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Study of Various Technologies Available For Treatment of Dairy Wastewater- A Review

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Abstract— Dairy industries have shown tremendous growth in size and number in most countries of the world. These industries discharge wastewater in huge quantity which is characterized by high chemical oxygen demand, biological oxygen demand, nutrients, and organic and inorganic contents. Such wastewaters, if discharged without proper treatment, severely pollute receiving water bodies. In this review paper, various recent technologies of dairy wastewater have been discussed. The wastewaters discharged by raw milk quality control laboratories are more complex than the ones commonly generated by dairy factories because of presence of certain chemicals such as sodium azide or chloramphenicol, which are used for preserving milk before analysis. Pretreatment of effluents consists of screening, flow equalization, neutralization, which are normally followed by biological treatment. If space is available, land treatment or pond systems are potential treatment methods. Other possible biological treatment systems include activated carbon, packed bed filters, electrocoagulation, reverse osmosis techniques, Biofilms.

Keywords— Dairy Industry, Dairy Effluent, Recent Technologies, Pollution impacts.

I. INTRODUCTION

Milk demand increase with increase in population, large quantity of wastewater produced from dairy industrial operations. The organic substance in wastes comes directly in same form or in degraded form. Sources of dairy wastewater are from receiving stations, boiling plant, cheese plant, butter and dried milk plant as well as from can washing plant. Dairy wastewater is organic in nature so when dairy wastewater directly discharged into river or stream then deficiency in oxygen level may get occur. Dairy wastewater have highly pungent odour and that is biologically active. Due to variations in discharge flow of dairy wastewater it is necessary to provide equalization tank with provision of aeration tank which will reduce BOD level up to 50%. Food industry have a largest water consumption industry in addition they generate large amount of sludge through operation process. The organic loads in terms of high BOD and COD values so as well as large amount of oil and grease. Some automated cleaning systems generated wastewater of P^H 12 to 13. So that in order to reduce effect of dairy wastewater on environment it is important to choose advance techniques. The dairy wastewater treatment process is based on five principles. 1) Screening 2) Oil and Grease trap 3) Flow Equalization 4) Activated Sludge Process and Tertiary Treatment with minimization of pollution index, wastewater volume reduction, wastewater strength reduction. Equalization and neutralization of wastewater those terms also effects on treatment of wastewater generated from dairy industry those considerations not only in terms of treatment but also an opportunity to reduce cost and increase efficiency of process and profit. The provision of effluent treatment plant with primary, secondary and tertiary treatment helps to avoid ill effect of discharged untreated effluent into environment with maintain pollution free environment. The purpose of review paper is to describe various technological options available for treatment of wastewater with technological efficiency and finding out new alternatives for effective treatment for dairy wastewater.

II. LITERATURE REVIEW

Javed Iqbal Qazi *et al* (2011) studied, biofilm support media including foam cubes, bamboo rings, fire bricks, PVC rings and gravels were employed to immobilize biomass for reduction in BOD5, COD and VSS of dairy wastewater in batch and repeated batch cultivation systems. He considered Main factors like efficiency of COD removal is associated with nature and properties of support material for effective results. Maximum percentage removal of COD, BOD5 and VSS turned out to be as 96 %, 93 % and 90 %, with application of 21 Kg COD/m3/d loading in batch reactor filled with gravels. Further he stated that dynamics of repeated batch evaluated in three cycles indicated that almost 89% reduction of volatile suspended solids (VSS) occurred after 12 d hydraulic retention time (HRT) in each cycle and results evaluated under bio treatment process for high conversion of organic fraction to combustible methane gas for successful completion of experiment Material and method selected as inoculum development and bacterial activities for treatment of dairy wastewater.

Indrajit N. Yadav (2014) studied, performance packed bed bioreactor in batch and continuous process for treatment of dairy wastewater. He gives Aeration time26 hours and initial COD concentration was of 299 mg/l, removal efficiency was 73% for batch process and same aeration time and effluent COD concentration changed from 2991 mg/l to 1576 mg/l, removal efficiency increased to 81% while in a continuous process, at 26 hour hydraulic retention time, effluent COD concentration was 1576 mg/l and air flow rate 1 lpm. The average COD removal efficiency was 83%. He found that as HRT was reduced from 26 to 10 hour, removal efficiency decreased to 51%. COD removal efficiency in reactor without packing and compared with packed bed bioreactor. He used parameters in packed bed bioreactor like pH, COD concentration, temperature are same for activated sludge process (ASP). Result obtained for packed bed reactor showed that system effectively removed COD of dairy wastewater. In this experiment reactor achieved a COD removal efficiency of 83% at 26 hydraulic retention time (HRT) and an air flow rate of 1 lpm. Reactors in relation to HRT, Effect of hydraulic retention time on effluent suspended solids (SS) concentration and its removal efficiency and Effect of Organic Loading Rate on COD removal efficiency these factors considered in this research paper.

