Chapter 6
Industrial Wastewater Pollution and Advanced Treatment Techniques

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ABSTRACT

Industry creates more pressure on water resources by wastewater discharge than the quantity used in production. The wastewater produced by industries may be either excessively acidic or alkaline or may contain high or low concentrations of colored matter, organic or toxic materials, and possibly pathogenic bacteria. It is necessary to pre-treat the wastes prior to release to the sewer or a full treatment is necessary when this is discharged directly to surface or ground waters and it must be within the effluent standard limits provided by the environmental protection organizations. The management and control of liquid wastes in the industry as well as the selection of the different possible treatments for the wastewater prior to its discharge to the sewer system was studied. These would protect the environment and also benefits from the waste materials can be gained. Opportunities for introducing pollution prevention measures for different types of pollutants produced by different industries are discussed in this chapter.

BACKGROUND

The main wastewater collector, the Cloaca Maxima, in Rome presumably follows the course of an old ditch which was used at about 500 BC as a collector for wastewater ((Lamprecht, 1988). By 1880, scientists began to understand pathogenic bacteria and their association with specific disease. For example, calcium chloride was used to treat faeces from typhoid patients before disposal to sewers (White, 1972). Frankland (1869) proposed ten parameters to analyses the river water quality. The first activated sludge wastewater treatment plant was taken into operation in 1932, Kyläsaari, Finland. The first modern treatment plant functioned properly built after the Second World War in 1957 in Tali. An Industrial ecology

DOI: 10.4018/978-1-5225-5754-8.ch006

was recognized as one step in "waste utilization" rather than "waste treatment" in the late 1990s. In 1996, the construction of a new blower building steel air lines, and provision of new sanitaire diffusers in the aeration chamber was established. The replacement of the original gas chlorination equipment was done with a liquid chlorination facility to meet *E. coli* effluent limitations in 2012. According to historical studies it has been observed that wastewater treatment techniques have improved with the development of economic conditions, civilization and awareness towards public health. The pollution due to industrial wastewater and the modern treatment techniques are discussed in this chapter.

INTRODUCTION

Wastewater can be defined as 'used water discharged from homes, industry, cities and agriculture'. Industry creates more pressure on water resources from the impacts of wastewater discharges and their pollution potential than by the quantity used in production. Industrial effluents are the most important sources of toxic contaminants in any environment (Mohana et al., 2008). Industries such as agricultural based, forest based and marine based on organic raw materials are the largest contributors to organic pollution, while oil, steel, and mining industries represent the major risk for heavy metal release. 70% of industrial wastes in developing countries are disposed off untreated into water supplies (UN- Water 2009). Wastewater discharges from industrial and commercial sources may contain pollutants at levels that could affect the quality of receiving waters. The AQUASTAT database of the Food and Agriculture Organization of the United Nations (FAO) estimates that global freshwater withdrawals rate is 3,928 km^3 per year (Raza et al., 2012). An estimated 44% (1,716 km^3 per year) of this water is consumed, mainly by agriculture through evaporation in irrigated cropland. The remaining 56% (2,212 km^3 per year) is released into the environment as wastewater. It has been reported that irrigation with sewage or sewage mixed with industrial effluents results in saving of 25 to 50% of N and P fertilizer and increase 15-27% higher crop productivity, over the normal waters (Anonymous, 2004). An estimated 38354 million litres per day (MLD), sewage is generated in major cities of India, but the sewage treatment capacity is only of 11786 MLD (~30%) Similarly, only 60% of industrial waste water, mostly of large scale industries, is treated (CPCB, 2009). Much industrial waste water is discharged without treatment to open water resources, reducing the quality of larger volumes of water and sometimes infiltrating aquifers and contaminating groundwater resources. The wastewater discharge from industries varies in flow rate and pollution strength. So, it is impossible to assign fixed values to their constituents. The treatment capacity is strongly correlated with the countries' income: in lower-middle-income countries on average 28% of the generated wastewater is reported to be treated, and in low-income countries, only 8% is treated, while in high income countries the ratio is closer to 70% (Sato *et al.,* 2013). India is a World leader in dairy sector with 15% of global share. The milk production has increased significantly from 137.7 to 164 million tonnes from 2013-14 to 2016-17. Dairy industry contributes market share of Pasteurized Milk (73%), Milk Power (8%), and Ghee (8%), Ice cream (4%), Butter (3%), and Rest (4%-Flavoured milk, Cheese etc.). It is very water intensive industry in terms of consumption & waste water generation (i.e. 4.0 Litter water per Litter of milk). Surat is one of the wealthiest city in India where dairy industries generates 800 m^3 wastewater effluent having high effluent COD, oil and grease content. The waste water treatment capacity in India has increased by about 2.5 times since 1978-79 yet hardly 10% of the sewage generated is treated effectively, while the rest discharge into the environment and is responsible for large-scale pollution of rivers and ground waters (Trivedy and Nakate, 2001). Industries are the

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