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Indirect Reuse of Reclaimed Wastewater for Potable Supply: Regulatory Considerations

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Indirect Reuse of Reclaimed Wastewater for Potable Supply: Regulatory Considerations

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Introduction

Rapid population, industrial, and agricultural growth in the southwestern U.S. is placing increasing demands on limited water resources. For example, the US Census Bureau has projected a 54% average population increase in the four corner states of AZ, CO, NM, and UT between 2000 and 2030. Increases in water supply in the U.S. have historically been provided by acquiring and developing unclaimed resources, trans-basin diversions, re-allocating agricultural water for municipal and industrial use, and extending existing supplies through water conservation programs. However, communities are increasingly finding that these options are not available or not sufficient to meet future needs. In that case, consideration may be given to reuse of treated wastewater.

A small resort community in the mountains of New Mexico offers a good example of these pressures. This community of about 750 permanent residents experiences enormous population increases during the summer associated due to an influx of seasonal residents and tourists. The community depends on ground water for its source of supply, and in the summer of 2004 faced a severe water shortage. The community implemented aggressive mandatory conservation measures and hired engineers and hydrogeologists to search for new sources of water to no avail. During the peak of the 2004 tourist season daily demand averaged 530 m^3/d (140,000 gal/d) whereas community wells were only able to provide 450 m^3/d (120,000 gal/d) of water.

The community came to the difficult decision to utilize treated wastewater to supplement their supply. They have obtained funds from a variety of sources to design and build a state-of-the-art plant to treat 340 m^3/d (90,000 gal/d) of wastewater for blending with well water. The process will use a membrane bioreactor (MBR) variation of the activated sludge process, followed by Reverse Osmosis (RO) (Figure 1). This process will produce very high qualtiy water as RO will achieve near total removal of both particulate and dissolved constituents. The reclaimed wastewater and native ground water will be piped to a lined reservoir that will provide up to 30 d of storage. Water from the reservoir will be given additional treatment by microfiltration, disinfected with chlorine, and introduced to the distribution system. A flow diagram of the process is given in Figure 1. At least two other communities in the state are considering similar strategies for augmenting their water supply.

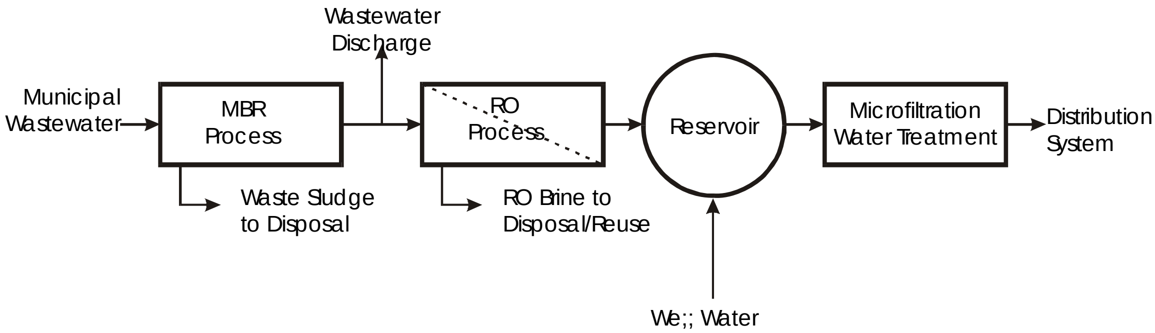

Figure 1. Flow diagram of the membrane bioreactor (MBR)-reverse osmosis (RO) process for indirect potable reuse.

While the State of New Mexico has well developed and effective regulations governing the use of reclaimed wastewater for non-potable purposes, these regulations do not address use of this water for human consumption. The New Mexico Environment Department (NMED) formed a Wastewater Reuse Workgroup consisting of NMED staff, state Department of Public Health Staff, consulting engineers, operators and research engineers to consider these issues and develop administrative policy to assist staff in evaluating indirect reuse projects to maintain compliance with the goals and regulations of the Safe Drinking Water Act, and more importantly, to assure protection of the public’s health. This paper discusses some of the issues addressed by the Workgroup.

Discussion

Drinking water regulations in NM are established by the state Environmental Improvement Board and administered by the Drinking Water Bureau (DWB) of the NMED. These regulations adopt the federal Safe Drinking Water Act regulations by reference, and the NMED has been granted primacy by EPA to administer drinking water programs within the state. Because of the immediacy of water shortages and associated plans to address them, the DWB elected to use the resources of the Workgroup to assist in development of policy to address issues of wastewater reuse. Some of the issues considered by the Workgroup include:

1. Clarify the distinction between indirect and direct reuse
2. Develop guidance for identifying acceptable treatment processes and the degree of treatment required
3. Address issues with non-regulated constituents such as pharmaceuticals and personal care products
4. Assure compliance with federal drinking water regulations
5. Identify benchmarks to evaluate a community’s ability to implement a potable re-use project
6. Integrate requirements for wastewater treatment under surface and/or ground water discharge permits with drinking water regulations

The first three topics have proven the most difficult to deal with and are briefly discussed.

