# Water Treatment Process in Industries, Review Article

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**Abstract:**

Water plays a prominent role in our daily life, but humans are wasting large gallons of water for our daily needs and unnecessary needs either it may be for household or for commercial use. It is creating a huge negative impact on life on Earth.

Usage of water, is even more in industries, as a large amount of water is being wasted and the polluted water is released directly into rivers without treating it. Polluted water is a mixture of harmful chemicals and oils which are the key reasons for the extinction of aquatic life.

This review is all about the Water Treatment Process in Industries, by showing different methodologies used for treating or purification for sustainable development.

**Keywords**

Water treatment methods, Sustainability, Importance of water, Effect on environment, Oil Skimmers

## 1.Introduction

Water is very important source of life but it is misused for economic growth and even increase in population is one of the reasons. Many dams, reservoirs, tanks etc were built in many places for storage which helps for future use. Industrial usage of water is more in every country for economic growth and even in agriculture water plays a vital role.

Sewage water from household or wastewater is directly released into the rivers or seas where the water is mixed with different pollutants such as pathogens and different hazardous chemicals effects the environment.

70% of the earth's surface is covered with water and getting effected by human activities like leakage of oil from the ships or oil industries where whole oil is covered on water which damages the aquatic life.(1)

Due to advancement of many technologies, industrial growth is increasing rapidly day by day which is the leading factor of industrial pollution. Lack of policies or old policies, less water disposable methods, using more natural resources are creating huge chaos on earth.

The main problem is water which used in industries gets polluted mixed with many contaminants and harmful chemicals in it. Releasing the polluted water into rivers, lakes without treating it causes severe damage to plant, animal and human life. Burning of coal, oil, petroleum and others, the gases released from them are toxic as they mixed with atmosphere like vapours results in acid rains.(2)

Oil spill create severe damage to the eco system as it effects the life of aquatic animals depending on its damage. Oil spreads over the top layer of water, where it obstructs the sunlight to pass, cause respiration problems to under water animals, and other issues.

Oil spills are mostly occurred in seas and oceans, Mauritius oil spill is the recent example in the year 2020 as nearly 1000 tonnes of oil spill in Indian ocean as it stretched 15km long.(3)

Waste water is produced in all the industries for example in steel industry water is used for cooling, cleaning, transporting the waste materials, heat treatment, and other usages. Every waste that is produced in the industries and in households, should be treated accordingly to save the environment as industrial and pollution is main cause for the global warming.

Treating the waste water and other solid wastes have many advantages as the water can be reused for any other purpose like flushing toilets, fighting fires and solid waste can be recycled for the further use.

## 2.Methodology

### 2.1 Reclamation concepts

- Reclamation is the concept where the waste water is treated for other beneficial uses.
- Recycling refers to the re using the water generated in the same cyclic process.
- Reuse is usage of water in agricultural sectors, manufacturing industries and other.

### 2.2 Factors to reuse water

- Increase in population
- Water scarcity in urban and rural areas
- High demand of water in industrial and agricultural sectors and other reasons.

### 2.3 Water reuse methods

- Direct potable reuse is used for drinking water treatment plant.
- Indirect reuse is used as ground water which is treated.
- Non potable reuse where the water is used for many other purposes but not for the drinking. Water can be used in industries, public toilets, etc.

### 2.4 Advantages using treated water

- Fresh water will be conserved for the drinking purpose.
- Decreases the usage of ground water.
- Fulfils the public demands and less impact on environment.
- Leads to sustainable lifestyle.(4)

## 3. Introduction of different industries

**3.1 Primary industry:** goods are produced with help of nature. Agriculture, fishing and others come into primary industry sector.

**3.2 Genetic industry:** reproduction, multiplication or increasing the growth of the species of plants and animals for their profits. Poultry, cattle breeding, nurseries come under genetic category.

**3.3 Extractive industry:** mining, oil refining, coal etc come under extractive industry**,** Manufacturing, service, construction, are some other ongoing industries to meet the needs of the public.

## 4 Various industrial impact on water usage

In industries without water there is nothing to do, as water is used for manufacturing, cleaning, sanitising, and for cooling purpose in case of any machinery overheating.

