monthly.

#### 2.1.2 Municipal mains

Supply could be contaminated at source or through corroded pipelines leading to the fishery harbour. Mixing with sewage lines due to defective piping has been known to occur often. Complete tests should be carried out every half year, and the authorities should be informed when results indicate contamination.

#### 2.1.3 Water tanks and reservoirs

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Both types of structure are prone to bacterial growth if the residual chlorine levels in them are low or non-existent. Testing may not be necessary if periodic scrubbing is carried out. Bacteriological tests should be done at least half-yearly.

### 2.1.4 Harbour basin water

Typically, harbour basins are tested yearly. However, in areas where monsoons are very active, it may be advisable to test at the peak of the dry season when effluent point discharges tend to remain concentrated in the water body and again during the wet season when agriculture run-off may be considerable. Another critical period for harbours is the peak of the fishing season when the harbour is at its busiest and vessel-generated pollution is likely to be at its peak.

- ❖ Testing procedures and parameters may be grouped into physical, chemical, bacteriological and microscopic categories.
  - Physical tests indicate properties detectable by the senses.
  - Chemical tests determine the amounts of mineral and organic substances that affect water quality.
  - Bacteriological tests show the presence of bacteria, characteristic of faecal pollution.

### Physical tests

Colour, turbidity, total solids, dissolved solids, suspended solids, odour and taste are recorded.

- Colour in water may be caused by the presence of minerals such as iron and manganese or by substances of vegetable origin such as algae and weeds. Colour tests indicate the efficacy of the water treatment system.
- Turbidity in water is because of suspended solids and colloidal matter. It may be due to eroded soil caused by dredging or due to the growth of micro-organisms. High turbidity makes filtration expensive. If sewage solids are present, pathogens may be encased in the particles and escape the action of chlorine during disinfection.
- Odour and taste are associated with the presence of living microscopic organisms; or decaying organic matter including weeds, algae; or industrial wastes containing ammonia, phenols, halogens, hydrocarbons. This taste is imparted to fish, rendering them unpalatable. While chlorination dilutes odour and taste caused by some contaminants, it generates a foul odour itself when added to waters polluted with detergents, algae and some other wastes.

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### Intake Structure

The basic function of the intake structure is to help in safely withdrawing water from the source over predetermined pool levels and then to discharge this water into the withdrawal conduit (normally called intake conduit), through which it flows up to water treatment plant.

### Factors Governing Location of Intake

1. As far as possible, the site should be near the treatment plant so that the cost of conveying water to the city is less.
2. The intake must be located in the purer zone of the source to draw best quality water from the source, thereby reducing load on the treatment plant.
3. The intake must never be located at the downstream or in the vicinity of the point of disposal of wastewater.
4. The site should be such as to permit greater withdrawal of water, if required at a future date.
5. The intake must be located at a place from where it can draw water even during the driest period of the year.
6. The intake site should remain easily accessible during floods and should not get flooded. Moreover, the flood waters should not be concentrated in the vicinity of the intake.

### Design Considerations

1. sufficient factor of safety against external forces such as heavy currents, floating materials, submerged bodies, ice pressure, etc.
2. should have sufficient self-weight so that it does not float by upthrust of water.

### Types of Intake

Depending on the source of water, the intake works are classified as follows:

#### Pumping

A pump is a device which converts mechanical energy into hydraulic energy. It lifts water from a lower to a higher level and delivers it at high pressure. Pumps are employed in water supply projects at various stages for following purposes:

1. To lift raw water from wells.
2. To deliver treated water to the consumer at desired pressure.
3. To supply pressured water for fire hydrants.
4. To boost up pressure in water mains.
5. To fill elevated overhead water tanks.

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6. To back-wash filters.
7. To pump chemical solutions, needed for water treatment.

