Microbiology of Sewage

Sewage has been defined as the used water supply of a community. It consists of the following materials: (i) domestic water-borne wastes, including human excrement and wash water, (ii) industrial water-borne wastes, such as acids, oils and animal and vegetable wastes, and (iii) ground, surface and atmospheric waters that enter the sewage system. The sewage of a city is collected through a sewage system, which carries the used water to its ultimate point of treatment and disposal. There are three kinds of sewage systems: (i) sanitary sewers, which carry domestic and industrial sewage, (ii) storm sewers designed to carry off-surface and atmospheric waters, and (iii) combined sewers which carry all the sewage through a single system of sewers.

Sewage contains about 99.9 per cent water. The chemical constituents vary with the community, population, season and even in different periods of a day. The organic substances present in the water supply finally reach the sewage. Organic compounds are contributed through human excrement, and vegetable and animal wastes. Industrial wastes like slaughter house waste, paper mill waste, sugar factory waste are also mostly organic substances. The amount of organic matter present shows the strength of sewage, which is measured and expressed in terms of *biological oxygen demand* (BOD). The aerobic decomposition of the organic material in sewage results in oxidation of organic substances contained in it. This action is desirable, and the resulting product is called stabilized sewage. Microorganisms in sewage are of aerobic, anaerobic or micro-aerophilic nature. As long as oxygen is available in the sewage, aerobic microbial decomposition will occur. The amount of oxygen absorbed during this process is expressed as the BOD. In the laboratory, BOD test is performed by diluting a sample of sewage with water containing a known amount of dissolved oxygen; the container is tightly stoppered and incubated for a period of 5 days at 20°C; then the amount of oxygen remaining is determined, and from this the amount of oxygen consumed is calculated. The results are expressed in ppm; for medium or strong sewage it is 100 ppm or less. This procedure does not determine the total absolute oxygen demand, but it does measure the more readily oxidizable substances that are of great importance. Thus, BOD provides the best information concerning the strength of sewage and the efficiency of sewage treatment process.

Since sewage is a variable mixture of substances, its microflora will fluctuate both in quantity and quality. Raw sewage may contain millions of bacteria per ml. Prominent among these are coliforms, streptococci, anaerobic spore formers, the *Proteus* group, and other types which have their origin in the intestinal tract of man. Sewage is also a potential source of pathogenic intestinal organisms. The poliomyelitis, hepatitis and adeno viruses have been shown to occur in sewage, and the bacteriophages can be readily isolated from it. An analysis of sewage for microflora gives an idea of epidemiology as well as the variations in the population and their characteristics. All these organisms help in decomposition of organic matter in the sewage. There is also a shift in the types of microorganisms during the course of sewage decomposition. Initially, aerobic and facultative organisms predominate. This is followed by strict anaerobes, especially methanogenic bacteria

which convert H_2 and CO_2 to CH_4. Methane gas can be entrapped and used as an alternative power energy source.

Small amounts of sewage discharged into a stream or large body of water are diluted enough; as a result, aerobic conditions are obtained. Organic matter in sewage is almost completely oxidized by microorganisms under aerobic conditions. This action is desirable and yields inoffensive products, and the sewage is stabilized. Aerobic microorganisms thus consume oxygen during the oxidation of organic matter in sewage. Large amounts of sewage introduced into a body of water do not get diluted sufficiently. Microorganisms use up all the oxygen in the water to oxidize organic matter. As a result, conditions become highly anaerobic. Flora and fauna soon die; foul odours are produced because of incomplete decomposition, and the water becomes useless for drinking or for other purposes.

The sewage treatment and disposal may be classified into (i) disposal of untreated sewage by dilution, (ii) primary treatment which removes part of the suspended and floating solids, and (iii) secondary treatment usually preceded by primary treatment, designed to provide some means of satisfying the oxygen demand.