Indirect Reuse: The NMED has clear policy that direct reuse of municipal wastewater (introduction of treated wastewater into the distribution system) is not allowed. However indirect reuse is not clearly defined. Crook (1998) refers to indirect reuse as wastewater discharge to a stream, reservoir, or aquifer with later withdrawal for use as potable supply. There is no consideration or discussion of dilution by native water, residence time between discharge and withdrawal, or the quality of the native water or treated wastewater. The treatment sequence presented in Figure 1 is considered by the community to consist of indirect reuse because the treated wastewater is sent to a reservoir with up to 30 d detention time, it is blended with native ground water, and then the blended water is treated by a conventional drinking water treatment process. It is interesting to review this treatment sequence in light of the fact that wastewater treated by the RO process is likely of higher quality for most measurable parameters than untreated ground water.

There was considerable discussion as to whether the definition of indirect reuse should be connected to the degree of treatment provided by the wastewater and/or drinking water system. For example, if the wastewater was treated by RO, it might be possible to allow a higher fraction of treated wastewater in the mix than if the wastewater was simply treated by conventional activated sludge alone. An important consideration in the deliberations was that a simple definition of indirect reuse was needed because indirect potable reuse will require public involvement. It was eventually concluded that indirect reuse would constitute a blend of less than 50% treated wastewater and the balance native water. Further treatment of the blend would be established based on the quality of both the treated wastewater and the native water.

Treatment Requirements: The treatment train identified in Figure 1 is very conservative and, if properly designed, constructed and operated, will provide potable water of exceptionally high quality. It will provide a much higher quality of water than most conventional drinking water treatment plants treating surface waters containing a mix of native and secondary treated wastewater. It also will provide a higher degree of treatment than that described by EPA (2004) for indirect potable reuse. The process was selected in large part to gain acceptance of the reuse concept by the local community, and to provide assurance that the treated water would meet future criteria for unregulated constituents. However, the NMED Workgroup recognized that processes less robust than RO might also be selected by some utilities because RO is expensive and difficult to operate. For example, conventional activated sludge treatment of wastewater followed by advanced oxidation and adsorption of organics might be appropriate, though it would be less familiar and possibly less acceptable to the public.

Because conventional wastewater and water treatment technologies generally provide efficient removal of regulated contaminants, there were two classes of constituents that were given special attention by the NMED Workgroup: microbial pathogens and unregulated trace constituents, especially pharmaceuticals and personal care products (PPCPs). The Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR – Federal Register, 2006) addresses microbial contaminants in surface water by using a bin classification based on the quality of the source water; raw water of poorer quality has a higher bin number and therefore requires a higher degree of treatment. LT2ESWTR establishes logarithmic removal requirements for *E. coli* and *Cryptosporidium* depending on the concentration of these constituents in the raw water. Because it is possible that the treated wastewater may be of higher quality than the native water, the Workgroup recommended that the bin classification be based on the water with the worst quality, and that the bin number be increased by one to provide additional assurance that pathogenic organisms will not threaten the community.

Unregulated Constituents: Developing policy to address unregulated constituents has proven to be more difficult to accomplish due to three factors. First, there is a large amount of uncertainty associated with their occurrence and threat to human health and the environment. This is cofounded by the fact that many of the PPCPs are present at extremely low concentrations. Second, analysis of most o these compounds is difficult and costly. Further, removal by water and wastewater treatment processes is inconsistent with good removal of some compounds and poor removal of others (Westerhoff et al., 2005). Finally, because they are not regulated, it is not clear that the NMED can establish policy requiring their removal.

The Workgroup considered two strategies for addressing unregulated constituents. One strategy is to require treatment processes equivalent to RO, an extremely robust process which will provide high removal of all suspended and dissolved contaminants. However, it is recognized that this degree of treatment may not be necessary in all situations so that processes which provide better treatment than conventional wastewater and water treatment may be appropriate in some cases. For such systems, an alternate strategy utilizing enhanced treatment processes may be allowed. For microbial contaminants these might included greater logarithmic reduction of pathogens through removal or inactivation processes. For trace constituents it might be possible to specify a surrogate compound such as TOC could be used to monitor performance. Alternatively, treatment processes with independently documented performance might be required. This remains an unresolved issue at the moment.

Summary

The winter of 2005-2006 in central NM was one of the driest on record and communities throughout the state are facing severe summer water shortages. Regardless of the lack of NMED policy, the resort community described above has begun construction on their indirect reuse system which is projected to be operational in September 2006. Other communities are evaluating similar solutions to their water crises. It is incumbent on the regulatory agencies to develop policies and regulations that will allow these communities to address their problems while protecting human health and the environment. This will require an extensive dialog between all participants including regulators, design engineers, water utility managers, and especially the public. This dialog has begun in NM, but likely will continue for years to come.

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