UV DISINFECTION - A METHOD OF PURIFYING WASTEWATER FROM FARMS – A REVIEW

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ABSTRACT

The livestock industry increased significantly globally due to increasing demand for animal products. There are however, growing concerns on the environmental risks, associated with the disposal of untreated livestock wastewater into streams and rivers. Disinfection is considered to be the primary mechanism for the inactivation/ destruction of pathogenic organisms to prevent the spread of waterbornediseases to downstream users and the environment. Water disinfection using ultraviolet light is a newer process that currently has a limited use area [5]. The purpose of this paper is to present the ultraviolet disinfection process used for the treatment of waste water.

INTRODUCTION

Disinfection of treated wastewater effluent is needed as theprimary step to prevent the spread of waterborne diseases todownstream users and the environment. Wastewater from farmshas been identified as one of the main sources of pathogenic agents and the potential vector of diseases as a result of accidentalconsumption of untreated or poorly treated wastewater, skin contact, or ingestion of food species exposed to wastewater [4].

Disinfection is considered to be the primary mechanism for the inactivation/ destruction of pathogenic organisms to prevent the spread of waterborne diseases to downstream users and the enviroment. It is important that wastewater to be adequately treated prior to disinfection in order to any disinfectant to be effective [8]. Ultraviolet (UV) disinfection is a well established, cost-competitive technology. In the late 1800's researchers first discovered the germicidal effects of sunlight, and systems based on fluorescent tube technology have been operating since the 1950's. More recently, UV disinfection has been attracting a lot of attention due to the discovery of chlorinated Disinfection Byproducts (DBP), and new measurements confirming the effectiveness of UV to inactivate Cryptosporidium [2].

UV light, which continues to be a reliable means of disinfection, involves exposing contaminatedwater to radiation from UV light. Ultraviolet or UV energy is found in the electromagnetic spectrum between visible light and x-rays andcan best be described as invisible radiation. In order to kill microorganisms, the UV rays must actually strike the cell. UV energy penetrates the outer cell membrane, passes through the cell body and disrupts its DNA preventing reproduction. UV treatment does not alter water chemically; nothing is being added except energy. The sterilized microorganisms are not removed from the water. UV disinfection does not remove dissolved organics, inorganics or particles in the water.

Ultraviolet light (UV) is a form of energy called electromagnetic radiation. UV light is a small partof the entire electromagnetic spectrum made up ofother types of radiation including visible light, xrays,radio waves, and microwaves,

all at different wavelengths. UV light is electromagnetic radiation with wavelengths in the range of 100-400 nanometers (nm). In contrast visible light is in the range of 400-700 nm. So UV light is notvisible [7] – figure 1.

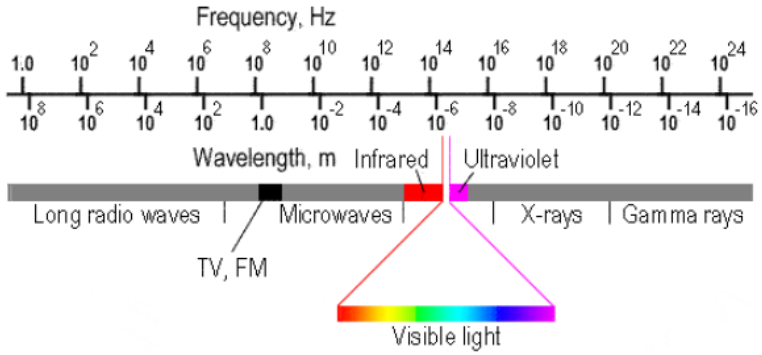

Figure 1 - The Electromagnetic Spectrum [10]

Microorganisms that cannot reproduce cannot infect and are thereby inactivated. In general, viruses are most resistant to UV disinfection compared to protozoan cysts (e.g., Cryptosporidium) and bacteria [7].

MATERIAL AND METHOD

UV light, which continues to be a reliable meansof disinfection, involves exposing contaminated water to radiation from UV light. The treatmentworks because UV light penetrates an organism's cell walls and disrupts the cell's genetic material, making reproduction impossible.

A special lamp generates the radiation that creates UV light by striking an electric arc through low-pressure mercury vapor.

This lamp emits abroad spectrum of radiation with intense peaks at UV wavelengths of 253.7 nm and a lesser peak at 184.9 nm. Research has shown that the optimum UV wavelength range to destroy bacteria is between 250 nm and 270 nm. At shorter wavelengths (e.g.185 nm), UV light ispowerful enough to produce ozone, hydroxyl,and other free radicals that destroy bacteria [5].A schematic of a UV reactor is shown in Figure 2, with more information on its constituent elementsprovided below [9].

