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Treatments on Industrial Effluents

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SUMMARY

The process of industrialization is adversely impacting the environment globally. Pollution due to inappropriate management of industrial wastewater is one of the major environmental problems particularly in India. With growing numbers of Small Scale Industries (SSIs), concern towards the ever increasing volume of the effluent generated has tremendously increased. This article deliberates the various treatments on industrial effluents to minimize the environmental impacts.

INTRODUCTION

Industrial wastewater treatment describes the processes used for treating wastewater that is produced by industries as an undesirable by-product. After treatment, the treated industrial wastewater (or effluent) may be reused or released to a sanitary sewer or to a surface water in the environment. The principal objective of industrial wastewater treatment is generally to allow industrial effluents to be disposed of without danger to human health or unacceptable damage to the natural environment. Industrial wastewater is generated as a consequence of industrial activities. There is a wide range of types of industrial wastewater (e.g. from processes, cleaning and cooling), with different types of pollutants. Most industrial processes use water in one way or another. Once used, the water has to be managed before being disposed of, regardless of whether it is returned to the natural environment or into the sewage network. Industrial wastewater can be managed until the discharge limits set by the local regulations are met, or it can be reused. For the former, the treatment must be sufficient so that the discharge has no detrimental environmental impact; and, if discharged into the sewage network, the wastewater physical and chemical properties must comply with current regulations. There is a third option for already treated industrial wastewater: re-use. Since water is a natural resource that should not be wasted, the most sustainable alternative is to treat wastewater until its quality is appropriate for re-use in the process. Environmental regulations, which are increasingly demanding, mean that re-use is the most competitive option in many cases.

Effluent Treatment Process

Preliminary Treatment

The purpose of preliminary treatment is to protect the operation of the wastewater treatment plant. This is achieved by removing from the wastewater any constituents which can clog or damage pumps, or interfere with subsequent treatment processes. They are designed to

- Remove or to reduce in size the large, entrained, suspended or floating solids.
- Remove heavy inorganic solids such as sand and gravel as well as metal or glass.
- Remove excessive amounts of oils or greases

Primary Treatment

The objective of primary treatment is the removal of settleable organic and inorganic solids. Approximately 25 to 50% of the incoming biochemical oxygen demand (BOD5), 50 to 70% of the total suspended solids (SS). It may be considered sufficient treatment if the wastewater is used to irrigate crops that are not consumed by humans or to irrigate orchards, vineyards, and some processed food crops. Primary sedimentation tanks or clarifiers may be round or rectangular basins, typically 3 to 5 m deep, with hydraulic retention time between 2 and 3 hours.

Working of Primary Process

Sludge from the primary sedimentation tanks is pumped to the sludge thickener. More settling occurs to concentrate the sludge prior to disposal. Primary treatment reduces the suspended solids and the B.O.D. of the wastewater.

Chemical Treatment Processes

Chemical treatment may be used at any stage in the treatment process as and when required

Neutralization-

Incoming untreated wastewater has a wide range of pH, and it is difficult to treat wastewater with such a high variability of pH. Neutralization is the process used for adjusting pH to optimize treatment efficiency. Acids such as sulphuric or hydrochloric may be added to reduce pH or alkalis such as dehydrated lime or sodium hydroxide may be added to raise pH values.

Precipitation-

For removal of metal compounds from the stream of wastewater, precipitation is carried out in two steps. Precipitants are mixed with wastewater allowing the formation of insoluble metal precipitants. Precipitated metals are removed from wastewater through clarification and/or filtration and the resulting sludge must be properly treated, recycled or disposed. pH is an important parameter to consider in chemical precipitation.

Secondary Treatment

The objective of secondary treatment is the further treatment of the effluent from primary treatment to remove the residual organics and suspended solids. High-rate biological processes are characterized by relatively small reactor volumes and high concentrations of microorganisms compared with low rate processes.

When the contamination is biodegradable, the removal of organic matter, nitrogen and phosphorus is feasible through this process, which is economical and efficient. Biological treatment can be aerobic or anaerobic, depending on the option of interest in each case.