### Classification of Pumps

Based on principle of operation, pumps may be classified as follows:

1. Displacement pumps (reciprocating, rotary)
2. Velocity pumps (centrifugal, turbine and jet pumps)
3. Buoyancy pumps (air lift pumps)
4. Impulse pumps (hydraulic rams)

### Capacity of Pumps

Work done by the pump,

$$\text{H.P.} = gQH/75$$

where,  $g$  = specific weight of water  $\text{kg/m}^3$ ,  $Q$  = discharge of pump,  $\text{m}^3/\text{s}$ ; and  $H$  = total head against which pump has to work.

$$H = H_s + H_d + H_f + (\text{losses due to exit, entrance, bends, valves, and so on})$$

where,  $H_s$  = suction head,  $H_d$  = delivery head, and  $H_f$  = friction loss.

$$\text{Efficiency of pump (E)} = gQH/\text{Brake H.P.}$$

$$\text{Total brake horse power required} = gQH/E$$

Provide even number of motors say 2,4,... with their total capacity being equal to the total BHP and provide half of the motors required as stand-by.

### Conveyance

There are two stages in the transportation of water:

1. Conveyance of water from the source to the treatment plant.
2. Conveyance of treated water from treatment plant to the distribution system.

In the first stage water is transported by gravity or by pumping or by the combined action of both, depending upon the relative elevations of the treatment plant and the source of supply. In the second stage water transmission may be either by pumping into an overhead tank and then supplying by gravity or by pumping directly into the water-main for distribution.

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### Free Flow System

In this system, the surface of water in the conveying section flows freely due to gravity. In such a conduit the hydraulic gradient line coincide with the water surface and is parallel to the bed of the conduit. It is often necessary to construct very long conveying sections, to suit the slope of the existing ground. The sections used for free-flow are: Canals, flumes, grade aqueducts and grade tunnels.

### Pressure System

In pressure conduits, which are closed conduits, the water flows under pressure above the atmospheric pressure. The bed or invert of the conduit in pressure flows is thus independent of the grade of the hydraulic gradient line and can, therefore, follow the natural available ground surface thus requiring lesser length of conduit. The pressure aqueducts may be in the form of closed pipes or closed aqueducts and tunnels called *pressure aqueducts* or *pressure tunnels* designed for the pressure likely to come on them. Due to their circular shapes, every pressure conduit is generally termed as a *pressure pipe*. When a pressure pipe drops beneath a valley, stream, or some other depression, it is called a depressed pipe or an *inverted siphon*. Depending upon the construction material, the pressure pipes are of following types: Cast iron, steel, R.C.C, hume steel, vitrified clay, asbestos cement, wrought iron, copper, brass and lead, plastic, and glass reinforced plastic pipes.

### Hydraulic Design

The design of water supply conduits depends on the resistance to flow, available pressure or head, and allowable velocities of flow. Generally, Hazen-William's formula for pressure conduits and Manning's formula for freeflow conduits are used.

Hazen-William's formula

$$U=0.85 C r_H^{0.63} S^{0.54}$$

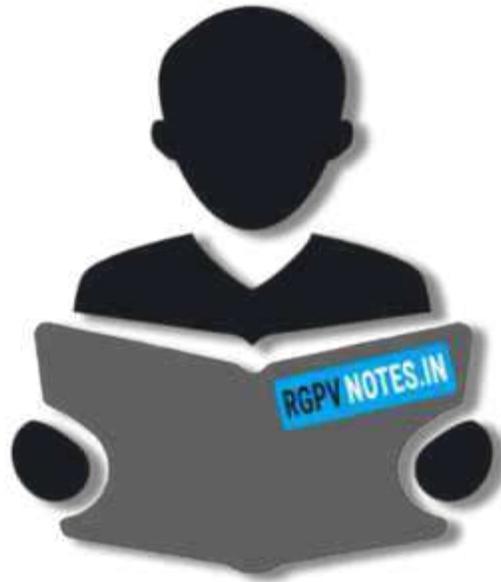
Manning's formula

$$U=1/n r_H^{2/3} S^{1/2}$$

where, U= velocity, m/s;  $r_H$ = hydraulic radius,m; S= slope, C= Hazen-William's coefficient, and n = Manning's coefficient.

Darcy-Weisbach formula

$$h_L=(fLU^2)/(2gd)$$



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