Abdul Salam and Tawfeeq Dawood *et al (2011)* studied, various phases of anaerobic treatment of synthetic milk wastewater which contain high concentrations of organic matter so that it need to be treatment prior to be discharge into environment. Author investigated degree of wastewater stabilization in terms of COD at variable temperature, organic loads and retention times, with and without providing additional seeds for treatment in batch reactor further he concluded that to process purification of drinking water and wastewater due to their large specific surface area and selective adsorption of substances, such as ammonia, dissolved organic matter and many other cations valid for organic matter expressed as COD (adsorption efficiency of fine-grained filter organo-zeolite, nitrate nitrogen and phosphate. Based on overall results of filtering effects of dairy industry wastewater, and taking into account filtration characteristics and effects of reduction of physical-chemical parameters of wastewater with 1.5 mm organo-zeolite grain size filters are to be useful which need to be combined with reactive filters of natural zeolites and other technologies for dairy industry wastewater treatment.

Ileana Mayela María and Moreno-Dávila *et al* (2014) focused on fermentative hydrogen production in packed bed batch reactors to assess influence of environmental factors over yield hydrogen production from dairy wastewater. Authors used dried stems of Opuntia imbricata as substratum adding a pretreated mixed culture for biofilm formation. Yield hydrogen production was significantly affected by initial COD concentration, temperature and dairy wastewater pH. Maximum yield obtained was 12.73 mm H2/g COD when initial COD concentration was 21.1 g COD, dairy wastewater pH with no adjustment and room temperature of 16 ± 3°C. Methane production was completely inhibit at an initial pH of 4 at all temperature studied with an initial pH of 11.32, exception for 16°C, methanogenic activity was not completely inhibit when final pH was over 5, showing an increase in methane production of 0.35 to 0.75 g CH4/l for 35 to 55°C.Pretreatment (acidic and thermal) of microbial mixed culture. Imbricate as substratum for biofilm formation under an acidic regime (4.0 to 5.0) con-tribute to achieve a complete inhibit of methanogenic activity and lead to an increase of yield hydrogen production.

Ana L. Torres-Sánchez *et al (2011),* studied that electrochemical treatment of dairy industry wastewater, in ice cream manufacturing using a combined system comprising of electrocoagulation (EC), Fenton reaction and ozone processing. Dairy industry wastewater is characterized by high biochemical oxygen demand (BOD5), chemical oxygen demand (COD), and other pollutants. Author investigated effects of operating parameters such as: applied current density (j), reaction time, hydrogen peroxide (H2O2), iron (Fe2+) and ozone dosage as a wastewater treatment method. Rectangular aluminium anodes and iron cathodes were used in parallel within an electrochemical device. Electrocoagulation is efficient and able to achieve a 40% COD removal at a current density (j) of 5 mA/cm2, he found that addition of a Fenton process to electrocoagulation further increases treatment efficiency close to 25% in at a ratio 1:1 H2O2/Fe2+.combination with ozone promotional system further contributes an additional 30% COD removal. He concluded that viability of coupled electrocoagulation with advance oxidation process processing as a reliable technique for removal of pollutants from ice cream manufacturing wastewater as part of dairy industry.

Mickael Vourch *et al* (2008) carried out experiment about water management of 11 dairy plants. Treatment of process water produced in starting, equilibrating, stopping and rinsing processing units was proposed to produce water for reuse in plant and to lower effluent volume. Reverse osmosis of such wastewaters, collected in dairy plants, was performed after a prior check of their stability during storage. Filtration performances focused on permeate flux versus water recovery and on water quality (TOC, conductivity).Reverse osmosis water similar to available vapour condensates achieved allowing this water to be reused for heating, cleaning and cooling purposes. A 540 m2 RO unit is required to treat100 m3/d of wastewater with 95% water recovery

Dr. C. B. Shivayogimath *et al* (2014) studied cost-effective treatment of dairy industry wastewater for environmental protection. He checked feasibility of electrocoagulation technology for dairy wastewater treatment. The batch experiments were conducted in

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electrocoagulation unit of 1.5L capacity with aluminium electrodes connected in monopolar parallel system with operating parameters such as pH, applied voltage and electrolysis time were used for investigation with emphasis on chemical oxygen demand (COD) and turbidity during study he found that 98.75% COD and 97.82% turbidity can be removed with vary short electrolysis duration of 10 minutes at applied voltage of 7V and pH 6.The energy consumption was also very less i.e. 0.00011kWh/kg COD removal and electrocoagulation process with monopolar parallel system appears to be feasible alternative for effective and economical treatment of dairy wastewater.

