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REVIEW ON WASTEWATER EFFLUENTS FROM PHARMACEUTICAL COMPANIES

KEYWORDS: Pharmaceutical wastewater, effluent, chemical process

R.B.Parmar	R.S.Patel	K.P.Mistry
Assistant Professor, Civil Engg. Dept., Babaria Institute of Technology, Varnama	Assistant Professor, Civil Engg. Dept., Babaria Institute of Technology, Varnama	Assistant Professor, Civil Engg. Dept., Babaria Institute of Technology, Varnama

ABSTRACT *Pharmaceutical waste is one of the major complex and toxic industrial wastes. The pharmaceutical industry employs various processes and a wide variety of raw materials to produce an array of final products needed to fulfill national demands. Generation of wastewater in industrial processes is sometimes unavoidable and in most of the cases a process to reduce the organic load. To remove part of the organic load, biological processes are usually used, because they are more economic than chemical processes. Many researchers have tried to find out different treatments for pharmaceutical wastewater to approaches worldwide; here an attempt is made to review some such researches done, with particular reference to Pharmaceutical wastewater effluent, in India and abroad also.*

This paper reviews various treatment methods for treating pharmaceutical waste water. Reviews from various researcher are referred in this study for various treatment methods of pharmaceutical waste water. These methods are broadly categorized into physico-chemical, biological and advanced oxidation processes.

INTRODUCTION:

In a growing world, it is necessary to treat Pharmaceutical wastewaters using environmentally green technologies. Current technologies often employ man-made chemicals as the primary treatment agent, but there are growing concerns and problems associated with the residual effects of putting more chemicals in wastewater. Displacing these chemicals with economic, environmentally friendly processes offers a significant market opportunity.

Pharmaceutical wastes are the one which result from Pharmaceutical processing operation.wastewaterinclude liquid, solids and gases, but presently concerned with the liquid part which is commonly known as Pharmaceuticalwastewater.The wastewater are treated before their discharge environment. In pharmaceutical industries wastewater is mainly generated through the washing activities of the equipment's. Though the wastewater discharged is small in volume, is highly polluted because of presence of substantial amounts of organic pollutants. Level of wastewater pollution varies from industry to industry depending on the type of process and the size of the industry.

Rapid industrialization has resulted in the rise of pollution. To preserve the high quality of the environment new concept are to be adopt in which waste minimization is being introduced, technology designed to prevent waste emission at the source of generation itself. Developing low cost technology for wastewater treatment offers an alternative and has been found to be most effective for treatment of industrial wastewater. Cleaner Production is one of such strategy in which one can improve environmental management strategy, which promotes eliminating waste before it is created to systematically reduce overall pollution generation and improve efficiencies of resources use.

Effluent Treatment Plants (ETP) are used by companies in the pharmaceutical industry to purify wastewater and remove pollutant from it. These plants are used by all companies for environment protection.

Pharmaceutical industry represents a range of industries with operation and processes as diverse as its product. Hence effluents coming from pharma industries vary from industry to industry. Thus it is almost impossible to describe a typical pharmaceutical effluent because of such diversity. Waste water is generally evaluated in terms of temp, pH, Total suspended solid (TSS), BOD, COD, Oil & grease, chlorides and sulphates.

Various treatment methods for wastewater found in the literature have contributed greatly to our knowledge regarding the fate of these compounds in different treatment systems. Generalizing compound behavior in these systems would allow further characterization of the fate and risk associated with water in the environment, yet this description of trends is hindered by the wide variation in removal efficiencies across therapeutic classes, treatment processes, and even among separate studies for the same individual compounds.

The majority of studies summarized used "removal" to describe the elimination of parent pharmaceuticals. The disappearance of the parent compound cannot be considered synonymous with complete removal. If adequate controls for physical and chemical removal mechanisms are in place, the loss of the parent compound indicates biotransformation of an unknown degree and not necessarily mineralization. Only monitoring for metabolites or end products of mineralization can provide information about the degree of biotransformation. The wastewaters from pharmaceutical manufacturing plants is more problematic due to number of different treatment method. Following are few research studies based on treatment methods for pharmaceutical waste water.

REVIEW:-

Chelliapan S and Golar S (2011), their study has demonstrated that the up-flow anaerobic packed bed reactor can be used effectively as an option for pre-treatment of antibiotic wastewaters that contain antibiotics.

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A. M. Deegan (2011),their paper concludes by showing that the problem of pharmaceuticals in wastewaters cannot be solved merely by adopting end of pipe measures. At source measures, such as replacement of critical chemicals, reduction in raw material consumption should continue to be pursued as the top priority.

