Understanding Waste Management – Part 2

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Waste Water Management

Introduction to Waste Water

In this second part of our series we shall try to understand the issues and problems associated with the generation and pollution caused by waste water streams.

We know that water is essential in sustaining life on the planet. However water is equally essential to sustain all economic activities which also require use of water in significant quantity.

All the water which is used for any activity generates a used stream which we generally term as waste water stream. Some simple examples shall illustrate this aspect.

Personal use of water for bathing, washing, cooking, cleaning etc generates a used stream which is no longer clean water !! Therefore it is a waste water stream, and contains contaminants arising out of the particular activity, like dirt, soap, chemicals etc etc.

When metals are to be produced, water is first used in mining process, after wards in the ore processing, then in metal furnace cooling, metal process cooling etc etc. All these used streams shall be containing contaminants from the respective processes and are therefore waste water streams.

Similarly all other economic activities in all industrial sectors, eg Coal, Petroleum, Power generation, nuclear power generation, textile production and processing, food processing, Chemical Industry, Hotel and Restaurants, etc etc generate numerous types of waste water streams.

Impact on Environment

These used waste water streams contain contaminants which are present either in **dissolved** form like salts, or other soluble substances, or in **suspended** form like dirt, food particles, or other insoluble matter, or in **colloidal** form like micro particles or microorganisms , or as **emulsions** formed by mixing of oily substances, etc etc….When these streams reach the natural water bodies the contaminants present interact with the surrounding water body by physical, chemical and biological processes. These interactions consume the **Dissolved Oxygen (DO)** present in the water bodies, thereby reducing the DO content. This reduction in DO has an adverse impact on the aquatic life as Oxygen availability for sustaining life is reduced.

These waste streams also have numerous substances which are **Toxic** to the aquatic life, and also to the consumers of the water. The world has had many unpleasant experiences during the last century in all parts of the world due to the Toxic substances causing serious health issues to the consumers of water, and also serious damage to the aquatic life. Recent surveys have indicated huge quantities of plastic which has travelled into the oceans and is impacting the food chain of the marine eco system.

Early Efforts to Reduce Impact

As the mankind made progress, the waste water generation increased and so too its adverse impact. This also initiated efforts to control the adverse impact or pollution caused by various waste water streams. The initial efforts were aimed at characterising these waste water streams as per certain standard parameters like pH, TDS, TSS, BOD, COD, Color etc…explained as below :-

pH indicates if the water is acidic or basic or neutral, **TDS** = Total Dissolved Solids , **TSS** = Total Suspended Solids, **BOD** = Biological Oxygen Demand, **COD** = Chemical Oxygen Demand

The earliest waste water to be characterised and treated was sewage from human settlements. Efforts to treat sewage led to use of microorganisms like bacteria and algae in the treatment process. As the sewage contains mainly organic contaminants the microorganism develop and feed on the organic content and help in cleaning or treating the waste water stream. This led to the development of parameters like BOD, COD, TDS and TSS for measuring the quality of these waste water streams. The most popular and widely used process for treating sewage is called the **activated sludge process**, and

involves use of bio mass containing the required bacteria along with a dose of air (**oxygen**). After the aeration treatment step, the activated sludge is separated and reused, and the treated water is discharge to its destination.

Present Day Scenario

When Industrial development progressed, the principles of activated sludge process were also applied in treating the waste water streams generated from the industries. With years of efforts and optimization by various groups in various parts of the globe, a standard method for treating the industrial waste water is prevalent today. This method has three broad stages, viz **Primary treatment** steps comprising physical and chemical methods to make the waste water suitable for the next step ie. **Secondary treatment** step comprising biological method based on the principle of activated sludge process or its variants. Another step generally called **Tertiary treatment** follows based on specific requirements of treating the stream for certain contaminants, and could be combination of physical, chemical or electrochemical processes.

This somewhat standard philosophy is popular and prevalent as it is most economical and easy to operate.
For specific industries or applications, specialised treatment for certain streams to make them fit for this three step process, are undertaken. For example if a stream has Chromium as contaminant, treatment scheme to remove this Chromium content will be used, prior to sending this stream for the standard treatment process.

Alternative Methods

There are still many waste water streams or waste liquid streams which cannot be treated by the methodology described above. For such streams specific treatment processes need to be developed. Some of this methods are listed in the next paragraph.

Incineration & Thermal methods : There are certain processes which are based on destruction / conversion of these waste streams into harmless products This involves burning of the waste stream in presence of fuel at elevated temperatures to destroy the stream into harmless compounds like CO2, H2O, N2 etc, and absorbing the other combustion products in a scrubbing system using normally an alkaline aqueous solution. These are costly methods and are used only if no other economic scheme is feasible. Incineration is also used for gaseous and solid wastes. It also contributes to addition in carbon footprint by releasing CO2 into the atmosphere. Nowadays all the medical wastes from hospitals is incinerated. Many variants of the Incineration technologies have been developed based on the type of waste to be destructed, and are commercially available with branded technical names world wide.

Membrane based methods like Ultra- Filtration & Reverse Osmosis : When the waste water streams have mainly dissolved solids content as contaminants and with a medium concentration, membrane processes are used to get purified water. These methods contribute to generation of high TDS reject streams which need to be handled by costly methods like evaporation or Incineration etc. These processes are at many times used as the Tertiary stages in the standard three step process described earlier.

Future Focus & Emphasis on Resource Recovery & Reuse

Lot of research is ongoing and has taken place during the last couple of decades in developing new techniques based on developments in science and technology and their application into waste water treatment methods. These techniques are aiming at reduction in cost of treatment, improving the efficiencies of treatment, and reducing quantities of treatment rejects. Techniques based on **combination of chemical, physical and electrical and magnetic** methods are regularly being developed to address these challenges.

During the last decade the focus has shifted from mere treatment to **recovery of resources** from the waste water streams. With improvements in technology and IT methods it is now possible to recover certain resources from these streams , which were earlier not possible to achieve. This focus has substantially altered the economics of waste water treatment now as valuable resources like metals, minerals, etc are possible to recover. It is now feasible and economical to treat and recycle the sewage waste water entirely. This helps to conserve fresh water for the future generations. Mini sewage treatment units are now installed in housing complex or offices and totally recycle the treated water for gardening and toilet use.

With this approach in focus, now the waste water treatment can easily be considered as a **resource recovery and reuse strategy**.

In today's time the country should aim for total treatment of all sewage and recycle of recovered clean water for use. This alone will help to avoid the impending water crisis in the country.

Bye till the next issue.