WASTE WATER ASSESSMENT AT A BEVERAGE UNIT IN LUCKNOW (A REVIEW)

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ABSTRACT

Water is used in most process industries for a wide range of applications. Processes and systems using water today are being subjected to increasingly strict environmental regulations on effluents and there is growing demand for fresh water. These changes have increased the need for better water management and wastewater minimization. The combination of water demand management and cleaner production concepts have resulted in both economic and ecological benefits. Beverage industry requires huge amount of fresh water, generating considerable amount of polluted waste water during different processes including drink production, washing bottles, plant washdown as well as washing the floors and the general work area. Most of the industries do not reuse the waste water and are consuming bulk of fresh water. The beverage industry is one of the major industries in India and the present study will be conducted on the beverage/soft drink industry at Kanpur road, Lucknow to assess the feasibility of reuse of wastewater form bottle washing plant by conducting treatment test, like dilution of the waste water in different ratios, reverse osmosis and ion exchange.

1.INTRODUCTION

Water pollution is a serious problem globally involving the discharge of dissolved or suspended substances into groundwater, streams, rivers and oceans. There are large variances in the percentage of water intake discharged as industrial effluent. This fact is due to the varying nature of products and processes. Generally anything from 50% to 80% of water intake is discharged as industrial effluent. This may account for up to about 70 percent of waste-water discharge which contains mainly sugars, sodium hydroxide and detergents. Effluent of this nature causes undesirable pH levels and high solid and organic loads. Since very few soft drink plants have on-site waste-water treatment facilities, municipal treatment works have to deal with the majority of this polluted effluent. The soft drink industry in India is significant both from a water intake and an effluent discharge point of view.

In addition to the water used in production, wastewater generation and disposal present another improvement opportunity for brewers. Most breweries discharge 70% of their incoming water as effluent. In most cases, brewery effluent disposal costs are much higher than water supply costs. In many communities, breweries may be the largest consumer of water and the largest source of organic effluent that must be treated by the municipal treatment plant. This presents unique supply and cost concerns. When combining that cost with treatment (physical and chemical) and effluent disposal costs, brewers are presented with a reflection of the true or full cost of water. The beverage industry brewing process generates large amounts of wastewater effluent and solid wastes that must be disposed of or treated in the least costly way to meet strict discharge regulations set by government entities. Brewery wastewater typically has a high biochemical oxygen demand (BOD) from all the organic components (sugars, soluble starch, ethanol, volatile fatty acids, etc.). Brewery wastewater usually has temperatures ranging from 25˚C to 38˚C. The pH levels can range between 2 and 12 and are influenced by the amount and type of chemicals used in cleaning and sanitation (e.g., caustic soda, phosphoric acid, nitric acid, etc.). Nitrogen and phosphorus levels are mainly dependent on the raw material and the amount of yeast present in the effluent. However, the beverage industries action

without any adequate treatment facilities has led to discharge of effluents into nearby rivers. The incoming industrial water that is to be used as product water (also called treated water) is treated to improve its overall quality. Again, systems may vary from plant to plant but the water treatment system generally used is described here. The incoming water is initially disinfected after which chemicals are added to remove alkalinity and to aid flocculation and settlement in the clarifiers. The sand filters remove suspended matter and finally activated carbon filters are used for the removal of taste, colour and odours as well as any excess chlorine and organic matter. The treated water is used in the product, for cleaning in place (CIP) and in their areas where water of high quality may be required.

2.LITERATURE REVIEW

2.1) Joel Tshuma et.al.(2016)[1] –According to these authors a detailed beverage effluent treatment technology was developed in a period of 4 months, using samples from an operating beverage plant. The total number of samples collected were 1304. The volume of the sample collected hourly was 500ml for 4 hours to give a composite sample. The plant operated continuously for 6 days a week and had two-12 hour shifts a day. The technology consisted of four water treatment methods combined consecutively which were chemical, physical, biological and physical treatment methods. The aim of developing the technology was to reduce the COD,BOD, TSS and pH parameters to the required environmental specification. The untreated beverage wastewater has high solids content, high organic matter, and low pH which need pretreatment before it is discharged into the municipal sewage treatment works. The developed technology reduced the high solid content, high organic load and adjusted the pH to the required Bulawayo Municipality environmental specifications. The average percentage reduction in COD and TSS was 91.1% and 90.6% respectively. The pH was adjusted to 8.05. The obtained results indicated that the developed technology was effective for treating beverage wastewater at ambient temperature to meet the quality of effluent that can be discharged into public water works.