- Active sludge: Biomass in suspension is an economical and efficient process, if space is available
- Sequencing batch reactor (SBR): A compact and discontinuous process, notable for its versatility and flexibility.
- Membrane bioreactor (MBR): It requires little space, is highly efficient and provides high quality effluent.
- Moving bed biofilm reactor (MBBR): Notable for having a fixed biomass, obtaining a high efficiency.
- Upflow anaerobic sludge blanket (UASB) reactor: This is particularly economical with high organic loads to be treated.

Trickling Filter

A trickling filter or bio filter consists of a basin or tower filled with support media such as stones, plastic shapes, or wooden slats. Wastewater is applied intermittently, or sometimes continuously, over the media. Microorganisms become attached to the media and form a biological layer or fixed film. Forced air can also be supplied by blowers but this is rarely necessary. The thickness of the biofilm increases as new organisms grow. Periodically, portions of the film 'slough off the media. The sloughed material is separated from the liquid in a secondary clarifier and discharged to sludge processing.

Rotating Biological Contactors (RBC)

Rotating biological contactors (RBCs) are fixed-film reactors similar to bio filters in that organisms are attached to support media. In the case of the RBC, the support media are slowly rotating discs that are partially submerged in flowing wastewater in the reactor. Oxygen is supplied to the attached biofilm from the air when the film is out of the water. Sloughed pieces of biofilm are removed in the same manner described for bio filters.

In case of toxic metals in the industrial effluent

The presence of toxic metals in the effluent prevents efficient growth of microorganisms and the process requires a long retention time. The advanced oxidation processes is gaining attention in the recent days due to the ability to treat almost all the solid components in the textile effluents. The photo-oxidation of the effluents is carried out using H_2O_2, combination of H_2O_2 and UV and Combination of TiO_2 and UV. Advanced oxidation process generates low waste.The effluents treated with advanced oxidation process were found to reduce 70-80% COD when compared to 30-45% reduction in biological treatment (Ghaly AE.*et.al*., 2014)

Tertiary Treatment

Tertiary and/or advanced wastewater treatment is employed when specific wastewater constituents which cannot be removed by secondary treatment must be removed. Individual treatment processes are necessary to remove nitrogen, phosphorus, additional suspended solids, refractory organics, heavy metals and dissolved solids.

Tertiary Treatment Process are-

- De-chlorination and disinfection
- Reverse Osmosis
- Ion Exchange
- Activated carbon–membranes.
- Ultraviolet (UV) Disinfection

Zero liquid discharge (ZLD)

ZLD refers to a treatment process in which the plant discharges no liquid effluent into surface waters, in effect completely eliminating the environmental pollution associated with treatment. Apart from this benefit, a ZLD process also makes effective use of wastewater treatment, recycling, and reuse, thereby contributing to water conservation through reduced intake of fresh water. Three-year target was set by the Indian government, known as the "Clean Ganga" project that imposes stringent regulations on wastewater discharge and compels high-polluting industries to move toward ZLD. India has extended ZLD to a range of industrial sectors including power, steel, pharmaceutical, chemical, textile, and food and beverage industries.

CONCLUSION

Water resources management exercises ever more pressing demands on wastewater treatment technologies to reduce industrial negative impact on natural water sources. Thus, the new regulations and emission limits are imposed and industrial activities are required to seek new methods and technologies capable of effective removal of heavy metal pollution loads and reduction of wastewater volume, closing the water cycle, or by reusing and recycling water waste. The implementation of ZLD systems is considered a significant strategy for industrial wastewater management that can diminish water contamination and enhance water supplies across the globe. Advanced oxidation processes (AOPs) are good alternatives for removal of toxic compounds from wastewater. Choosing the most suitable method of wastewater treatment studies require both increasing the effectiveness and economic efficiency (operating and investment costs).

REFERENCES

Ghaly AE, Ananthashankar R, Alhattab M and Ramakrishnan VV (2014): Production, Characterization and Treatment of Textile Effluents: A Critical Review. Journal of Chemical Engineering & Process Technology