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Review Article

A Review on Studies and Research on Applications of Ozonation and U.V. Treatment with Emphasis on Water Disinfection

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ABSTRACT

Purification of water is important research area because of increasing pollution and depletion in water resources. Water is normally treated by using carbon filter and chlorination for drinking purpose. The waste water can be treated by using different biological, chemical and advanced treatment processes. Disinfection of water can be carried out by ozonation and U.V. irradiation. U.V. irradiation with ozonation can exhibit synergic effect and can treat the water more effectively. Many investigators have studied ozonation- UV irradiation- hydrogen peroxide treatments in combination and separately and compared them. Present review summarizes the research and studies on application of ozonation, UV irradiation and H_2O_2 treatment.

Key words: Disinfection, UV treatment, oxidizers, cost effectiveness.

INTRODUCTION

Water scarcity is one of the major problems faced by the world. Effective treatment of wastewater becomes important for proper and economical use of water. The conventional treatments for removal of organic matter from water include activated sludge process, trickling filters and other biological processes. [1-4] The physical and chemical treatment processes such as adsorption are also effective and economical. [5-8]

Advanced methods such as membrane separation can also be used for more effective removal of salts and other solids. [9,10] The presence of pathogens and other biological pollutants limits the use of water for potable purpose. Generally, chlorination is used for disinfection. The treatment by using ozonation, UV radiation is promising area of research. The UV irradiation can be used for some other disinfection purposes also. The present review summarizes the research and studies on application of ozonation, UV irradiation and their combination with conventional treatment processes.

RESEARCH AND STUDIES ON OZONATION AND UV TREATMENT

Romero-Sanchez et.al carried out an investigation on the effect of exposure to different ozone concentrations and UV radiations on rubber. [11] During their investigation, they observed that the O_3, UV and UV/O3 treatment of S6 rubber improved wettability, created oxygen-containing moieties at the surface. They observed that adhesion was highly improved after UV and UV/O_3 treatments of S6 rubber, more markedly with increasing treatment time. They also observed that the O_3 treatment modifies

the S6 rubber surface to a lesser degree than does the UV or UV/O_3 treatments.

Kolte et.al conducted experiments with Ozone, Ozone–UV, and H_2O_2 -UV radiation process. [12] Increase in BOD indicated that recalcitrant organic material becomes biodegradable. They examined pretreated anaerobically digested spent wash (ADSW) with optimized combine of ozonation - H_2O_2 -UV treatment. They concluded that combine ozonation treatment to ADSW followed by aerobic treatment is better alternative treatment compared to an anaerobic treatment.

Summer felt et.al carried out an investigation for determination of the process requirements necessary to disinfect the full RAS flow, using ozonation followed by UV irradiation. [13] They used ozonation and ultraviolet (UV) irradiation processes separately or in combination to treat water in RAS before it returns to the fish culture tanks. Their research was focused on determination of the process requirements necessary to disinfect the full RAS flow, using ozonation followed by UV irradiation, just before the flow was returned to the fish culture tank(s). They observed that proportional-integral (PI) feed-back control loop was able to automatically adjust the concentration of ozone (O_3) generated in the oxygen feed gas. Rizvi et.al carried out investigation on treatment of UASB treated municipal wastewater by H_2O_2, UV, ozone and advanced methods and their combination. [14] They found that the use of combined systems was promising due to synergistic effect and cost effectiveness.

Effects of ozone depletion and increased ultraviolet-B radiation on northern vegetation were studies by Bjorn et.al. [15] They combined UV-B enhancement with changes in other factors such as carbon dioxide concentration, water availability, and temperature. According to them, indirect effects may take many years to be manifest as ecological dysfunction in Arctic ecosystems. Willekens et.al carried out an investigation on the expression of antioxidant genes in response to near ambient conditions of O, SO_2, and ultraviolet B (UV-B) in Nicotiana plumbaginifolia. [16] Bock et.al studied relation between erythemal UV dose, global solar radiation, total ozone column and aerosol optical depth. [17] They carried out their investigation at Uccle, Belgium. Simultaneous measurements of erythemal ultraviolet (UV) dose (Sery), global solar radiation (Sg), total ozone column (QO_3) and aerosol optical depth (at 320.1 nm) was available. They observed linear trends for the different monthly anomalies time series. Crozes et.al studied UV d disinfection and ozone in water treatment. [18] Their studies outlined the benefits of using ozone and UV. According to these studies the synergies of these two treatment alternatives can be utilized to demonstrate the cost effectiveness and robustness. The combination resulted in 50% additional cost savings than ozone system alone.

Hussein et.al studied the effect of ozone gas and ultraviolet radiation and microwave on the degradation of aflatoxin B1. [19] They observed significant reduction in A. flavus growth between treated and non-treated cultures for all the agents. Matsumi et.al investigated the ultraviolet photolysis of ozone in production of O (^1D). [20] Bustos et.al investigated UV radiation and ozonation as disinfection alternatives for the wastewater treatment plant. [21] They also evaluated the inactivation of total and fecal coliforms using ozone and ultraviolet radiation as separate treatments. They obtained 72% and 78% of fecal and total coliforms, respectively for ozone doses near 20 mg/min. They observed that the UV light offered a high bacterial inactivation (over 80%). Effects of ozonation on characteristics of aquatic fulvic acid were studied by Gul et.al. [22] They examined the influence of ozonation on the subsequent water treatment process such

as flocculation and chlorination. They observed that the DOC concentration of the 20 min ozonated FA samples was reduced only a small amount (5%). The reduction in DOC was 40% in the UV absorption process. Dahlback carried out global monitoring of atmospheric ozone and solar UV radiation. [23] Mainly Dobson and Brewer spectrophotometers were used for the monitoring. Ozone monitoring indicated a nearly linear downward trend from 1980 to mid 1990s.According to him; the existing time series for UV radiation are too short for estimations of global trends.

Summer felt introduced examples of current applications of ozonation and UV irradiation. [24] He discussed aspects such as ozone transfer, Ozone disinfection and maintaining ozone residual, ozone toxicity and ozone destruction. They also discussed ozone irradiation. According to him, UV irradiation for disinfection can be both less costly and less complex than using ozone. In turbid water however UV irradiation can become ineffective. Sharrer and summer felt observed that ozonation followed by ultraviolet irradiation provides effective bacteria inactivation in a freshwater recirculating system. [25] The aim of their research was to evaluate the effectiveness of ozone application alone or ozone application followed by UV irradiation to reduce abundance of heterotrophic and total coliform bacteria in a water reuse system. They observed that combining ozonation and UV irradiation can effectively disinfect recirculating water before it returns to the fish culture tank(s).

In their investigation, Rozema et.al observed that enhanced UV-B radiation affects chemical quality and decomposition of leaves of the dune grassland species Calamagrostis epigejos. [26] They reported changes in the plant's chemical composition and the decomposition of this plant material under enhanced solar UV-B radiation. They observed change in the chemical quality of the leaves grown under enhanced solar UV-B accompanied by an increase in the leaf content of lignin. They observed that there were no significant changes in the content of cellulose, hemicelluloses and tannins.

CONCLUSION

Many investigators have investigated the ozonation and UV methods separately and in combination. UV irradiation is highly effective disinfection method. The combination of UV irradiation with ozonation is found to increase the effectiveness. It is also observed that two methods work synergically.

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