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Disinfection of Water: Review on Research towards Effective and Economical Alternatives

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ABSTRACT

The water consumption in chemical, pharmaceutical and construction activities constitutes sizeable amount out of total water consumption. The reuse and recycle of industrial wastewater needs to be effectively carried out. Disinfection of water used for domestic and potable purposes is still a challenge for developing and under developed countries. Disinfection of water can be done physical, chemical and biological methods. Recycle and reuse of wastewater can be carried out by treating the wastewater and further using advanced treatment methods like membrane separation, electro-dialysis and pervaporation. Maintaining water quality in water distribution system is one of the major problems in developing countries.

Key words: Membrane separation, chlorination, ozonation, microfiltration.

INTRODUCTION

Conservation and effective utilization of water resources is important aspect of modern day civilization and industrialization. The water consumption in chemical, pharmaceutical and construction activities constitutes sizeable amount out of total water consumption. The reuse and recycle of industrial wastewater needs to be effectively carried out. The industrial wastewater from different industries contains organic matter, phenol, heavy metals and oil and grease. [1-5] Removal of organic matter can be carried out by various physical, chemical and biological methods. [6-10] Recycle and reuse of wastewater can be carried out by treating the wastewater and further using advanced treatment methods like membrane separation, electro-dialysis and pervaporation. [11-15]

REVIEW ON DISINFECTION

Kumar investigated chlorination of raw Yamuna river water. [16] He chlorinated the samples with increasing doses of standard chlorine water. He measured residual chlorine by Starch- Iodide method. He obtained chlorination curve for each sample. These curves indicated typical irregularity attributed to the formation and destruction of chloramines. He reported presence of two breakpoints for many samples. He attributed this existence of double break point to the formation and destruction of numerous chemical disinfection by-products (DBPs) and biological bacteria/alga.

An investigation into the influence of disinfection with ozone, chlorine (Cl_2) and chlorine dioxide (ClO_2) on the aldehydes formation was carried out by Dąbrowska et.al. [17] They treated three types of water with different doses of these disinfectants. They observed that the level of carbonyls concentration can significantly increase with the time of Cl_2 and ClO_2 reaction with aldehyde precursors in treated water. Also they concluded that productivity of aldehydes in water treated with ClO_2 or Cl_2 was very similar. Somani and Ingole studied disinfection methods of water other than chlorination. [18] They classified these methods as physical, chemical and membrane processes. The physical methods they discussed included boiling, solar, TiO_2 films and sunlight, U-V radiation, electromagnetic radiation, ultra-sonic sound and activated carbon. Chemical methods, they considered were ozone, hydrogen

peroxide, acid & alkali, metallic ions, other halogens, lime, chlorite and chlorine dioxide etc. Microfiltration, ultrafiltration, reverses osmosis were important membrane separation processes studied by them. According to them, ozone and UV radiation were good choices but their use is restricted in developing countries due to cost factor. Hasan et.al. carried out investigation on local exhaust ventilation (LEV)system to prevent chlorine gas leakage in water treatment plant. [19] According to them, large volume of chlorine gases used and stored in these treatment plants have the potential to create a disaster. Kremer et.al. studied a randomly phased-in distribution of dilute sodium hypochlorite. [20] They clustered households by their drinking water source. They found that 48% of treatment households had detectable chlorine in their water. The treatment assignment reduced chlorine content by 69 percent.

Hamdy et.al. carried out investigation onfree residual chlorine calibration. [21] According to them, maintaining water quality in water distribution system is one of the major problems in developing countries. According to them, residual chlorine concentration is the indicator to ensure the quality of water. For hydraulic analysis and calibration of residual chlorine in water distribution network, they used Water CAD software. Wang et.al. carried out studies on the effectiveness of UV and chlorination, used individually and sequentially. [22] They found that Complete inactivation of HPC in microfilter water required a chlorine dose higher than 5.5 mg/L. For membrane bioreactorwaste water, 4.5 mg/L chlorine gave the equivalent result. Lamar et.al. studied identification and measurement of chlorinated organic pesticides in water. [23] They used electron-capture gas chromatography for the purpose. According to them, pesticides, even in minute quantity can be very harmful as they may concentrate in sediments, aquatic organisms, and edible aquatic foods. According to their investigations, gas chromatographic procedure was convenient and extremely sensitive procedure for the detection and measurement of organic pesticides.

According to Gustin and Fines, chemical reactions involving free chlorine in the chemical industry are very important from safety point of view. [24] It is important to have the collection of experiences and experimental data. Their studies indicated that compared to the literature on oxidation reactions using oxygen, literature on the safety of chlorination reactions is very limited. For studying relevant flammability data, they designed 20 liter spheres. According to them, the runaway reaction hazard in chlorination reactions can be caused due to factors such as delay in reaction initiation, reaction mixture instability, Production of unstable species, de-mixing or separation of unstable species.

CONCLUSION

Disinfection of water can be done physical, chemical and biological methods. Recycle and reuse of wastewater can be carried out by treating the wastewater and further using advanced treatment methods like membrane separation, electro-dialysis and pervaporation.

Membrane separation is very effective and practical alternative for disinfection. It can be combined with few low cost conventional methods to have better results. Disinfection of water used for domestic and potable purposes is still a challenge for developing and under developed countries.

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