

# Low cost solution to treating nitrates in drinking water

by Ken Arnold, P.E.

The Village of Blissfield, Michigan, located in southeast Lenawee County, experienced seasonal high nitrate levels in its drinking water source – the River Raisin. The elevated nitrate levels were caused by the combination of agricultural fertilizer used in the watershed and runoff from storm events.

## Problem

Nitrate is an inorganic compound that can be a natural or man-made contaminant in drinking water. Nitrate ( $\text{NO}_3$ ), and its chemical cousin Nitrite ( $\text{NO}_2$ ), can cause methemoglobinemia, or “blue baby” disease.

In the past, the Village of Blissfield was periodically in violation with the Environmental Protection Agency (EPA) for nitrate concentra-

tions above 10 parts per million (mg/L), a real nuisance as well as a health and safety hazard to residents. Each time the village noted an elevated level of nitrate in the raw water, residents had to purchase bottled water, often for days at a time.

A means of reducing nitrates needed to be designed.

In March 2000, the village built a new water treatment plant to serve its 3,300 residents. The plant uses a conventional treatment process of flocculation, sedimentation, filtration and chlorination but this process does not significantly reduce nitrate concentrations from the river water. At the time of plant construction, the nitrate problem was well understood but priorities were set to first construct a new water treatment plant and then, in

a separate follow-up project, undertake the problem of nitrate removal.

## Chosen approach

After considering a number of alternatives, anion exchange was chosen by the Village as the preferred method to treat River Raisin water for nitrates. Ion exchange is commonly used in residential water softeners to treat hard water as well as in industrial processes to remove metals and other contaminants from wastewater. At Blissfield, anions (negatively charged nitrate and sulfate ions) are selectively removed in the treatment process.

According to Bethel Skinker, district engineer at the Michigan Department of Environmental Quality (MDEQ) in Jackson, the

use of anion exchange as a treatment process for nitrates in drinking water is unprecedented in Michigan.

Anion exchange systems work by using special resin media within pressurized tanks. Filtered water is pumped through tanks where the media removes the nitrates from the water. After the media removes a given amount of nitrate it becomes exhausted and must be regenerated using a salt solution that “exchanges” chloride ions with the nitrate and sulfate ions stuck to the media. This regeneration restores the media, allowing it to be reused.

## Benefits to the residents

### Social benefit

The Village of Blissfield’s drinking water has been dramatically cleaned-up, ensuring a safe and healthy drinking water supply. Prior to treatment, drinking water samples showed levels of nitrate as high as 15 mg/L. After treatment, several samples were measured below the detection limit of sensitive laboratory instruments.

The anion exchange process has restored a safe and reliable source of drinking water.

### Economic benefit

Anion exchange saved the Village of Blissfield half the cost of construction when compared to the raw water reservoir alternative. In addition to savings in construction and engineering costs, the village did not have site acquisition expenses associated with the construction of the reservoir.

The process was designed to have a basic capacity to handle the expected average daily flow in the year 2020 in a 14-hour day. It will only operate during episodes of high nitrates in the River Raisin – when farmers fertilize their fields. Annual operations and maintenance costs are minimal since the equipment is only used when

needed. The system can be easily augmented in the future beyond the 20-year design period.

### Sustainable design benefits

The village realized environmental benefits by confining the entire treatment process to the existing water treatment plant site. Pumps, piping and process equipment are housed inside the plant. The only part of the process located outside the building is the salt storage tank. In addition, earth movement was not needed, wetlands were not impacted and construction did not impact the River Raisin.

The spent salt solution used in the filter media regeneration process is discharged to the sanitary sewer system. The wastewater treatment plant’s activated sludge process easily tolerates the additional chloride load.

## Safe, affordable drinking water

Anion exchange is a proven, relatively inexpensive water clean-up technology. It is useful and effective in reducing nitrates in a community drinking water system.

“The Village of Blissfield is very satisfied with the design of the nitrate removal process,” said

James Wonacott, Blissfield village administrator. “Our goal was to provide our citizens with the cleanest, safest drinking water possible and to meet the regulatory limits using the best available technology.”

According to Wonacott, another advantage of the design is that the system can be turned off and on during and after the seasonal high levels of nitrates in the River Raisin. “This flexibility allows the village to control operating costs,” he added.

The draw toward the use of anion exchange in this application is that it is not complex – merely an innovative use of old technology. Being a “tried and true” treatment technology meant that the village had limited training costs and time associated with the system start-up.

The use of this proven technology demonstrates that innovative designs often need not be complex.



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