Sudhir Kumar Gupta and Sunil Kumar Gupta(2006)highlighted on treatability study of almost all kinds of waste streams that indicated the waste is biologically treatable. Hence, a combination of physical, chemical, and biological processes seem to be feasible for the treatment of pharmaceutical wastewater. A two-stage biological system or a combination of aerobic and anaerobic processes proved effective for some pharmaceutical wastewater. Keeping in mind the varying characteristics of pharmaceutical wastewater, the shock loading capacity of the treatment units must also be given much attention in identifying and evaluating the technical feasibility of the processes. After identifying the technical feasibility of the processes, the final selection should be made based on economic analysis.

Gome A. and Upadhyay K. (2013), theirstudy deals with the treatment of pharmaceutical industry wastewater by ozone. An attempt has been made to assess the biodegradability of the selected pharmaceutical wastewater sample. It was found that higher treatment time favored the enhancement of biodegradability of selected sample. It can be concluded that ozone treatment can improve biodegradability of pharmaceutical wastewater.

Prashant K. Lalwani,Malu D. Devadasan (2013), their experiments conclude that conventional biological treatment of the common effluent treatment plant (CETP) should be replaced with physico-chemical process like advanced oxidation process. The study showed that among the two oxidants Sodium Hypochlorite and Fenton's reagent, the latter is the most efficient as the maximum COD and BOD reduction was observed for this oxidant.

Hannah Briers, Paul J. Sallis, Ali Yuzir, Norhayati Abdullah, S. Chelliapan (2012)stated that the treatment of the antibiotic wastewater with various different AOP (advance oxidation process) combinations proved to be successful in the removal of COD and TOC. An increase in sulphate concentrations was also witnessed. H2O2 concentrations were experimented with for the O3/H2O2 combined AOP. Although O3 is able to produce H2O2 alone by the breakdown of organic matter, it was concluded that the addition of H2O2 artificially to the system greatly accelerated the formation of the hydroxyl radicals necessary for the efficacy of the system and allowed shorter contact times.

Amit Kumar Tiwari and Vijay Kumar Upadhyay(2013) conclude that Fenton's oxidation enhances the biodegradability of Aqueous Mother Liquor Effluent (AMLE) which further treated by coagulation and Activated Sludge Treatment Process (ASP). The biodegradable organic matter present in waste water removes in ASP by biosorption, biooxidation including nitrification and bioflocculation but due to the high organic load, biorecalcitrant compound, surfactants or biotoxicity in the Activated Sludge Treatment Process (ASP) did not perform effective treatment as a result we obtained biologically treated effluent with high COD, TSS and TDS value, loss of biomass in treated effluent, biomass rupturing in aeration tank and poor settling of biomass in secondary clarifier. Therefore to deactivate the property and to prevent shock loading and to improve the biodegradability for ASP the Advanced Oxidation played very important role.

Nora San SebastiánMart´ýnez, (2003) express the Operational parameters influencing the Fenton's reaction in the pre-oxidation of an extremely polluted wastewater have been studied by means of an experimental design, in which the factors considered were temperature, ferrous ion and hydrogen peroxide concentration. The temperature only showed a mild positive effect on COD removal. Consequently, temperature should not be considered in the optimization of the Fenton's reaction for this wastewater. This finding is of special interest in the industrial application of Fenton's reagent, because it permits a significant COD reduction in a very short period of time.The results here presented can be considered as an effective pretreatment of this type of wastewaters, when direct biological treatments are not possible.

N.ASWINI, V SRIDEVI (2014) highlighted the Electro coagulation is a treatment process that is capable of being an effective treatment process as conventional methods such as chemical coagulation. It observed trends over the last years, it has been noted that electro coagulation is capable of having high removal efficiencies of colour, chemical oxygen demand (COD), bio chemical oxygen demand (BOD), and achieving a more efficient treatment processes quicker than traditional coagulation and inexpensive than other methods of treatment such as ultraviolet (UV) or ozone.

SayyedHussaina, ShahidShaikha and MazaharFarooquib (2011)compared the advanced oxidation processes (AOPs) utilizing H2O2/Fe+2, Fenton reactions were investigated inlab-scale experiments for the COD degradation of different waste water streams of ActivePharmaceutical Intermediates -ISMN (Isosorbide 5- Mononitrate) . The experimental resultsshowed that the Fenton process using H2O2/Fe+2 was the most effective Pretreatment processfor waste water streams before Activated sludge process. With Fenton processes, CODReduction of wastewater can be achieved successfully. It is suggested that Fenton processes areviable techniques for the degradation of Active Pharmaceutical Intermediates- ISMN (Isosorbide5- Mononitrate) waste water stream with relatively low toxicity of the by-products in the effluentwhich can be easily biodegradable in the activated sludge process, and other less degradedstreams with high total dissolved solids can be taken to multiple effect evaporator or Reverseosmosis.

