Ultrasonic Technology Used to Control Algae in Drinking Water Reservoirs

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Algae are present on vegetation, in the air, soil and water. Their microscopic spores are continuously introduced by wind, dust storms, rain showers, etc. into reservoirs. When algae growth overtakes a water site, water quality deteriorates to a point of being unusable. Controlling algae in large drinking water reservoirs has become a significant challenge. The reduction and/or complete elimination of many chemical algaecides currently in use are generally a goal for municipalities and other environmental entities.

The use of ultrasound for controlling algae has been known for some time and many publications have been written on the topic. However, the recent practical use of such tools is driven by the technological improvements made in the last ten years. Utilizing state-of-the-art technology, ultrasonic devices kill algae by producing frequencies that disrupt and destroy the cellular functioning and structure of the algae cell. Ultrasonic waves in a medium such as water are produced by introducing ultrasonic frequencies into that medium by a suitable device.

The quantity and quality of water stored in drinking water reservoirs is directly affected by the climatic conditions, system draft, runoff from headwaters, and off-stream diversions. Reservoir inflow of the surface water supply system primarily depends on the amount of rainfall. During droughts or periods of very high usage, water purveyors may pump water from nearby rivers to augment its reservoir storage. A consequence of a large quantity nutrient rich river-water diversion is high nutrient loading to the impounding reservoir. While the need for augmenting storage reserve (i.e., utilization of the reservoir to store pumped river water for water supply) is of foremost importance, excessive nutrient loading creates conditions favorable to algal blooms that affects water quality and subsequently impacts water treatment plant operations and costs. If such conditions remain uncontrolled, reservoir degradation will occur. The symptoms of reservoir degradation include frequent algal blooms, surface scum, loss of volume in the reservoirs, production of noxious odor compounds, and dissolved oxygen depletion.(1)

Since 2002, AquaSonic units have been installed in reservoirs in the United States and United Kingdom as a non-chemical treatment of algae in raw water reservoirs. In 2004, Dr. Pen Tao gave a presentation at the Annual AWWA Conference in which he first introduced the use of the ultrasonic devices at the Wanaque Reservoir in New Jersey as part of his integrated approach for controlling Algae. Dr. Neville Hampton gave a presentation at the 2006 AWWA Water Resource Conference on the cost-effectiveness of their use at the Barcombe Reservoir in the United Kingdom.

Barcombe Reservoir, United Kingdom

Algae alter both the physical and chemical quality of water making it more difficult to treat. Process technology can remove algae during normal water treatment but the presence of algae increases facility loading; reduces facility efficiency and throughput resulting in higher operating costs.

South East Water operates a number of water treatment works (WTW) in the UK that use surface water reservoirs as their primary source of drinking water. The largest of these is Barcombe WTW, and the occurrence of algal blooms within the reservoir cause significant complications for the treatment process.

This means that for much of the year WTW has to resort to direct abstraction from the River Ouse. The risks associated with this practice, such as low river flow, source pollutions, etc. become unavoidable.

There are two treatment Works: No. 1 Works can take water from either the river or the reservoir and No. 2 Works can treat either source or a blend of the two. The reservoir is very shallow, 4 meters (13 feet) maximum depth. To ensure a supply of raw water for treatment, and to avoid the loss of supply as a result of pollution incidents, the residence time of the water in the reservoir is between 10-12 days. The reservoir characteristics provide ideal conditions for algae growth. Consequently, during the summer months No. 1 Works is forced to abstract only from the river while No: 2 Works can treat a blend of river water a limited amount of reservoir water. (2)

Algae control was commenced in April 2003 with the installation of six units with AC power supplies around the edge of the reservoir wall. This ultrasonic treatment led to significant reductions in treatment Works loading due to the algae control achieved by these units. Substantial cost savings resulted in

- Reduction of chemical and coagulant usage use
- Elimination of Cryptosporidium monitoring
- Filtration due to less need for filter washing, air scouring and pumping
- Reduced backwash water treatment
- Less sludge production with savings in polymer usage and sludge disposal

for a total savings of $142,000 per year. The payback in months on the investment of the installation of the ultrasonic units was 3.6 months.(2)

Wanaque Reservoir, New Jersey, USA

Since June 2002, The New Jersey District Water Supply Commission (NJDWSC) has been using Aquasonic Algae Controllers as part of a comprehensive water treatment at the Wanaque Reservoir in New Jersey. The Wanaque Reservoir is a 30 billion gallon impounding facility with 2,310 acres of water surface area.

The Wanaque Reservoir System provides drinking water supply to approximately two million residents in northern New Jersey. During the period from late 2001 to early 2002, the Eastern United States experienced a serious rainfall deficit which caused a severe water shortage in the northeastern region of New Jersey. The reservoir inflow of the surface water supply system was greatly reduced while consumption demand remained high. To meet regional water supply demand during that period, 38 billion gallons of nutrient-high water was pumped from the Passaic, Pompton, and Ramapo Rivers into the Wanaque Reservoir (the Wanaque Reservoir's capacity is 30 billion gallons). The NJDWSC implemented several algal control measures to protect the Wanaque Reservoir from the excessive algal growth and to achieve efficiency in controlling blue-green algae in the Reservoir. The algae management strategy consists of Phosphorus Inactivation, Hypolimnetic (Reservoir Bottom) Release, Aquasonic Algae Controllers, Reservoir Aeration, and Biomanipulation.(1)

The units were bundled into three sets and placed at three strategic locations near Raymond Dam intake area treating approximately 60 acres. These units were installed in June 2002 and have continued to

be used as part of the integrated tactics for controlling algae growth every year in the warm seasons since then with no equipment failures.

References:

(1) Tao, Pen C., PhD, "Wanaque Reservoir Water Quality Management Program and Algal Growth Control Measures" (2005); "How to Produce More Potable Water with Higher Quality and Reliability," AWWA 124th Annual Conference (2005); "Improving Customer Confidence by Managing Source Water and Impounding Reservoir Water Quality" AWWA 123rd Annual Conference (2004).

(2) Hampton, A. Neville, PhD, "Ultrasonic Waves – Non-Chemical Algae Control in Drinking Water Lakes and Reservoirs," AWWA Water Resource Conference (2006).

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