Disinfection

Disinfection Methods Disinfection of wastewater is achieved using a variety of methods in Victoria, including: • chemical (for example, chlorination, ozonation); • physical (for example, ultraviolet radiation, microfiltration); and • biological (for example, detention lagoons). Chemical Chlorination Chlorine is used to disinfect wastewater in either gaseous form (Cl2), or as hypochlorite salts. Disinfection by ozonation is achieved using the formation of free radicals as oxidizing*- agents. Ozonation is more effective against viruses and bacteria than chlorination, yet problems with effective bactericidal action occur when conditions are not ideal. The low solubility of ozone in water is the main factor that greatly reduces its disinfection capacity, and any ozone residual produced rapidly dissipates as a consequence of its reactive nature. The absence of a lasting residual may also be seen as a disadvantage as this may allow possible microbial DISINFECTION OF TREATED WASTEWATER EPA Victoria 8 re-growth and make it difficult to measure the efficiency of the disinfection process. Physical Ultraviolet radiation The disinfection of treated wastewater via ultraviolet (UV) radiation is a physical process that principally involves passing a film of wastewater within close proximity of a UV source (lamp). The efficiency of UV disinfection depends on the physical and chemical water quality characteristics of the wastewater prior to disinfection. With a better quality of wastewater comes a more efficient UV disinfection process. The advantage of the UV disinfection process is that it is rapid and does not add to the toxicity of the wastewater. There have been no reports of byproducts produced from UV disinfection that adversely impact on the receiving environment. UV disinfection does not

result in a lasting residual in the wastewater. This is a disadvantage when wastewater must be piped or stored over significant distances and time (particularly relevant to reuse schemes) as re-growth of the microbial population is considered a risk. Membrane filtration Membrane technologies disinfect treated wastewater by physically filtering out microorganisms. This disinfection process does not require the addition of reactive chemicals and as such, no toxic disinfection by-products are produced. Key membrane technologies include: • reverse osmosis; • ultrafiltration; • nanofiltration; and • microfiltration. Microfiltration is the most commercially viable technology for the disinfection of treated wastewater. The wastewater passes through membrane fibres, hollow cylinders permeated with millions of microscopic pores. These pores allow wastewater to flow through the same fibres that act as a physical barrier to particles and microorganisms. Microfiltration efficiently reduces particulates, bacteria, and a range of viruses, algae and protozoans. Protozoa are generally larger than 0.2 micron and are removed effectively by microfiltration, giving this method an advantage over other technologies. Viruses larger than 0.2 micron (which includes most enteric viruses) are also reduced effectively. The main disadvantages associated with microfiltration include the potentially high capital costs, the resultant concentrated backwash with significant microbial contamination, and the handling and management of contaminated chemicals produced by periodic cleaning of the membranes. Biological Lagoons The storage of secondary treated wastewater in pondage systems (nominally 30 days) allows natural disinfection to take place before discharging or reusing the treated wastewater. Natural disinfection can occur via sunlight and/or natural microbial dieoff. Natural disinfection processes can be affected by a number of factors such as the: DISINFECTION OF TREATED

WASTEWATER Guidelines for Environmental Management 9 • turbidity of the wastewater, as it affects sunlight penetration; • amount of suspended matter in the water, as viruses and bacteria may be shielded from the rays of the sun by being absorbed into surface pores; and • ineffectiveness of sunlight in seawater compared with freshwater. Temperature, pH, adsorption and sedimentation further influence the natural disinfection and inactivation processes occurring in wastewater stored in lagoons. The ability of ponds to remove or reduce the number of pathogens depends on such factors as the load of incoming solids and microorganisms, temperature, sunlight and pond design related to detention time. Re-infection of ponds by bird populations can also pose a problem for operators. Algal blooms in the ponds over summer will also reduce the efficiency of the natural disinfection process. Systems using only detention do not typically result in a Class A effluent and are unsuitable as the sole means of pathogen reduction for high contact uses.