Review of for Indirect Potable Reuse through Surface Water

“Proposed Recycling Criteria for Indirect Potable Reuse through Surface Water

3. Treatment that provides a 12 log enteric virus, 10-log Giardia cysts, and 10-log Cryptosporidium oocyst reduction for portable reuse projects will ensure microbiologically safe drinking water (Ref 60320.308. Pathogenic Microorganism Control)

I believe in general that the assumptions on pathogen reduction by treatment process are generally conservative at this time. However, there are certain limitations in these estimates that should require a reevaluation in the future based upon new data on the concentration of pathogens in untreated wastewater.

The 12 log removal requirement used for pathogen reduction is based on data on the estimated concentration of pathogens in a 1996 published document (Metcalf and Eddy, 2007). Since that time significant advances have made in our ability to detect and quantify viruses in untreated sewage and the levels of viruses may be significantly greater than the maximum of $10^6$ per liter on which this requirement was based (Metcalf and Eddy, 2007). In addition many new viruses have been discovered which can be excreted in fecal material and urine (La Rosa et al, 2012). For example, adenoviruses and Aichiviruses have been detected in concentrations as great as $10^8$ to $10^9$ per liter (Kitajima et al., 2014; Hata et al., 2012; Girones et al., 2010). These are just two of now more than 150 different types known viruses which can occur in wastewater. Also water conservation efforts (i.e. increased use of low flush toilets and washing machines which use less water) will result in increasing concentrations of viruses and other pathogens in domestic wastewater. For these reasons the estimates for a 12 log reduction should be revisited on a regular basis to ensure the desired risk level from viruses is achieved.

References


4. The criteria that ensure multi-barrier treatment will promote the use of reliable, resilient, and robust treatment train for the control of microorganisms, (Ref 60320.308. Pathogenic Microorganism Control).

I believe the assumptions made for the removal of pathogens by the different barriers are conservative at this time. Placing a limit on the removal for one treatment processes of 6-log is also conservative and prevents over extrapolation of what can be measured for removal by a given processes i.e. laboratory assessment of treatment processes can generally measure a 4 to 6 log reduction of a pathogen.

5. The progressive actions to be taken in the event recycled water treatment falls to provide the full organism log reductions are adequate to ensure a microbiologically acceptable source for a surface water treatment plant. (Ref 60320.308. Pathogenic Microorganism Control).

The requirements stated for failure to provide full organism log reductions appear adequate given the buffer capacity of the reservoir and dilution likely in the reservoir.

6. A surface water treatment plant will continue the minimum organism log reductions required by the surface water treatment regulations when its source water becomes part of a surface water augmentation project. (Red 60302.208. Pathogenic Microorganism Control).

The draft regulation relies on modeling for some compliance determinations over seen by the limnology subgroup done for the City of San Diego. Modeling the fate of pathogens in reservoirs can be challenging because microorganisms are particulates and not solutes. Differences among the different types of pathogens (protozoa, bacteria, viruses) in density, shape, hydrophobicity, charge and size can result in significant differences in how they will become distributed in a reservoir (Brookes et al., 2004; 2005). The two studies referenced did not use microbial tracers or other type of particulate tracers (e.g.
fluorescent beads) (Flow Science, 2012a; 2012b). One model showed good agreement with temperature and conductivity, and utilized a (lanthanum chloride) tracer which exhibited a significant amount of tracer loss due to coagulation/flocculation and settling during the study. The other used simulations of various “hypothetical tracers”. These approaches may not totally reflect the behavior of particulate pathogens within a reservoir. It is recommended that microbial tracers such as coliphages be used in the future to add assurances that these modeling approaches reflect the behavior of at least viral pathogens.

References


10. The theoretical retention time (TRT) of the reservoir is a valuable measure of the reservoir’s potential to provide the required mixing and provide a meaningful barrier to inadequately treated recycled water reaching the public water system (Ref 64668.30. SWSAP Augmented Reservoir Requirements).

It is important to recognize this is only a theoretical retention time and may not reflect the behavior of all pathogens, because of differences in shape, size, density etc. For example, hydrophobic properties of some microorganisms may result in their accumulation at the air water interface and not be diluted in the same manner as microorganisms less hydrophobic (Armanious et al., 2016).

Reference


The Big Picture
I think it needs to be recognized that assumptions on setting overall reductions for pathogens by treatment processes will always be a moving target. New viruses which are excreted in both the feces and urine are recognized every year. How effectively these viruses are removed by treatment processes is unknown. In addition, this increases the known concentration of total viruses in untreated wastewater, thus bringing into question if a 12 log removal for viruses is enough for reclaimed wastewater treatment systems designed to produce potable water. Based on current scientific knowledge I believe the assumptions used in the risk assessment to develop the proposed regulations are conservative.