Chapter 10
An Overview of Treatment of Antibiotics Using Advanced Oxidation Process

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ABSTRACT

Antibiotics present in the environment are originated from pharmaceutical manufacturing processes or through wastes such as urine and feces. As antibiotics remain recalcitrant and persist in the treated water, consumption of treated water containing antibiotics raises a concern in the development of antibiotic resistance bacteria which would be later released to the environment. It might result in a vicious cycle which new antibiotics needs to be developed and dosage has to increase. Advanced oxidation processes (AOP) have been studied to effectively degrade antibiotics. During this process, hydroxyl radicals are formed to degrade organic compounds. Different APO are available in the literature such as photo-Fenton, Fenton, ozonation, sonolysis (UV), ultrasound combined with ozone, TiO2/direct photolysis, UV/H2O2, UV/ TiO2, UV/IGBT. To treat the high level of concentration of antibiotics, retention time of AOPs needs to be extended or/and OH• radicals need to be produced in a higher concentration for a complete mineralization.

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INTRODUCTION

Over the last 45 years, most of the major industrialized countries have instituted controls on the treatment and the disposal of hazardous wastes. Legislation was placed upon the procedures of hazardous wastes disposal without causing any environmental hazards. In most cases, waste producers are responsible for the direct cost of treatment and disposal, whereas the disposal of household waste is usually funded from general taxation revenue (Stokoe, 1986).

Hazardous waste is a by-product of industrialization - a process which has gathered pace in Asia during the last decade. A method must be found to control hazardous wastes and for their disposal by appropriate facilities in Asian countries in order to avoid some of the environmental effects that have in the past resulted from the uncontrolled disposal of hazardous waste in the older industries societies. However, the solutions appropriate in Asia need not be the same as those that have applied in Europe and North America, where the industrial framework, infrastructure, environment and climate are quite different.

And moreover because of financial constraint on treating the effluent to a high standard and lenient environmental regulation on the effluent disposal limit, limit the Asian industries to adopt the latest technologies in treating the hazardous waste. During antibiotic production the compound still remain in the effluent and also it persist in domestic wastewater when the humans consume for their health care. However this is mostly neglected in consideration while designing the wastewater treatment plant in Asian countries. Since this type of hazardous waste will not be degraded by conventional wastewater treatment plant advanced oxidation process is required.

With the increase in emphasis on higher technology industries in Hong Kong, hazardous waste production has become more significant and the range of wastes produced more varied. Regulations to control the transportation, treatment and disposal of hazardous wastes have been drafted and outline proposals for a hazardous waste treatment centre have been developed. The regulations will assign responsibility to specialist contractors rather than waste producers, for adopting professional standards in the management of hazardous wastes (Stokoe, 1986). These contractors will be controlled by licenses. The licenses are meant to govern the standards of operation of the contractors. Codes of practice are being introduced, setting out appropriate standards for all stages of the management of hazardous waste. The transportation of hazardous waste will be controlled by a trip-ticket system enabling a close check on individual loads of waste in transit between waste producer and disposal site. The hazardous waste treatment centre will include facilities for the treatment of inorganic aqueous based wastes and oily wastes, hazardous waste incineration and the recovery of waste oils and solvents. Public notices in overseas technical journals produced a large response from companies interested in building and operating the plant on behalf of the Government during 1988 (Stokoe, 1986). The control, treatment and disposal of hazardous waste is a justifiable objective in itself and provides other environmental benefits as well. The control of toxic wastes presently discharged directly to sewer, will reduce the incidence of disruption of sewage works and increase the options available for sludge disposal.

Among the hazardous wastes, attention is withdrawn on the use of antibiotics. Despite their vital importance in our daily life, antibiotics have been known to raise concern as a persistent water pollutant in the environment. The occurrence of antibiotics in the aquatic systems has biological impacts on the aquatic life and human health. The use of antibiotic chemical in the pharmaceutical products has reached an estimation from 100,000 to 200,00 tons per year (Kummerer, 2003). The purposes of antibiotics are to treat diseases in human and to promote growth in the agriculture (Hollis, A. and Ahmed, 2013). Antibiotics are made to interfere with the cell walls of bacterial organisms. Since their purpose is to