

Ultraviolet Disinfection Technology

FOR MUNICIPAL WASTEWATER TREATMENT PLANT APPLICATIONS IN CANADA

This manual reviews ultraviolet disinfection technology and advancements for application in disinfecting effluents from municipal wastewater treatment plants (WWTPs). The report is intended to serve as an information source and decision-support tool to assist municipal engineers and managers at WWTPs. It discusses the commercially available UV technologies and respective manufacturers, and the criteria and issues involved in the application of UV disinfection. This can include new installations or retrofitting of existing UV equipment.

Based on a review of recent relevant literature sources and input from UV system manufacturers, this manual provides detailed information on UV technology use in North America. The report consolidates key planning, design, operation and cost information for UV disinfection installations at WWTPs. The manual concentrates on UV disinfection of secondary activated sludge wastewater treatment plant effluents. However, consideration is also given to applications involving UV disinfection of effluents from other municipal wastewater treatment process types.

A complete review of UV technology and equipment is provided. The review shows that UV irradiation is a viable, economical option for disinfection of secondary wastewater effluents. The technology has been available since the early 1920's but has only been applied commercially for full-scale wastewater applications since around 1980. The principal parameter controlling the process is the UV dose, which is a function of UV intensity and exposure time. Factors impacting UV performance include UV light intensity, exposure time and wastewater characteristics. Three major lamp technologies are available for UV disinfection of wastewater effluents, including low pressure/low intensity (LP/LI), low pressure/high intensity (LP/HI) and medium pressure/high intensity (MP/HI). LP/HI lamps are common to multiple manufacturers and are available for a wide range of electrical inputs. For this manual LP/HI lamps are subdivided into two categories; lamps rated less than 500 W are referred to as Level 1 lamps, and those above are referred to as Level 2 lamps.

This report covers the needs for applying UV technology to various situations. Many factors need to be considered when choosing a UV system for a particular site. Issues such as site conditions, effluent characteristics, compliance requirements, plant hydraulics and layout, and others need to be considered for a particular site. A detailed list of screening criteria has been provided for all UV installations. A preliminary decision-tree was developed to assist in suggesting an appropriate UV technology for a given site, which together with a list of various factors and considerations can lead to the selection of an appropriate process. Additional criteria items are also provided for consideration by the manual user. It should be cautioned that the decision tree or selection tool follows an arbitrary approach and only identifies a format or process to make an initial screening of potential issues and the impact these may have on UV selection. The user can use this approach and their own criteria and weighting to make a decision tree or selection tool for their own application.

It must be emphasized that the preliminary decision tree is intended for preliminary process screening and that the actual selection of an appropriate technology and design will be site specific. The suggested category of lamp technology identified as being most appropriate based on process screening is not intended to be exclusive. The suggestions should not be construed as ruling out consideration of the other UV process alternatives. The list and discussion of factors and considerations provided in this manual should be reviewed together with the use of the sample decision tree in identifying appropriate solutions.

Generic pricing for a range of plant sizes from small to large and with poor (i.e., average UV transmittance of 50%) or good (i.e., average UV transmittance of 70%) secondary effluent was obtained for comparison. Issues such as the impact of effluent quality and transmittance, lamp life, plant size and installed power requirements are discussed for each lamp type.

This manual's purpose is to provide information and guidance to communities investigating UV technology for application at their wastewater plants. Criteria and tools provided are to assist in the initial evaluation of the issues and the preliminary selection of UV technologies. At this point additional engineering consultation and manufacturer input should be obtained to develop the best system and solution for a particular installation.