STREAM QUALITY AND ITS SELF PURIFICATION PROCESS

The self-purification of natural water systems is a complex process that often involves physical, chemical, and biological processes working simultaneously. The amount of dissolved Oxygen (DO) in water is one of the most commonly used indicators of a river health. As DO drops below 4 or 5 mg/L the forms of life that can survive begin to be reduced. A minimum of about 2.0 mg/L of dissolved oxygen is required to maintain higher life forms. A number of factors affect the amount of DO available in a river. Oxygen demanding wastes remove DO; plants add DO during day but remove it at night; respiration of organisms removes oxygen. In summer, rising temperature reduces solubility of oxygen, while lower flows reduce the rate at which oxygen enters the water from atmosphere. When sewage of concentration Cs flow at a rate Qs into a river stream will concentration Cr flowing at a rate QR the concentration C of the resulting mixture is given by

\[ C = \frac{(CsQs + CrQr)}{(Qs + Qr)} \]

This equation is applicable separately to concentration of different impurities, such as oxygen content, BOD, suspended sediments & other characteristic contents of the sewage.
FACTORS AFFECTING SELF PURIFICATION

a. **Dilution**

When sufficient dilution water is available in the receiving water body, where the wastewater is discharged, the DO level in the receiving stream may not reach to zero or critical DO due to availability of sufficient DO initially in the river water before receiving discharge of wastewater.

b. **Sedimentation**

The settable solids, if present in effluents will settle down into the bed of the river, near the outfall of the sewage, thus helping in the self-purification process.

c. **Sunlight**

The sunlight has a bleaching & stabilizing effect on bacteria. It also helps to derive chlorophyll containing micro-organisms to derive energy from it & convert themselves into food for other forms of life. Thus absorbing CO2 & releasing oxygen by process known as photosynthesis. The release (evolution) of oxygen in river water due to sunlight will help in achieving self-purification through oxidation.

d. **Oxidation**

The oxidation of the organic matter present in sewage effluence will start as soon as the sewage outfalls into the river water containing dissolved oxygen. The deficiency of oxygen so created will be filled up by the atmospheric oxygen. The process of oxidation will continue till the organic matter has completely oxidized. This is the most important action responsible for effecting self-purification.

e. **Reduction**

Reduction occurs due to hydrolysis organic matter settled at the bottom either chemically or biologically. Anaerobic bacteria will help in splitting the composition of organic constituents of sewage into liquid & gases & thus paving the way for their ultimate stabilization.
Factors on which these natural forces of purification depends

a) Temperature

b) Turbulence

c) Hydrographs such as velocity, surface expands of the river

d) Available dissolved oxygen & the amount & the type of organic matter present.

e) Rate of reaeration etc.

a) Temperature

 Besides affecting the dilution & sedimentation rates, the temperature also affects the rate of biological & chemical activities which are enhanced at higher temperature & depressed at lower temperatures. The dissolved oxygen content of water, which is very essential for maintaining aquatic life & aerobic conditions, is also influenced by temperature. At higher temperature the capacity to maintain the DO concentration is low, while the rate of biological & chemical activities are high, causing rapid depilation of DO. This is likely to lead to anaerobic conditions, when the pollution due to participle organic matter is heavy.

b) Turbulence

 Turbulence in the body of water helps in breaking the surface of the stream or lake & helps in rapid recreation from the atmosphere. Thus it helps in maintaining aerobic conditions in the river stream & in keeping it clear. Too much of turbulence, however is
not desirable because it scours the bottom sediment, increases the turbidity and retards photosynthesis process (such as algal growth which is useful in reaeration process).

c) **Hydrography**

The hydrography affects the velocity and surface expanses of the river stream. High velocities cause turbulence and rapid reaeration, while large surface expands (for the same cubic contents) will also have the same effects.

d) **Amount & type of organic matter**

The amount & the organic matter & biological growth present in water will also affect the rate of self purification. Algae which absorbs CO2 & gives out oxygen is thus very helpful in the self purification process.

e) **Rate of reaeration**

That is the rate at which DO Deficiency is replenished will considerably govern the self purification & there will be no chances of development of anaerobic conditions.

The effect of wastewater on the water environment may be physical, chemical and biological. Physical effect includes increase in turbidity and suspended solids, addition of color, taste and odor producing substances, and formation of sludge banks on the beds and sides of the water bodies. Industrial wastes such as cooling waters from power stations, dyeing and printing wastes from textile industry, spent wash from alcohol distilleries etc raise the temperature of water in the receiving body and reduce the DO content in it. These conditions impart an aesthetically unacceptable appearance to the water, create an environment unsuitable for aquatic creatures such as fish, render it difficult to treat, and initiate the chain of chemical and biological effects.

Chemical effects include a drastic change in the pH value of the receiving water due to a discharge of acidic wastes such as mine drainages or alkaline wastes such as
textile wastes. High chlorides renders the water unacceptable as a source of drinking water, high sulphates, under favorable circumstances tend to form hydrogen sulphide and produce malodorous condition, nitrates and phosphates encourage algal and other aquatic growths, toxic and inhibitory substances either wipe out the aquatic life or severely limit its growth and reduce the available DO in the water. The DO may even become zero in the presence of a slag of oxygen-demanding wastewater.

Biological effects due to industrial wastes alone are not very serious because many of them do not contain pathogenic organisms that are present in domestic sewage. When industrial wastes are discharged in combination with domestic sewage, biological effects become significant although a large number of micro-organisms in the sewage are killed by unfavourable environmental conditions in the industrial waste. The physical and chemical effects have an adverse effect on the aquatic life, turbidity and suspended solids, along with color, cut-off penetration of sunlight into the water and reduce photosynthetic activity. Suspended solids can choke the gills of fish and kill them. Organic suspended solids settle to the bottom of the receiving body of water and in the presence of micro-organisms, decompose anaerobically. The products of anaerobic decomposition gradually diffuse to the upper layers of water and add to the total oxygen demand. Anions such as chlorides, sulphates add to the total dissolved solids content of the water and interfere with the metabolic process of micro-organisms. Nitrates and phosphates encourage enormous algal growth in the water.