(Figure 4.0)

### 4.1 Thermal power plant:

Thermal power plants nearly contribute 75% to 85% in discharging the waste water. Zero Liquid Discharge (ZLD) should be achieved in thermal plants as it is introduced by Ministry of Environment, Forest and Climate change.ZLD is the process where the waste water is treated and helps to reuse in many other ways, it seen in steam power industries as these industries are coal fired power plants where large amount of water is required in cooling, quenching of ash, scrubbing etc. (5)

Due to Flue Gas Desulfurization (FGD) in power plants, heavy metals are introduced which are very harmful like mercury, mixture of dissolved solids, arsenic and many other which are creating large impact on the environment.

### 4.2 Distillery Industries

Alcoholic beverages are produced using sugarcane molasses, argo products, cereals. In these industries coloured waste water is produced because of fermentation and distillation process and it is also one of the major polluting industries(6). Nearly 70 to 100 litres of waste is produced for 1 litre of alcohol. Stillage, cooling water, condenser, are the sources for waste water.Methanogenesis (biomethanation) is the two stages of biological process used in the distillery industries for treatment of the water.

### 4.3 Tanning industry

Leather is produced in these industries from hides and skins of the animals. Curing, soaking, bating, wringing sorting, and other processes are used to produce leather. During these processes many chemicals are used in each stage such as sodium chloride, sodium sulphide, caustic soda, ammonium chloride and sulphate, petrochemicals, cadmium pigment, lead chrome pigment and many other are used. (7) Due to usage of such harmful chemicals, water is polluted and causes skin problems to workers in the industry and creates harmful impact on the environment. Rotating drums, chrome recovery, screening operations, equalization and sulphide oxidation and other techniques are used in the waste water treatment in the tanning industries.

### 4.4 Pulp and Paper industry

Wood and fibre (recycled) are converted into the pulp and paper in these industries. Raw material process, wood yard, recovery of chemical, bleaching, paper production, products and recycling are stages of production process.Air is polluted due to emission of gases such as methanol, nitrous oxide, hydrogen chloride, sulphur dioxide, and other chlorinated compounds. (8)Waste water is also produced containing suspended sediments, chlorinated phenolics, phosphates and other harmful chemicals.Hydrolysis, Acidogenesis, Acetogenesis, Methanogenesis are the stages used in waste water treatment.

### 4.5 Automobile industries

In automobile industries water usage is more for manufacturing, washing, painting, coolants, etc. As for cleaning any product water jets are used where lot of water is being wasted as some of the workers don't know the value of water. Reference of some studies, to manufacture a car nearly 40000 gallons of water is used and 80000 litres of water for tyre manufacturing. In automobiles, water is mixed with harmful chemicals and with oils, many techniques were introduced for separating oil from water. In figure (4.4) shows that usage of water in automobile industries.

(Fig4.5)

**Automobile companies urging for sustainability**

| COMPANY NAME | INITIATIVES |
|---|---|
| | |
| TOYOTA | Usage of rain water |
| VOLKSWAGEN | "Think blue factory" initiative |
| Ford motors | Innovative and updating water usage strategies |
| Hero motors | Treated water used in cooling towers |
| BMW | Using more renewable energy |
| Hyundai | Dry wash initiative |

### 5 Waste water treatment plants in industries

- Effluent Treatment Plants (ETP): This treatment process is highly used in big companies of pharma and many manufacturing industries used to treat toxic substances present in the waste water. Evaporation, Filtration, Drying and other techniques are used in the ETP process. (10)
- Sewage Treatment Plants (STP): Physical, Chemical, Bio methods are used for treating wastewater from the household.
- Common and Combined Effluent Treatment Plants (CETP): These plants are used in the medium scale industries as these are less in cost compared to ETP.

### 6 Conventional techniques to treat waste water

### 6.1 Physical methods

- Sedimentation is a process where solids or heavy bodies settle down from its suspension, it is also called as 'Clarification'.

- Screening is the process where the large bodies such as plastics, papers, or any other substances are separated for the treatment process.
- Aeration process helps to enter oxygen into the water, helps in removing dissolved gases and removal of CO2
- Filtration is important where it stops the solid particles flowing in the water, were only fluid entered for further steps. (11)
- Skimming is removal of small particles of oil, grease which floats on the water.
- Degasification where the dissolved gases are removed in fluid or aqueous solution.
- Equalization helps to maintain the flow of fluid consistent.