Dr. A. Ried, M. Kampmann (2006) stated that advanced COD reduction is required and an existing biological treatment does not achieve the limits given by existing or new regulations, several options are available to achieve lower COD levels. During ozonation of waste waters the generation of hydroxyl radicals takes place without using additional arrangements. A certain balance between direct ozone reactions and radical reactions will appear. Whether an additional enhancement by UV or H2O2 is actually promising, has to be evaluated separately.

Ahmad Ashfaq and AmnaKhatoon (2014)concluded that there are various conventional treatment processes available for treating pharmaceuticals in waste water. In addition there are a number of promising new treatments including AOPs such as oxidation, ozonation, perozonation, direct photolysis, TiO2 photocatalysis, solar photocatalysis, and Fenton reactions ultrasonic irradiation. These significantly enhance the removal rate of pharmaceuticals from wastewaters. Comparisons among these technologies are prob-

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lematic since most researchers used synthetic water rather than actual wastewater samples.

M.P.D.PRASAD (2014), mentioned in his study,the biological treatment which requires specific conditions, therefore limiting the ability to treat many wastewaters with high toxicity, pH and electro- coagulation can be used to treat multifaceted wastewaters, including industrial, agricultural, and domestic. Continual research using this technology will not only improve its efficiency, but new modelling techniques can be used to predict many factors and develop.

Prof. V.C. Renge , Prof. S. V. Khedkar , Miss. Khushabu S. Bhoyar (2012) concluded thatthere are a number of promising new treatments including AOP's such as oxidation, ozonation,direct photolysis, TiO2 photocatalysis, solar photocatalysis, Fenton reactions and ultrasonic irradiation. These significantly enhance the removal rate of micropollutant from wastewaters. Comparisons among these technologies are problematic since most researchers used synthetic water rather than actual wastewater samples. Research is required in this area to improve treatment efficiencies, identify degradation compounds and to determine the cost and feasibility of full-scale applications. There is also interest in coupling AOPs with more conventional treatments such as activated carbon. Finally, the problem of micropollutant in wastewaters cannot be solved even if it is considerably alleviated - merely by adopting end of pipe measures. At-source measures like replacement of critical chemicals, reduction in raw material consumption should continue to be pursued as the top priority.

Dr. J. Mielcke (2006) stated that the best available advanced oxidation process (AOP) depends on the waste water conditions and the treatment goals by taking also the actual cost into account. As advanced treatment of municipal and industrial waste waters the use of ozone and probably AOP (Advanced oxidation process) enables to meet future water clarification and recycling standards in an economic feasible way. Especially the existing regulations for COD and the possible future regulations for different kind of persistent substances, e.g. industrial chemicals, ozone / H2O2.

CONCLUSION:-

The pharmaceutical industry is one of the most important for modern civilization. The life of millions of humans and animals depends on the life-saving medicines manufactured by these industries. Apart from this, pollutants are also generated during the manufacturing process of medicines.Therefore, an increasing number of pharmaceutical industries lead to hazardous impact on water quality and thus affect the surrounding environment and human health. Thus, the pharmaceutical industry has become one of the major causes of concern. The day by day increased level of water pollution highlights the need for time to time assessment/characterization of pharmaceutical industrial wastewater. Due to the rapid decrease in the level of water resources and increasing demand of water for consumption in our daily life, it is necessary to reuse the wastewater by developing a sustainable treatment process to clean up contaminated wastewater economically and safely, which could be easily adopted by the common masses.

Various treatment methods for pharmaceuticals wastewater found in the literature have contributed greatly to our knowledge regarding the different treatment systems. The majority of studies summarized is used to "removal" the describe elimination of parent pharmaceuticals. Generalizing compound behavior in these systems would allow further characterization of the fate and risk associated with pharmaceuticals in the environment, yet this trends is hindered by the wide variation in removal efficiencies across treatment processes, and even among separate studies for the same individual compounds. If adequate controls for physical and chemical removal mechanisms are in place. The pollutants generated during the manufacturing process are easier to handle, as an industry is a point source of pollution and it is possible to install pollutant specific treatment facilities.

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