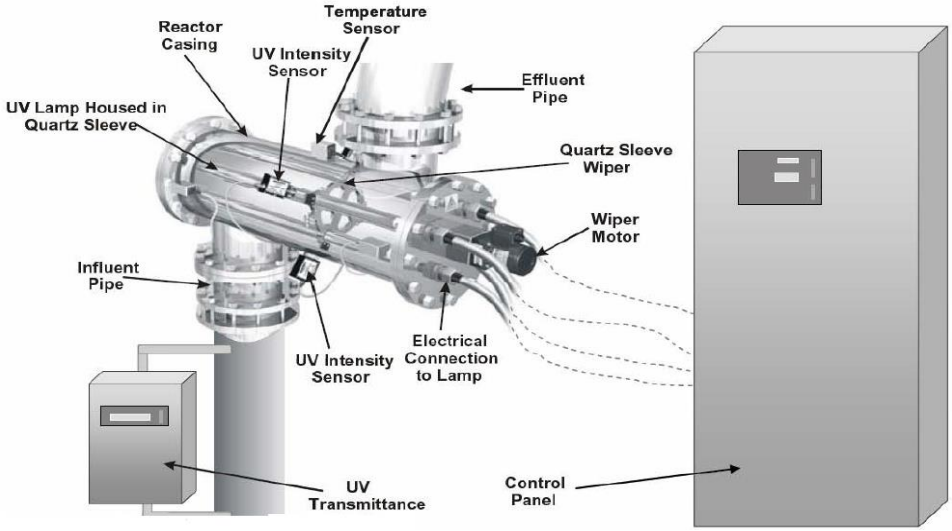

***Figure 2* - Schematic of typical UV Reactor [9]**

The UV device is designed to ensure all the water being treated is channeled through the device as close to the quartz sleeve as possible to ensure the water receives the longest amount of exposure possible at the maximum UV intensity. UV devices work best when treating clear water, so UV devices are typically located after filtration treatment processes.

RESULTSAND DISCUSSIONS

Research over the years have identified ultraviolet (UV) sterilizers as probably the most cost effectiveand efficient alternative technology available to home owners to eliminate a wide range of biological contaminants from their water supply. The advantages, according to research findings, lie in the fact that: itintroduces no chemicals to the water, produces no bi-products and it does not alter the taste, pH, or otherproperties of the water [1].There are two types of UV disinfection reactor configurations that exists: contact types and noncontact types. In both the contact and noncontact types, wastewater can flow either perpendicular or parallel to the lamps. In the contact reactor, a series of mercury lamps are enclosed in quartz sleeves to minimize the cooling effects of the wastewater. Figure 3 shows two UV contact reactors with submerge lamps placed parallel and perpendicular to the direction of the wastewater flow [8].

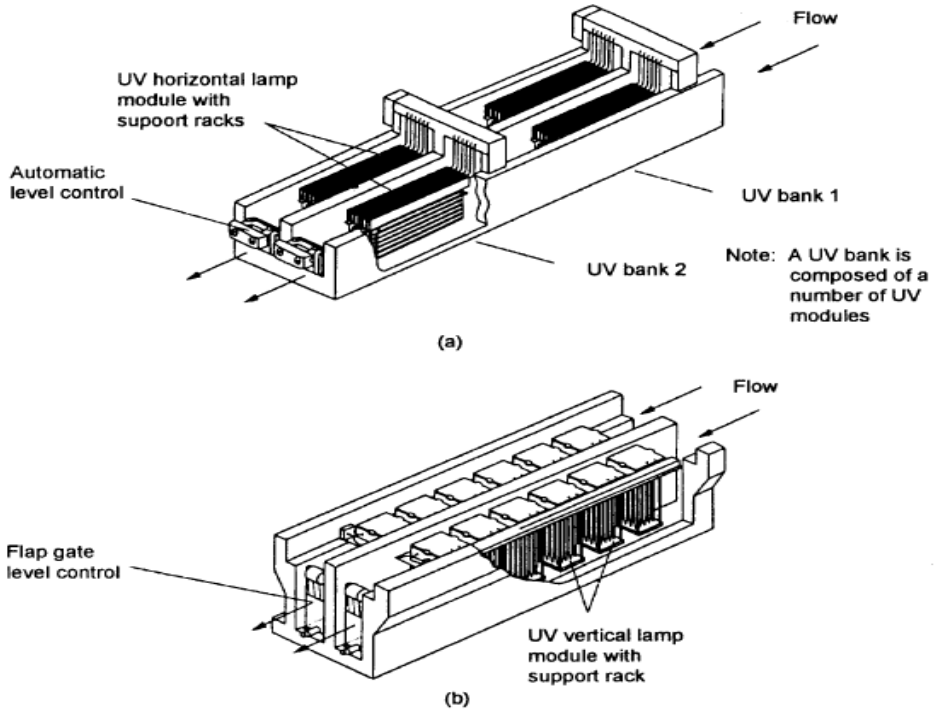

***Figure 3*–Isometric cut-away views of typical UV disinfection systems [3]**
a- Adapted from Trojan Technologies, Inc.
b- Adapted from Infilcodegremont, Inc.

Flap gates or weirs are used to control the level of the wastewater. There are three potential health risks associated with using UV devices – formation of disinfection byproducts; mercury exposure due to UV lamp breakage; and direct exposure to UV light. generated by the UV device. All these potential health risks are generally considered minimal [7].

Microbial and chemical characteristics are two major water quality factors that affect the UV unit performance. Microbial characteristics of water include type, source, age, and density. Chemical water characteristics

include nitrites, sulfites, iron, hardness, and aromatic organic levels.

UV radiation is not suitable for water with high levels of suspended solids, turbidity, color, orsoluble organic matter. These materials can react with UV radiation, and reduce disinfection performance. Turbidity makes it difficult for radiation to penetrate water.

CONCLUSIONS

Wastewater from farmshas been identified as one of the main sources of pathogenic agents and the potential vector of diseases as a result of accidentalconsumption of untreated or poorly treated wastewater, skin con-tact, or ingestion of food species exposed to wastewater. Disinfection is considered to be the primary mechanism for the inactivation/ destruction of pathogenic organisms to prevent the spread of water-borne diseases to downstream users and the enviroment. UV disinfection is a well established, cost-competitive technology. Ultraviolet light is a form of energy calledelectromagnetic radiation.

UV radiation is not suitable for water with highlevels of suspended solids, turbidity, color, orsoluble organic matter.

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