### 6.2 Chemical methods

- Sodium hypochlorite is the chemical which is added in water to kill the viruses, bacteria and other harmful organisms present in the water
- Ozonation is the infusion of three oxygen atoms(O3) into the water. It is also called as advanced oxidation process destroys all the microorganisms.
- Neutralization is to achieve the required Ph value for the water treatment. It neutralizes acidity and alkalinity of polluted water.
- Coagulation is the chemical process where the suspended solids are removed in waste water. (Aluminium sulphate, Ferrous sulphate, Ferric sulphate, Ferric chloride are used as chemicals in this process)
- Adsorption is widely used in industrial waste water treatment where the atoms or molecules stick to the solid surface
- Ion exchange method is the reversible reaction, were ions are exchanged with similar electric charge ions present in the water.

### 6.3 Biological methods

- Aerobic water treatment: Oxygen is pumped to feed the organisms for organic matter, a cell called ‘protoplasm’ is developed from nitrogen, carbons, and some other gases which breakdown these contaminants.
- Anaerobic water treatment: Oxygen is not used and biodegradable materials are breakdown by the microorganisms widely used for industrial waste water and even for household.

### 6.4 Disadvantages in above treatment processes

- Sludge is formed in both the physical and chemical process, proper care should be taken to dispose the sludge and more space is required.
- In biological method time taken is more than chemical treatment, as the toxic substances helps to grow more and more microorganisms.

### 7.0 Introduction of Oil Skimmers

Oil skimmers are used to remove the oil from the surface of the water caused by oil spills. These are designed in different types as per the usage(12). Manufacturing industries use these to remove oil from coolants and from used water for cleaning.

### 7.1 Types of Oil Skimmers

**7.2 Belt:** These skimmers are commonly used for removal of oil, grease or others without any limitations in the thickness of the oils(13). These are less economic and highly effective.

(Figure 7.2)

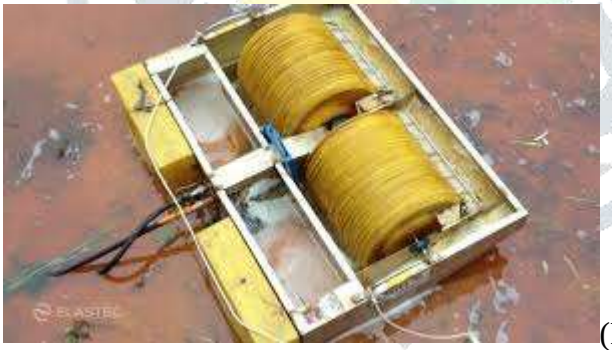
Limitations: 1. It cannot remove oil of low viscosity.

2. Belt should be changed at frequent intervals of time

**7.3 Disc:** These are circular in shape or a disc shape used to remove oils with high volumes, discs are made up of steel or aluminium and depends on the size and number of discs for the removal rate of oil(14). It is used in oils which have medium range of viscosity.

**(**Figure 7.3)

**7.4 Drum:** Drum type skimmer is placed on the liquid surface, as the drums starts rotating the oil sticks to it and it is pumped out, mostly used in oil spills(15). Efficient working in medium viscosity of oils and depends on number of drums and size for oil removal rate.



(Figure 7.4)

**7.5 Weir:** This is used in large surface areas such as rivers, oceans, etc where oil can be collected flow under and above the weir. (16)

(Figure 7.5)

### 7.6 Disadvantages in oil skimmers

- All the skimmers are different from each other so there will be variations in their efficiencies as Weir type skimmer is more efficient in removal of more volume of oil than others.
- Movement in the same direction as some skimmers have this disadvantage.
- Belt, Drum, Disc are called as Oleophilic skimmer, will work more efficiently in oily water but not mixture of different chemicals. In such cases Weir skimmer is used.
- Maintenance of these skimmers is very costly.

## 8 Conclusion:

- Treating the waste or polluted water for reusing purpose is the best way to save water either in industrial or household usage. Water scarcity is increasing day by day everywhere in the world, by using the different treatment techniques water pollution will be decreased and many lives can be saved.
- Industries should take proper care on chemicals which they are releasing into atmosphere or into rivers.
- Strict rules should be implemented by Central and State pollution control boards.
- Public awareness in schools, villages, universities about reuse of water by using any platforms such as social media.
- Plantation helps to reduce the dust and smoke in the air.

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