Disinfection of Wastewater using UV Radiation Andrew Wagner

Abstract

Radiation processing technology for industrial applications began in the early 1960's with the sterilization of medical products. It has since grown to and industry in which irradiators consumer and medical products, and to chemically modify a large number of materials. Its application as a waste treatment process is relatively new. UV radiation is defined as the portion of the electromagnetic radiation spectrum lying between visible light and x-ray. Certain portions of the UV radiation spectrum have been found to have more pronounced bactericidal action then others. The germicidal action of UV result forms its exposure of direct contact with organisms and can only be effective if it is absorbed. As public concerns for the environment increase and regulatory requirements expand, radiation technology will play a more important role in the practice of civil and environmental engineering.

Keywords

Ultraviolet (UV) radiation, dimerization, pyrimidine,

Introduction

The first recorded attempt to use UV for public water supply treatment was made in 1910 at Marseilles, France (Walden and Powell, 1911). Later, four municipalities in the United States adopted UV for water treatment during the period dating from 1916 to 1928 (Baker, 1948). The main reasons given for abandoning the UV method of treatment were: relatively high operating costs, operating and maintenance problem, and the advent of chlorination which was found to be more efficient and reliable. Subsequent environmental problems and certain limitations associated with chlorination have prompted research into UV for disinfection of potable water and wastewater effluent.

Wastewater disinfection by use of UV radiation

Elimination of pathogenic microorganisms from water and wastewater effluents depends upon improvement of existing disinfection techniques or development and application of new economical processes. In response to this need, several studies are underway to evaluate UV radiation as a potential wastewater disinfectant. The need for adequate disinfection of wastewater with minimal reliance on chemicals has focused attention recently on UV and its effect on microorganisms. UV radiation is comparable to other current methods used for wastewater disinfection, including disinfection mechanisms, dose relationships, effects of wastewater characteristics, and the sensitivity of microorganisms.

The mechanism of disinfection for UV light involves photochemical damage to RNA and DNA within the cell of an organism (Summer, 1962). To be effective as a disinfectant, UV radiation must penetrate the pathogen's cellular machinery and permanently disrupt the living cell's ability to reproduce and to cause infection. The nucleic acids in microbes are the most important absorbers of the light energy. Because RNA and DNA carry genetic information for reproduction, damage of these substances can effectively inactivate the cell. UV light usually will form the dimerization of two pyrimidine molecules in DNA. Once the two pyrimidine molecules are bonded microbes has difficulty replicating.