POE / POU

A Benefit for Small Community Water Treatment

By Kelly A. Reynolds, MSPH, Ph.D.

POE/POU systems came out on top when evaluated against centralized treatment facilities for their ability to produce safe, high-quality water at a reasonable price in rural Australia. In a recent study of several communities with varying water treatment challenges (high salinity, turbidity or color constituents), POE/POU systems proved to be the more cost effective option for consumers and drinking water providers in small communities, while meeting the country's regulatory requirements for potable water quality.

Similar to the US, the challenge of promoting POE/POU systems is how to manage the maintenance of household-level treatments. Australia's Cooperative Research Center for Water Quality and Treatment (CRC) recently published a report describing the effective and practical use of point of entry (POE) and point of use (POU) drinking water systems.

Australia's CRC report suggests five models aimed at the management of on-site water treatment systems. These include the homeowner awareness model, the maintenance contract model, the operating permit model, the responsible management entity operation and maintenance model and the responsible management entity ownership model, which will be addressed later in more detail.

Small communities—stringent guidelines

Scientists predict Australia's decade-long drought to worsen, leading to a crisis in the economic viability of many agricultural towns and increased water pollution due to dwindling supplies. Reduced reservoir volumes and limited flow result in poor source water quality; however, the country has in place strict water quality guidelines and high expectations for the supply of safe drinking water.

Given the terms of the *Victorian Safe Drinking Water Act* (2003) and the *Safe Drinking Water Regulations* (2005), high-quality drinking water is expected and enforced. As in the US, however, utilities serving remote and small communities have difficulty meeting the stringent drinking water guidelines.

Constructing centralized treatment facilities with the technology to meet these guidelines is often cost-prohibitive for the smaller water authorities. But the public health goal remains to provide the same quality drinking water to all consumers.

Typically, centralized treatment plants (i.e., municipal treatment plants) are the most cost-effective way to provide potable water to medium- or large-sized communities. These operations are centrally located and used to treat large volumes of water that are often stored and then delivered to consumers via a distribution network.

In addition to the cost-effectiveness of centralized treatment, the water and treatment processes can be continuously monitored. In the event of a breakdown in the treatment or distribution system, however, large populations may be exposed to waterborne toxicants simultaneously.

On-site (i.e., POE/POU) treatment devices have the advantage of the final treatment barrier being at the point of consumption where it is not vulnerable to treatment plant failures or distribution system contamination. The disadvantage is that they can be difficult to monitor or maintain routinely, potentially placing more responsibility on the water authority or the property owner.

In 2003, the CRC organized a workshop to discuss how to best serve the potable water needs of rural Australia. Speakers from the US EPA shared experiences of how POU devices in the US are being used successfully to address compliance with chronic health issue contaminants such as arsenic.

In the US, a conservative maintenance approach is used, changing cartridge filters when two-thirds of their estimated adsorption capacity is consumed. A subset of the POU devices are monitored given that monitoring all would be cost prohibitive. Concern was expressed that with acute health-issue contaminants, the risk of improper maintenance of on-site units might be too high.

Real-time field testing of POE/POU device efficacy

Australia's CRC published a report on the extensive study of both the efficacy of POE/POU systems and the practical implications of their use relative to construction of centralized treatment systems and distribution in small communities.[1] The study addressed the problem head on to determine the efficacy and cost efficiency of POE/POU systems for small community water treatment in rural Victoria.

The comprehensive study involved three constructed mobile water treatment plants and two commercially available POE and POU treatment units to treat four different raw water sources throughout Victoria.

Victoria is a state in the southeastern corner of Australia and one of the most densely populated regions (population estimates in June 2007 were 5.2 million). Melbourne is the capital city where about 70 percent of the state's residents live.

Water authorities serving rural regions in Victoria are dealing with a range of communities where the current water quality does not meet *Australian Drinking Water Guidelines*. One particular local water authority was reported to supply untreated water to 40 towns, many with a population of less than 100 people.