Ashutosh Pachpute et al (2011) studied that, consumption of large volumes of water and generation of organic compounds as liquid effluents are major environmental problems in milk processing industry. He examined wastewater samples For Constructed wetland Physico-chemical and organic parameters to determine quality and extent of pollution. pH, suspended solids, TDS, and significant reduction in parameters were observed. He stated that initially waste water sample was too alkaline but after treatment pH was observed near Neutral also TSS and TDS removal efficiency of 81% and 42%. In Constructed Wetland treatment process initially pH of Dairy waste sample was more alkaline but due to techniques implemented pH was brought up much near to neutral axis also removal efficiency of Total suspended solids is 81%, Total dissolved solid is 42%, so treated waste can be effectively used for irrigation and local purpose and he concluded that constructed wetland treatment process may prove to be a handy solution for organic effluents from food based industries

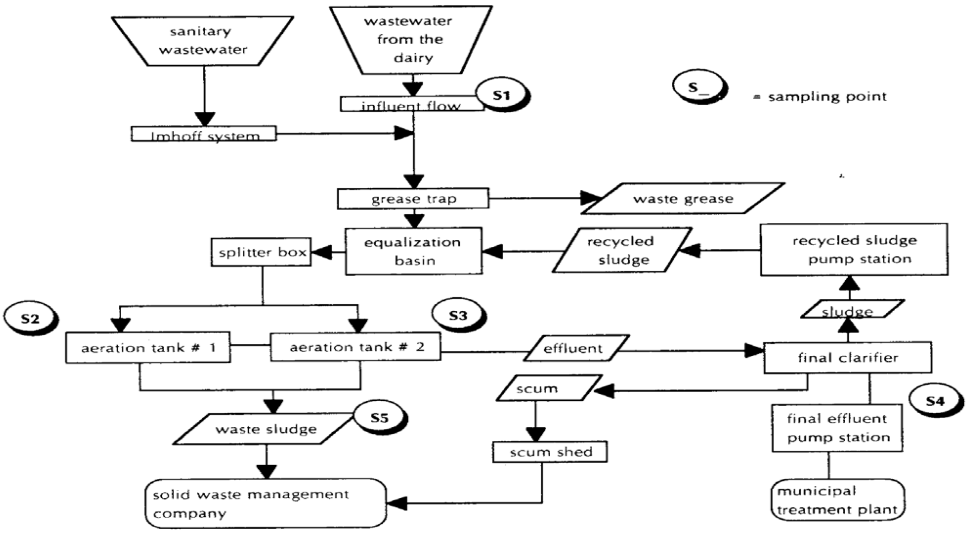

Fig 1: Effluent Treatment plant of Dairy Industry

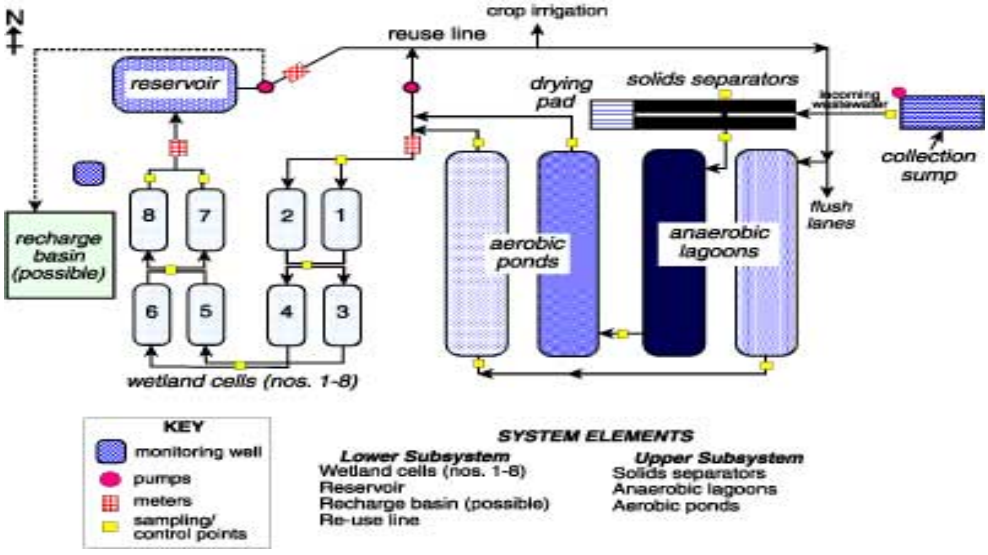

Fig 2: Reverse Osmosis Treatment in Dairy Industry

III.SUMMARY OF LITETATURE

After throughout evaluation of related literature, it can be revealed that most of treatment technologies are need to be combined with conventional treatment technologies. Certain experiments are done with treatment of activated carbon, packed bed filters, electrocoagulation, reverse osmosis techniques, Biofilms techniques. The paper has revealed current technological options related with treatment of dairy wastewater. The review empowers researchers to choose available technologies will not only improve the treatment efficiency but new treatment techniques can be used to design an economical and efficient wastewater treatment plant especially for dairy industry.

