**Govt. Engineering College, Ajmer**
**Department of Civil Engineering**

Old Test Paper Session 2016-17

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Subject Environmental Engineering –II
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Q. 1: Write a detail notes on physical and chemical characteristics of sewage. (3)
Q. 2: Describe the classification of water carriage system with advantages & disadvantages. (3)
Q. 3: Design a sewer for a population of 36000, the daily water supply being 135 lit., of which 80% finds its way into sewer. Takes: slope 1 in 625, peak factor four times of D.W.F. running full, and n= 0.012. Also determine the velocity of flow when sewer running full. (4)

## Solution

**Ans. 1:-**

**Sewage Characteristics**

Characterization of wastes is essential for an effective and economical waste management programme. It helps in the choice of treatment methods deciding the extent of treatment, assessing the beneficial uses of wastes and utilizing the waste purification capacity of natural bodies of water in a planned and controlled manner. The factors which contribute to variations in characteristics of the domestic sewage are daily per capita use of water, quality of water supply and the type, condition and extent of sewerage system, and habits of the people. Municipal sewage, which contains both domestic and industrial wastewater, may differ from place to place depending upon the type of industries and industrial establishment. The important characteristics of sewage are discussed here.

**1Temperatur**

The observations of temperature of sewage are useful in indicating solubility of oxygen, which affects transfer capacity of aeration equipment in aerobic systems, and rate of biological activity. Extremely low temperature affects adversely on the efficiency of biological treatment systems and on efficiency of sedimentation. In general, under Indian conditions the temperature of the raw sewage is observed to be between 15 and 35 0 C at various places in different seasons.

**2 The pH**

The hydrogen ion concentration expressed as pH, is a valuable parameter in the operation of biological units. The pH of the fresh sewage is slightly more than the water supplied to the community. However, decomposition of organic matter may lower the pH, while the presence of industrial wastewater may produce extreme fluctuations. Generally the pH of raw sewage is in the range 5.5 to 8.0.

**3 Colour and Odour**

Fresh domestic sewage has a slightly soapy and cloudy appearance depending upon its concentration. As time passes the sewage becomes stale, darkening in colour with a pronounced smell due to microbial activity.

**4 Solids**

Though sewage generally contains less than 0.5 percent solids, the rest being water, still the nuisance caused by the solids cannot be overlooked, as these solids are highly degradable and

therefore need proper disposal. The sewage solids may be classified into dissolved solids, suspended solids and volatile suspended solids.

**5 Nitrogen and Phosphorus**

The principal nitrogen compounds in domestic sewage are proteins, amines, amino acids, and urea. Ammonia nitrogen in sewage results from the bacterial decomposition of these organic constituents. Nitrogen being an essential component of biological protoplasm, its concentration is important for proper functioning of biological treatment systems and disposal on land. Generally nitrogen content in the untreated sewage is observed to be in the range of 20 to 50 mg/L measured as TKN. Phosphorus is contributing to domestic sewage from food residues containing phosphorus and their breakdown products. The use of increased quantities of synthetic detergents adds substantially to the phosphorus content of sewage. Phosphorus is also an essential nutrient for the biological processes. The concentration of phosphorus in domestic sewage is generally adequate to support aerobic biological wastewater treatment.

**6 Chlorides**

Concentration of chlorides in sewage is greater than the normal chloride content of water supply. The chloride concentration in excess than the water supplied can be used as an index of the strength of the sewage. The daily contribution of chloride averages to about 8 gm per person. Based on an average sewage flow of 150 LPCD, this would result in the chloride. Any abnormal increase should indicate discharge of chloride bearing wastes or saline groundwater infiltration, the latter adding to the sulphates as well, which may lead to excessive generation of hydrogen sulphide.

**7 Organic Materials**

A large variety of microorganisms (that may be present in the sewage or in the receiving water body) interact with the organic material by using it as an energy or material source. The utilization of the organic material by microorganisms is called metabolism. To describe the metabolism of microorganisms and oxidation of organic material, it is necessary to characterize quantitatively concentration of organic matter in different forms. In practice two properties of almost all organic compounds can be used: (1) organic compound can be oxidized; and (2) organic compounds contain organic carbon. In environmental engineering there are two standard tests based on the oxidation of organic material: 1) the Biochemical Oxygen Demand (BOD) and 2) the Chemical Oxygen Demand (COD) tests. In both tests, the organic material concentration is measured during the test.

**Ans. 2:-**

1) SEPARATE SYSTEM OF SEWAGE
2) COMBINED SYSTEM OF SEWAGE
3) PARTIALLY COMINED OR PARTIALLY SEPARATE SYSTEM

**1 SEPARATE SYSTEM OF SEWERAGE**

In this system two sets of sewers are laid .The sanitary sewage is carried through sanitary sewers while the storm sewage is carried through storm sewers. The sewage is carried to the treatment plant and storm water is disposed of to the river.

**Advantages:**

1) Size of the sewers are small 2) Sewage load on treatment unit is less 3) Rivers are not polluted 4) Storm water can be discharged to rivers without treatment.

**Disadvantage**:

1) Sewerage being small, difficulty in cleaning them 2) Frequent choking problem will be their 3) System proves costly as it involves two sets of sewers 4) The use of storm sewer is only partial because in dry season the will be converted in to dumping places and may get clogged.

**2 COMBINED SYSTEM OF SEWAGE**

When only one set of sewers are used to carry both sanitary sewage and surface water. This system is called combined system. Sewage and storm water both are carried to the treatment plant through combined sewers

**Advantages:**

1) Size of the sewers being large, chocking problems are less and easy to clean. 2) It proves economical as 1 set of sewers are laid. 3) Because of dilution of sanitary sewage with storm water nuisance potential is reduced

**Disadvantages:**

1) Size of the sewers being large, difficulty in handling and transportation. 2) Load on treatment plant is unnecessarily increased. 3) It is uneconomical if pumping is needed because of large amount of combined flow. 4) Unnecessarily storm water is polluted.

**3 PARTIALLY COMINED OR PARTIALLY SEPARATE SYSTEM**

A portion of storm water during rain is allowed to enter sanitary sewer to treatment plants while the remaining storm water is carried through open drains to the point of disposal.

**Advantages:**

1) The sizes of sewers are not very large as some portion of storm water is carried through open drains. 2) Combines the advantages of both the previous systems. 3) Silting problem is completely eliminated.

**Disadvantages:**

1) During dry weather, the velocity of flow may be low. 2) The storm water is unnecessary put load on to the treatment plants to extend. 3) Pumping of storm water in unnecessary over-load on the pumps.

**Ans. 3:-**

Population=36000, Per capita water supply=135lit/person/day
Therefore average dily water supply= 36000*135 lit/day
Or =36000*135/(1000*24*60*60) cumecs
=0.0562 cumecs
Ave. Sewage discharge=80% of water supply =0.8*0.0562 = 0.045 cumecs
Therefore DWF = 0.045 cumecs
Max. Discharge for which sewer should be designed running full = 4*0.045 = 0.18 cumecs
Using Manning's formula

$$Q = \frac{1}{N} A\, R^{2/3} \sqrt{S}$$

Therefore, $0.18 = 1/0.012*(\pi/4*D^2)(D/4)^{2/3}$

Or $D^{8/3} = 0.173$ or D= 0.52m **Ans.**

Velocity of flow when running full

= $V=Q/A = 0.18/(\pi/4(0.52)^2) = 0.85$m/sec. **Ans.**