2.2) Joe Beah et.al.(2017)[3] -This analysis of industrial effluents at Sierra Leone Bottling Company Limited (SLBC) in Freetown, the capital city of Sierra Leone were conducted to assess its composition, and removal efficiency of physio-chemical parameters. Fifteen (15) samples were collected from the drain water (influent), pretreatment effluent and treated effluent (effluent) for five days. There were significantly higher concentrations of influents parameters relative to those of the corresponding effluents. The influent levels were checked for pH, electrical conductivity and chloride were higher than permissible threshold. 80% of the samples at the influent point were within permissible guideline for TDS but all were in total agreement with the effluent samples for the same parameter. Comparative analyses showed significant reduction in values for pH, temperature, iron and chromium in the effluent samples relative to the influent samples and all of the other parameters did not show any statistically significant differences. The treatment plant was noted to be highly efficient in removing iron and chromium but least efficient for total dissolved solids and water temperature.

2.3) Marin Matosic et al.(2008)[6]-The paper reports on the results of treatment of wastewater from the bottling of water and soft drinks with a membrane bioreactor (MBR) pilot plant. The existing conventional activated sludge process could not produce effluent suitable for discharge due to significant fluctuations of wastewater composition and flow rate. MBR successfully removed pollutants measured as COD, BOD and TOC from the wastewater with an efficiency of over 90%. The main factors negatively influencing the MBR treatment were low biomass concentration which were significant in the case of highly polluted wastewater. Membrane fouling was more pronounced during the first 10 days of the filtration and then gradually slowed down. The most significant fouling was caused by scale precipitation, which was responsible for 70–80% of the loss of membrane permeability. After 60 days of continuous filtration, it was possible to restore the original permeability of the membrane through intensive chemical cleaning with hypochlorite, acid and alkaline solutions**.**

2.4) Emrah Alkayaa and Göksel Niyazi Demire (2015)[2] -The aim of this study was to investigate water conservation and reuse opportunities in a soft drink/beverage manufacturing company. Water use analysis was carried out to determine the areas and processes where significant water saving potential is present. Based on evaluations, water recycling and reuse practices were realized in cooling systems. As a result of applying these practices, the total specific cooling water demand oft the company was reduced from 14.4 to 1.2 m3/m3 product or by 91.8%. Moreover, the total specific water intensity of the company was decreased by 55.0%. Thus, the achieved total annual water saving was 503,893 m3. After applications, specific wastewater generation of the company was reduced by 57.4% and hydraulic overload issues in wastewater treatment plant of Kayseri organized industrial zone were resolved. This study proved that water recycling and reuse can successfully be implemented in soft drink/beverage industry as a sustainable industrial water management approach.

2.5) Remya Neelanchari et al.(2018)[10]- The study investigated the photolytic and photocatalytic treatment of soft drink industry wastewater (SDIW) in presence of microwave (MW) irradiation. The treatment efficiency was investigated in terms of removal rate of chemical oxygen demand (COD), total nitrogen and total phosphate in microwave photolysis (MWP) system, MW photo catalytic system with one and two electrode less discharge lamp (EDL), denoted as MWPC-1 and MWPC-2 respectively. The MWPC-2 system showed highest efficiency with a COD, TN and TP removal rate of 7.48, 82.5 and 0.63 mg/L/min respectively. The COD removal was achieved by direct interaction MW and UV with organics. The photo catalytic oxidation of NH 3 to nitrite and nitrate at catalyst surface cause TN removal from SDIW. On the other hand, major route of TP removal was phosphate reduction occurred in the aqueous phase. On the other hand, the desorption study performed with the catalyst used in the MWPC experiments indicated a TP concentration < 2 mg/L and COD and TKN concentrations < 5 mg/L indicating the complete removal of organic matter, TKN and TP from aqueous and solid phase during the process.

2.6) Yingjun Chen et al.(2017)[4] - Beverage industries are one of the most polluting industries producing huge amount of wastewater effluents. These industries have been recognized to cause pollution by discharging effluent into receiving environment especially to the nearby rivers. The aim of this study was to determine the status of waste water effluent discharge of beverage industry in Ethiopia. Samples were collected from 8 beverage industries' wastewater effluent discharge end pipe and examined for different physico-Chemical parameters such as: COD, BOD, TSS, ammonia, total nitrogen, PH and phosphate. The observed values were ranged between 9 - 397.5 mg/L for TSS, 0.185 - 69.7 mg/l for phosphate, 0.265 - 71 mg/l for ammonia, 226 - 1975 mg/l for COD, 15 - 576 mg/L for BOD, 4 - 86.6 mg/l for total nitrogen and 5.21 - 12.37 for PH. The finding of the study revealed that most of the beverage industries had extremely high amount of total suspended solids (TSS), BOD and COD effluent discharge were found above the Ethiopian beverage industry effluent discharge limit value. Half of the sampled beverage industries' effluent discharge of PH, total nitrogen, ammonia and phosphate were found within the limit value while the rest of the industries are still discharging their effluent above the national standard limit value.

