Methodologies for assessing and controlling water loss during water treatment processes have been a mainstay for drinking water treatment plants for years and more recently in the industrial water treatment sector. With the implementation of best management practices charged with establishing safe, reliable water while reducing wasteful usage, a framework is being established for treatment plant management and operation, water-use priorities and local plumbing and use ordinances, targeting both short- and long-term conservation activities.

By James Knoll, Nichole Pennisi & Robert Russo

conservation strategies for arsenic treatment

The effects of media selection on water loss and wastewater generation

Recognized in the drought-prone, arid regions of the country, water conservation plans are defining the specific criteria necessary for administering feasible and efficient water usage. Many of these conservation strategies are directed specifically toward management and operation within a treatment plant. Controlling overall water consumption and minimizing water loss through the operation of a treatment facility can represent a significant percentage of the overall water withdrawal. Water conservation measures applied to treatment plant activities can often provide immediate operational and financial savings.

For new treatment facilities, water conservation considerations should be assessed during the initial design and evaluation of the desired treatment technique because treatment technologies can vary significantly in the use of water and generation of wastewater. This is evident in the design and operation of treatment technologies for the removal of arsenic.

Even with the advancement in arsenic removal technologies, nearly all proven arsenic removal technologies generate a residual wastewater. A thorough backwash rinse is required during the initial start-up and periodically throughout use for all arsenic adsorbent media regardless of specific type in order to:

- Reduce fines generated during transportation and installation activities;
- Expel particulate build-up on the media surface to avoid operating head-loss; and
- Redistribute the media bed to avoid channeling and subsequent arsenic breakthrough.

The volume of water generated during each backwash event can vary significantly between commercial media. Several factors influencing backwash volume generation include:

- Media density;
- Physical attrition and particle stability; and
- Source water quality.

Media density plays a significant role in determining backwash flowrate, as less dense media requires less energy to overcome the incipient head-loss of the media bed. This results in lower backwash rates.

Additionally, a softer, more friable adsorbent media can generate a significant amount of fines under normal hydraulic operating conditions. The attrition of fines under normal operating conditions results in head-loss across the media bed requiring removal through the backwash process. Thus, a softer media will result in the necessity to run more frequent backwash events.

Similarly, elevated levels of total suspended solids (TSS) and turbidity in the source water being treated will contribute to an increased backwash frequency. Pretreatment to remove particulate matter is often employed during arsenic treatment to eliminate the impact of suspended particles on the media bed.

Experimental Method & Results

In an effort to explore the differences, an evaluation was recently conducted to quantify the backwash water generation from three commercially available arsenic adsorbent media, including:

- Granular ferric oxide (GFO);
- Granular ferric hydroxide (GFH); and
- Titanium oxide (MetSorb).

Figure 1. Backwash Water Quality

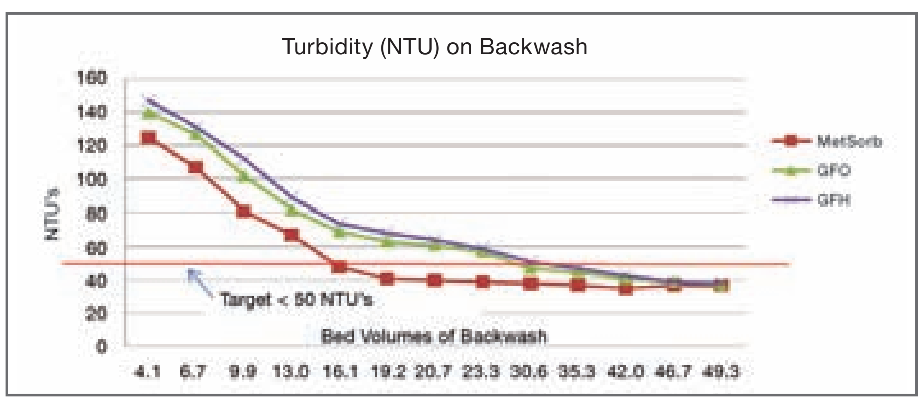
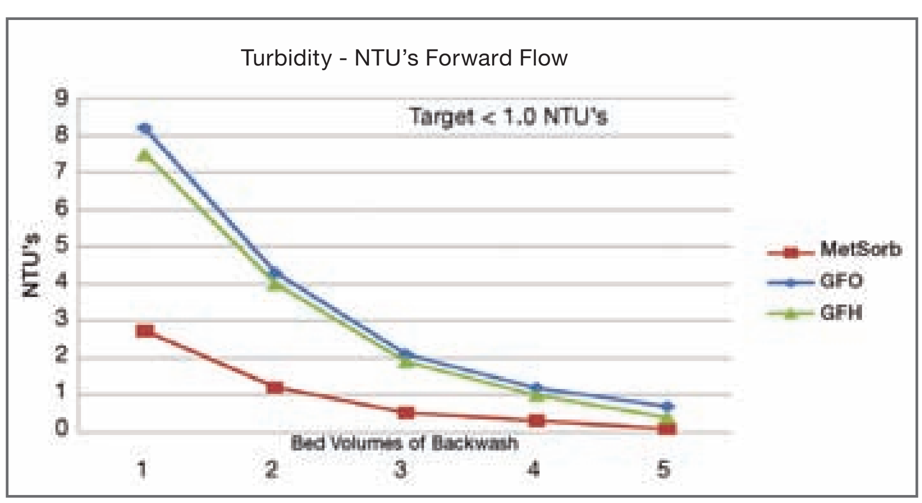


Figure 2. Forward Rinse Water Quality



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The evaluation employed an equal volume (1.5 cu ft) of the three media in individual standard 12-in.-by-54-in. pressure vessels. Each vessel maintained prefiltration with a 25-micron (µm) pleated cartridge filter to eliminate source water quality as a variable.

Backwash supply to each vessel was regulated at the manufacturers' recommended backwash rate. Samples of the backwash water were taken at five-minute intervals and analyzed for turbidity to determine the relative water quality for acceptable discharge to the local sewer authority (Figure 1).

A turbidity value of 50 nephelometric turbidity units (NTUs) was chosen to represent acceptability for discharge. Upon achieving the backwash water quality of 50 NTUs, the backwash flow was halted and the vessel placed in forward-flow to provide the necessary media rinse. Samples of the rinse water were again run to waste and analyzed for turbidity (Figure 2). The turbidity testing at this point was used to determine the acceptability of the water quality for use within the distribution system. A turbidity level of <1 NTU was utilized to determine acceptability for general consumption.

The variation in the quality and quantity of wastewater is apparent in varying technologies available for the removal of arsenic. As demonstrated within this evaluation, the volume of wastewater generated (Table 1) can vary from as low as 12% between technologies to well over 100% depending on operational and site conditions.

The most efficient media in terms of control of water loss and wastewater generation was shown to be titanium oxide. Given the size limitation of the evaluation exercise, extrapolation of the data for a large-scale treatment installation would suggest significant differences in wastewater generation. With the control and mitigation of water loss and wastewater generation becoming increasingly important, proper media selection as well as the evaluation and selection of treatment technologies is vital to water conservation measures. *wqp*

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Table 1. Data Summary of Wastewater Generation

	Backwash Rate (GPM/Ft^2)	Gallons to < 50 NTU Target (gal)	Rinse Water Flow Rate (GPM/Ft^2)	Gallons of Rinse-water to <1 NTU (gal)	Total Wastewater Produced (gal)
Titanium Oxide	5	120	7	25	145
GFO	5	228	7	48	276
GFH	5	264	7	45	309