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# BASIC ENVIRONMENTAL ENGINEERING



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method of disposing the sewage to the treatment plant.

#### 2.9.4 Treatment of Wastewater

The objective of sewage treatment is to make the sewage harmless before it is disposed. The disposal means final laying of sewage on the land or leaving it on land to flow and mix in some body of water like the river or a pond. The sewage has many characteristics like temperature, hydrogen ion concentration (pH), colour and odour, solids, nitrogen, phosphorous, chlorides, bio-chemical oxygen demand (BOD), chemical oxygen demand (COD), and toxic metals etc. Though all of them are important for determination of disposal criteria, BOD is the most important one.

The Bio-chemical oxygen demand (BOD) of sewage or polluted water is the amount of oxygen required for the biological decomposition of biodegradable organic matter under aerobic conditions. Actually the food items, human excreta, urine etc. all these are the organic matters. The organic matter has a tendency of decomposition and it always tends to be converted into the inorganic form that is stable. Higher is this tendency more fast is the decomposition. Readily decomposable organic matter is known as the putrescible matter. The decomposition of organic matter is done by the bacteria, which is available in plenty in the sewage. There are mainly two types of bacteria, one which works in presence of oxygen and the other which can work in absence of oxygen. The former is known as the aerobic bacteria and the later is known as the anaerobic bacteria. The facultative bacteria can work in both conditions. The decomposition of organic matter is done by the extra enzymatic reaction of bacteria. As the agency is living, i.e. bio and the reaction is chemical it is known as the bio-chemical reaction. The bacteria can decompose some of the organic matter, known as

the bio-degradable organic matter. The bacteria require oxygen for its metabolism and that demand of oxygen of the bacteria busy in decomposing the organic matter is known as the bio-chemical oxygen demand.

The carbonaceous portion of the organic matter is first oxidized and then the nitrogenous portion gets stabilized. About 68% of the organic matter (carbonaceous) gets stabilized in the initial 5 days and then the rate of decomposition becomes slower (because of the nitrogenous portion). Although the complete BOD is satisfied in infinite time but a large portion of it is satisfied in 5 days so 5 day BOD determination is popularly done. The general temperature of sewage is 20 degree celsius so it is termed as BOD<sub>5</sub> at 20 degree C as the standard BOD. The BOD satisfaction equation is as follows,

$$Y_t = L (1 - 10^{-K_d t})$$

Where

$$Y_t = \text{BOD at any time } t$$

$$L = \text{initial BOD at time } t = 0$$

$$K_d = \text{deoxygenation co-efficient (function of temperature)}$$

$$K_{dT} = K_{d20} \times 1.047^{T-20}$$

$$T = \text{temperature of the reaction}$$

$$K_{d20} = 0.1 \text{ per day (for normal sewage).}$$

So the BOD<sub>5</sub> determines the strength of the sewage. Higher is the BOD<sub>5</sub> stronger is the sewage. The average value of domestic sewage is 300 parts per million (ppm) or mg/liter. The industrial or commercial sewage has generally more value than this.

The chemical oxygen demand COD is known as the total oxygen demand of the bio degradable and non bio degradable organic matter. Obviously it is more than BOD. The COD can be readily (3-4 hours) measured in the laboratory where as the BOD<sub>5</sub> determination takes 5 days in the laboratory. The COD and BOD ratio for a particular type of wastewater can be predetermined and then for a given sample of wastewater by measuring the COD the BOD can be calculated indirectly. The COD /BOD ratio varies generally from 2.0 to 2.5. Actually, the BOD of the waste decides its foulness or the offensiveness. When wastewater is disposed in the river water it consumes the dissolved oxygen of the river water for the satisfaction of its BOD. This reduces the Dissolved Oxygen (D.O) of the river water. If the D.O goes below 4 p.p.m. almost all the fish and the other aquatic life shall be destroyed. The died fish will become organic matter that will further decompose and put more BOD and ultimately the whole of the DO of the fresh body of water shall be exhausted and it will convert into a polluted stale stinking useless body of water.