Partially treated water is delivered to an additional 17 towns with a range in population from 87-1,380. This water, which does not meet regulatory quality standards, is also being supplied to businesses, schools and hospitals. Unfortunately, supplying conventional drinking water treatment to these areas has not been economically feasible.

The goal of the study was to assist four specific water authorities serving rural communities in identifying appropriate on-site treatment technologies for providing drinking water compliant with current quality guidelines. Identifying both the performance capabilities and maintenance needs of POE/POU systems were additional objectives of the study. Given that raw source waters vary widely in contaminants and treatment needs, the study evaluated a variety of contaminants and treatment technologies.

Some of the primary contaminants and quality parameters monitored in the study included turbidity, color, hardness and total dissolved solids, *E. coli* and total coliforms, regrowth bacteria (HPC), pH, temperature, inorganic chemicals (iron, lead, manganese), organic compounds (trihalomethanes) and others. Technologies tested included sand, carbon and cartridge filters, UV disinfection and several membrane filters (reverse osmosis, ultrafiltration).

POE/POU treatment success

Details of individual source water and sampling sites, contaminant levels and treatment efficacy can be found in the CRC report. In short, commercially available on-site technologies were effective for addressing all water treatment needs and meeting water quality guidelines and regulations.

The authors recommend a thorough assessment of source water contaminants and use of the report to construct an optimal on-site treatment course. They considered both the public health risks and complexity of the treatment systems.

Color elimination proved to be the greatest challenge for the POU units tested. Color is primarily an aesthetic quality of water and is typically not a human health risk. Common contributors are dissolved organic matter from decaying plants or soil. Iron and algae may also be present in colored waters.

Colored waters have higher disinfection demands and produce greater harmful disinfection byproducts and thus are not desirable. Although not tested in this study, technology is available (such as small-scale nanofiltration) to address color contaminants.[2]

As expected, the use of multiple treatments was often needed to address the issue of mixed contaminants in the raw water sources. Attention to designated flow rates with disinfection units was necessary to consistently achieve microbiologically safe water.

Developing a management program

Given the many advantages of POE/POU systems for treating raw source water to potable quality in small communities, the challenge of managing these systems long-term is still a concern. Building on the US EPA guidelines for management of on-site wastewater treatment systems, the CRC report applies the same management models to the decentralized drinking water treatment framework.[3]

The greater the public health risk and/or complexity of the treatment system, the greater the management needs will be. On-site technology management is categorized into the following five functions: planning; design and construction; installation; operation and performance monitoring and maintenance.

The previously noted management models, in the order of increasing safeguards, were recommended in the report:

1. *Homeowner awareness model:* when risks to public health are low. Homeowners own and operate treatment systems but are assisted and reminded by the regulatory authority of appropriate technologies and scheduled maintenance needs.

2. *Maintenance contract model:* for more complex system designs that require professional observation and maintenance. Trained operators perform periodic checks and routine maintenance.

3. *Operating permit model:* used when sustained performance is critical to the protection of public health. The property owner gets operating permits valid for a limited time, renewable once it is demonstrated that systems are in compliance. The owner is encouraged to hire a licensed maintenance operator for routine performance testing.

4. *Responsible management entity operation and maintenance model:* similar to the operating permit model. But permits are issued to a third party responsible for the monitoring and maintenance of the system.

5. *Responsible management entity ownership model:* this is the only model where the property owner does not own the water treatment system. In this case, a third party owns, operates and manages the system, providing the highest level of system performance control. This model may be most appropriate for schools, hospitals and other high-risk populations.

Conclusion

The overall conclusion of the Australian study was that "commercially available equipment can produce safe drinking water generally at a lower cost per household than centralized treatment if a distribution per household network is in place." The study identified a significant cost savings for towns with less than 150 households and showed that POE/POU treatments were highly effective at producing potable water even with poor quality source waters.

Although more research is needed to determine the best management approach in terms of monitoring, maintenance and operation of on-site treatment systems, POE/POU systems can achieve high-quality water from raw water sources for small communities where centralized treatment plants are prohibitive due to significant costs. In addition, on-site treatment systems are currently available from commercial vendors allowing residents to have safe water in their home immediately after installation.

References

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