2.7) Mona Amin et.al (2016)[8]– These authors put forward a result based on a successful experimental result from laboratory and treatment of wastewater from beverages industry. They also explained how an industrial and efficient treatment unit is designed and constructed. The broad goal of this study was to design and construct effluent, cost effective and high quality treatment unit. The used technology is the activated sludge process of extended aeration type followed by rapid sand filters and chlorination as tertiary treatment. Experimental results have been considered as the basis for full scale design of the industrial capacity of 1600m3/day treatment plant. Final effluent characteristics after treatment resulted in reducing COD and BOD by about 97% and 95% respectively. So it is recommended to reuse treated waste wate in textile industry for dyeing purposes and other in house cleaning processes. This study has been very enriching.

2.8) Ran Mei et al.(2015)[9]– According to these authors the anaerobic packed-bed (AP) and hybrid packed-bed (HP) reactors containing methanogenic microbial consortia were applied to treat synthetic soft drink wastewater, which contains polyethylene glycol (PEG) and fructose as the primary constituents. The AP and

HP reactors achieved high COD removal efficiency (>95%) after 80 and 33 days of the operation, respectively, and operated stably over 2 years. Both AP and HP communities were predominated by Bacteroidetes, Chloroflexi, Firmicutes, and candidate phylum KSB3 that may degrade organic compound in wastewater treatment processes. Other OTUs related to uncharacterized Geobacter and Spirochaetes clades and candidate phylum GN04 were also detected at high abundance; however, their relationship to wastewater treatment has remained unclear. In particular, KSB3, GN04, Bacteroidetes, and Chloroflexi are consistently associated with the organic loading rate (OLR) increase to 1.5 g COD/L-d. Interestingly, KSB3 and GN04 dramatically decrease in both reactors after further OLR increase to 2.0 g COD/L-d. These results indicate that OLR strongly influences microbial community composition. This suggests that specific uncultivated taxa may take central roles in COD removal from soft drink waste water.

2.9) Nafees Mohammad et.al(2013)[7]- The objective of this study was to investigate the potential for reducing freshwater consumption through recycling,low cost wastewater treatment and beneficial use of sludge of beverage industry at Hattar industrial estate (HIE), Haripur, Pakistan, under the concept of clean technology and water recycling. Samples were collected from end of pipe and analyzed for various physico-chemical parameters such as flow rate, temperature, conductivity, odor, chloride, sulfate, sodium and calcium which were found below the National Environmental Quality Standards (NEQs), while pH, color, turbidity, alkalinity, hardness, total dissolved solids (TDS), total suspended solids (TSS) and chemical oxygen demand (COD) were found above the NEQs level. The treatment techniques comprised of sedimentation, coagulation and adsorption, were designed for those parameters which were beyond the Pak-NEQs. The optimum doses of coagulants were 15, 25, 35, 45 and 55 ml/l with 5:1 ml alkalinity were identified and removed significant amount of pollution loads. After treatment, the achieved sludge was processed for identification of organic and inorganic contents in terms of their beneficial purposes. The treated water was used for Agriculture, municipal and in industry such as washing of carats, bottles and floor, cooling and other minor activities within the premises of industry.

2.10) K M Hossain et al.(2007)[5] - According to these authors various types of waste effluents produced by two industries were studied to verify their environmental effects and to prepare a suggestion for management of those wastes. Two types of wastes were considered- wastewater and solid wastes. Analysis on three samples of wastewater was performed to determine the physical, chemical, organic and biological pollution. The pH values were 6.58, 6.75 & 6.64; amount of TDS were 235, 241 & 270 ppm; total hardness were 126, 123 & 144 ppm; calcium hardness were 105, 99 & 122 ppm, all the values of P-alkalinity were zero and values of M-alkalinity were 40, 40 & 45 mg/l. Iron concentrations were 0.21, 0.18 & 0.19 mg/l. Results suggested that iron concentrations, pH values, TDS and DO were within the standard range. Level of total hardness, alkalinity, BOD, COD and total bacterial count exceeded level of standards.. Study results show that, these selected industries do produce few waste linked problems which can be minimized following some strict management measures.

3. CONCLUSION

Based on information on the wastewater from soft drinks production, on-site effluent treatment sludge has the potential to: be acidic (depends on type of soft drinks being produced); have a high ammonia, biological oxygen demand (BOD) and chemical oxygen demand (COD) content; contain metals (dissolved phase metals may mostly remain in the wastewater, post treatment); contain residual pesticides (as will the wastewater), if fruit juices are being produced; and contain chloride, sodium and other disinfectants associated with cleaning of the treatment system. The wastewater generation and management in beverages industries become a serious threat to freshwater bodies, aquatic biota and human health. The continuous discharge of effluents into streams and rivers raises the level of trace and toxic metals, which have considerably adverse effect on fresh water bodies. In most developing countries particularly in India waste water discharge from beverage industry is high because the industries lacks adequate waste water treatment plants. This is the same situation in Lucknow.

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