

ENVIRONMENTAL ENGINEERING

Notes by-

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WATER SOFTENING

* Disadvantages of Hard water:-

- 1) It affects working of drying system & modifies some colour.
- 2) It causes corrosion & incrustation (Hard coating) of pipes & plumbing fixtures.
- 3) It causes more consumption of soap for laundry process.
- 4) It increases cost of fuel in boilers.
- 5) It makes food tasteless.
- 6) Scale formation in case of boilers.

Therefore hard water should made soft before consumption.

* Types of Hardness:-

- 1) Temporary Hardness / carbonate Hardness. [$\text{CaCO}_3, \text{MgCO}_3$]
- 2) Permanent Hardness / Bicarbonate Hardness.

Temporary hardness is only due to CaCO_3 & MgCO_3 which can be removed by adding lime & boiling. While permanent hardness is not removed easily. They requires softening treatment.

Following are softening treatment adopted for removal of permanent hardness -

- 1) Lime Soda Process
- 2) Zeolite Process
- 3) Demineralization Process.

MISCELLANEOUS METHODS

Treatment for Colour, odour & taste removal:-

- 1) Coagulation followed by filtration.
- 2) Pre-chlorination.
- 3) Super chlorination.
- 4) Use of chlorine dioxide.

Special Methods:-

- ① Aeration : Air diffusion, Cascade, spray nozzle, trickling beds
- ② Treatment of activated carbon
- ③ Use of copper sulphate.

CONVEYANCE OF WATER

Intake: Intake is a structure which is used for withdrawal of water.

Types of intake:-

- a) Canal intake
- b) Reservoir or lake intake
- c) River intake
- d) Portable intake
- e) Intake towers.

DISTRIBUTION OF WATER

Conveyance of water includes:-

- 1) Drawing the water from the source through intake
- 2) Conveying the water from intake to purification tank to the treatment plant to the consumer.

▷ Intake:-

- * factors affecting selection of site for intake:-
- ▷ controlling devices should be accessible; during flood.
- 2) cost of const' should be minimum.
- 3) Availability of 3M
- 4) Navigation channel should be avoided.
- quantity of water available during summer.
- 5) Quality of water.
- 6) Length of conveyance system.
- 7) Elevation of intake.

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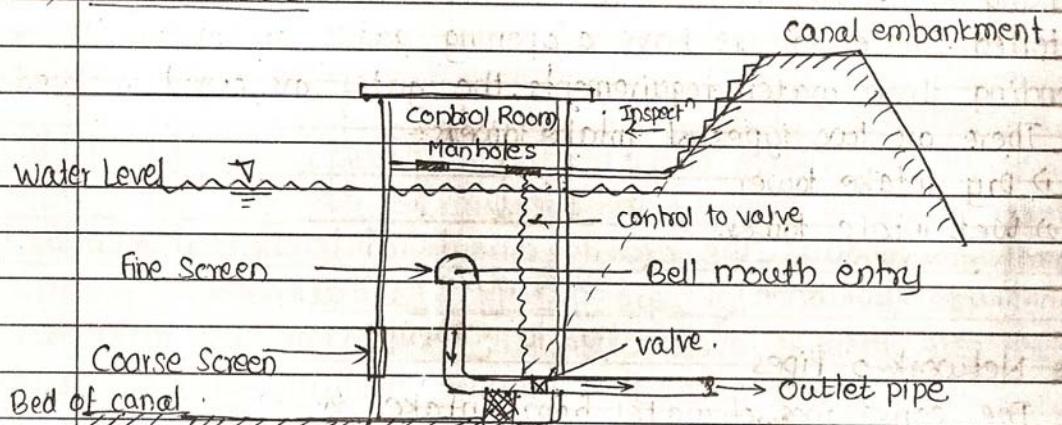
- Drawing the water from the source through intake
- Conveying the water from intake to purification tank (to the treatment plant) to the consumers.

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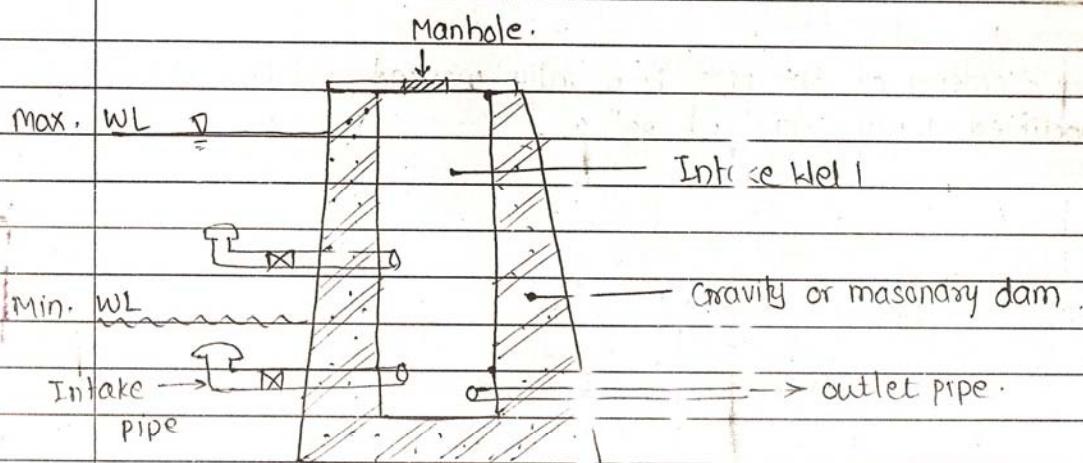
1) Canal Intake:



2) Reservoir or Lake inlet:

Fig. Same as canal intake but more than one outlet pipe is installed.

3) River Intake:



4) Portable Intake: In case of emergencies like festivals etc., the water can be withdrawn from movable portable intakes.

The whole assembly is fitted on trucks & when it is necessary to withdraw water, the truck is brought to the site & suction pipe is lowered in the water & pumping is done.

* Intake Towers:- In case of large project on river or dam, the water level is not constant throughout the year. So for smooth working of intake conveyance system, intake towers are generally preferred. These towers have a opening gates at various level & depending upon water requirements, the gates are open or closed.

There are two types of intake towers:-

- 1) Dry intake tower
- 2) Wet intake tower.

* Network of Pipes

The conveyance of water from intake to treatment plant & from treatment plant up to consumer is done by gravity conduits & pressure conduits. The gravity conduits are economical & water flows under the influence of gravity & at atmospheric pressure. In such case there is evaporation loss, percolation loss takes place.

In second case, the pressure conduits, generally pipes are used, which conveys water under pressure. But this is costly.

The size of pipe mainly depend upon discharge & velocity of water, as, $Q = V \cdot A$

The diameter of the pipe is usually worked out by using modified Darcy - Weisbach eqⁿ as,

$$hf = \frac{f \cdot L \cdot Q^2}{12.1 d^5} = f \cdot L \cdot V^2$$

where, hf = frictional head loss.

f = coefficient of friction.

L = Length of pipe

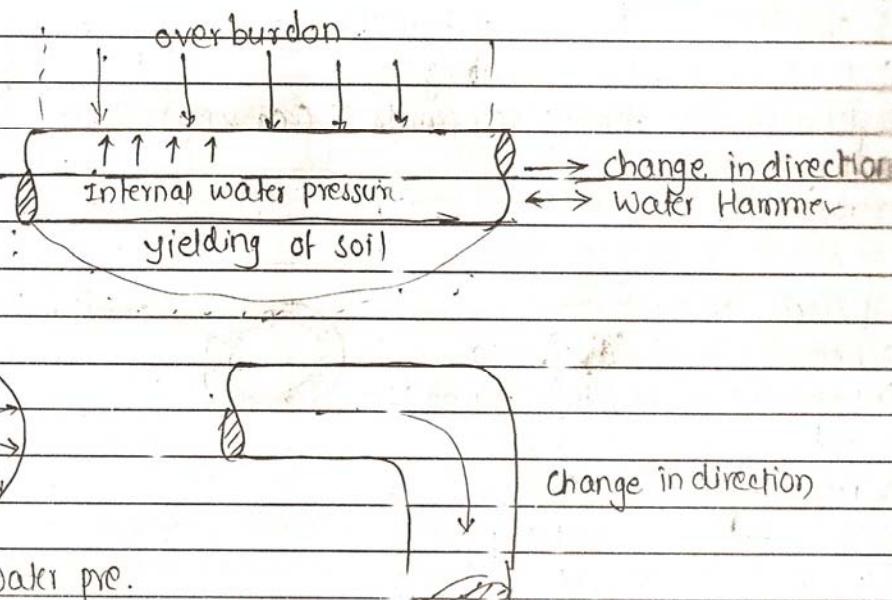
Q = Discharge through pipe

d = dia. of pipe.

* The selection of material of pipe depends upon -

- 1) Stresses due to change in direction
- 2) Internal water pressure
- 3) Overburden pressure.

- 4) stresses due to yielding of soil below pipe
- 5) Temp.
- 6) Maintenance cost, durability etc.



- * Various materials used for pipes
- a) Asbestos cement
- b) cast iron
- c) cement concrete
- d) copper
- e) Galvanized iron.
- f) Lead
- g) Plastic
- h) Steel
- i) wood.

* Pipe corrosion :-

Pipe corrosion indicates loss of material due to action of water. The disintegration of pipe material is caused due to action of flowing water (internal) & action of soil around pipe (external corrosion.)