IV.CONCLUSION

The review work was aimed to study technologies available for treatment of dairy wastewater. It is concluded that due to variation in quality and quantity of dairy wastewater, all previous discussed treatment technologies need to be combine with conventional effluent treatment plant with tertiary treatment. We studied that, it is possible to reduce COD, BOD and other constituents from dairy wastewater with the help of advance technologies available. Above mentioned literature summarised that technologies like activated carbon, packed bed filters, electrocoagulation, reverse osmosis techniques, Biofilms techniques gives efficient treatment to dairy wastewater.

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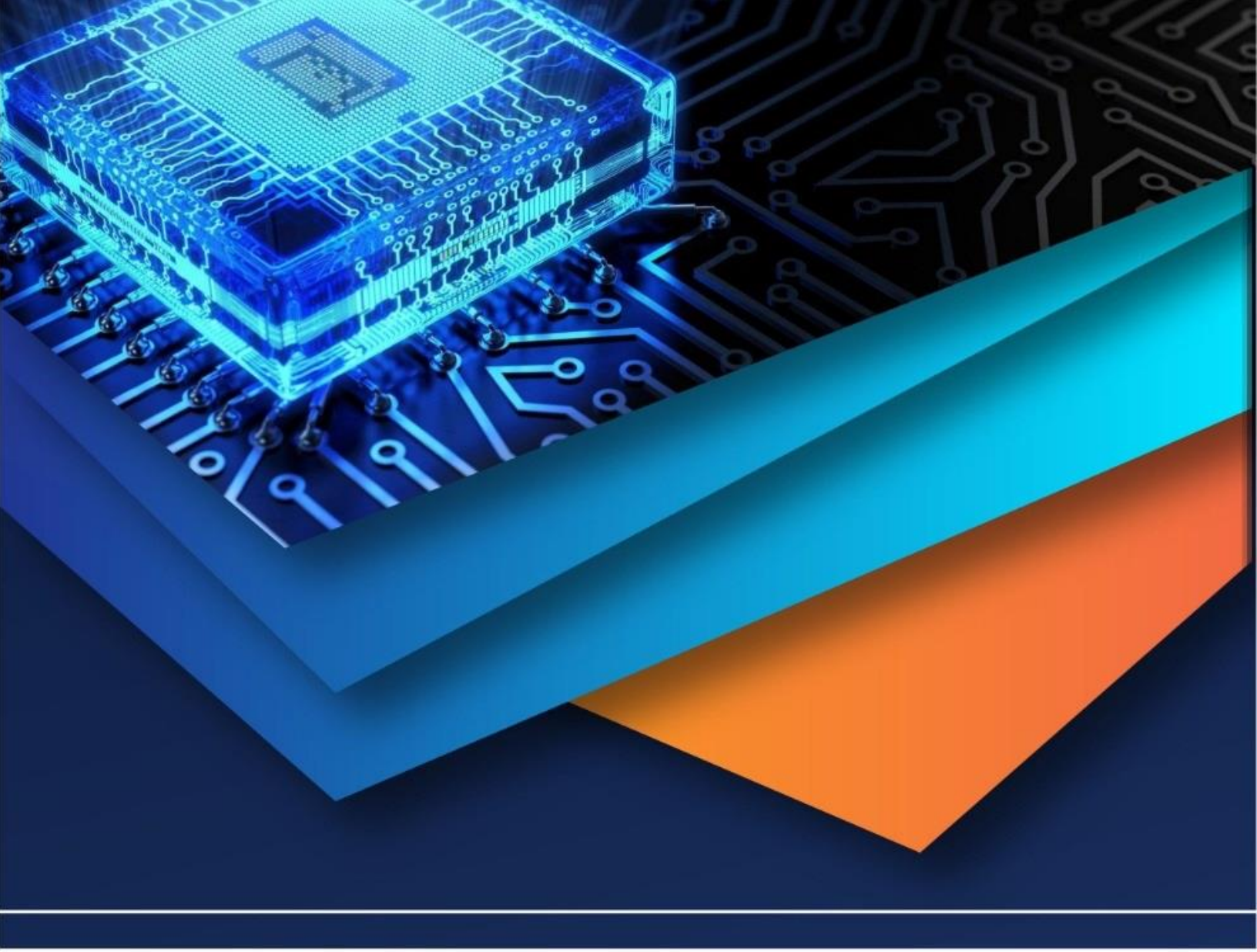

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