ADSORBSIA™ Arsenic Removal Media – Properties and Performance

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The Challenge

- EPA Lowers the Arsenic Maximum Contaminant Level (MCL) from 50 ppb to 10 ppb
- Announced January 2001
- Went into effect January 23, 2006
- Affects Group A community water systems (>25 people served)
- Affects Non-transient, non-community public water systems

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EPA Health Effects Statement

"Some people who drink water that contains arsenic in excess of the MCL over many years could experience skin damage or problems with their circulatory system, and may have an increased risk of getting cancer."

Table I-1. CCR Informational Statements1 and Health Effects Language, http://www.epa.gov/safewater/ccr/chgtable.html

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Treatment Options

- **Large Municipal** systems **can** cost effectively use conventional processes such as enhanced coagulation, direct filtration, coagulation assisted microfiltration, etc.
- **Small Municipalities** (<3300 people) **can't** cost effectively use conventional coagulation / filtration. Their most cost effective option is to treat with one of several media's.
- Conventional media's include Ion Exchange and Activated Alumina.
- A host of new adsorbent media's are being developed including Granular Ferric Hydroxide (GFH) and various versions of mixed metal oxides.

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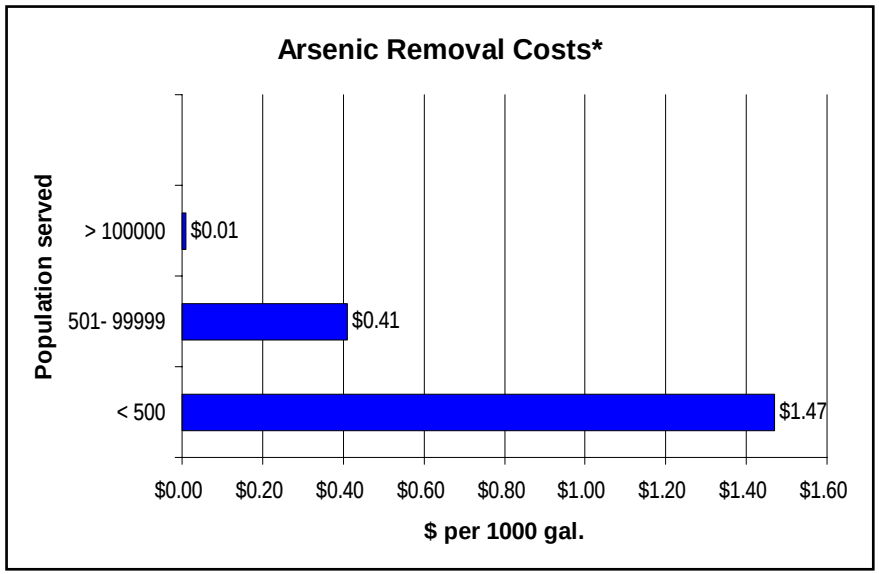
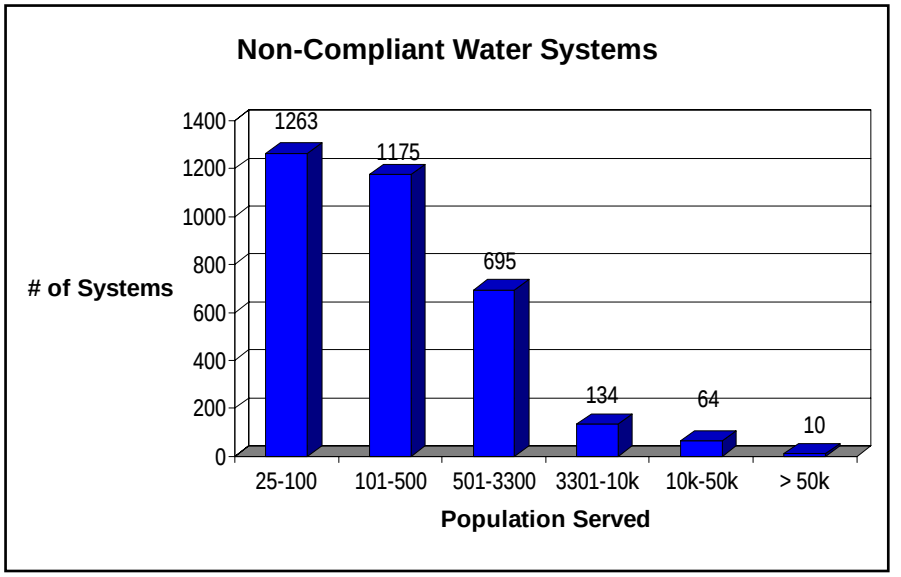
Arsenic Removal Costs



Costs rise drastically for smaller systems using conventional technology

Vast majority of systems are small



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Why use ADSORBSIA media

Dow technology applied to develop a formulation that provides *physical strength* to compliment the *adsorptive capacity* and *fast kinetics* of Titanium Oxide

High capacity and fast kinetics makes ADSORBSIA media well suited for single use in Municipal /POS/POE /POU operations

With many tools available to us, Dow believes ADSORBSIA GTO™ media is the best solution for arsenic removal

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ADSORBSIA GTO TiO Media

Physical Properties:

Product form	Dry Granule
Moisture Content	< 15%
Particle Size Range	10-60 US mesh
Bulk Density	44 lbs/ft^3

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The ADSORBSIA GTO Advantage

- Effective for both As(III) and As(V)
- Highest effective arsenic capacity available
- Fast kinetics allow for flexible system design
  - Smaller footprint
  - Lower capital costs
- Easy to use
  - No pre-treatment necessary
  - No arsenic containing regenerant or concentrate waste streams

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More Advantages

- Effective removal of Arsenic over a wide range of water conditions
- Best performing media in high silica and/or high phosphate waters
- Stable performance during pH fluctuations
- Dry, White granule that is easily installed and maintained

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More Advantages

- **NSF/ANSI 61 certified (without limitations)**
- **Passes extractive tests for:**
  - **TCLP (Toxic chemical leaching procedure)**
  - **CA WET (California Waste Extraction Test)**
  - **CA STCL (Solute Threshold Concentration Limit)**
- **Disposable as non-hazardous waste.**
  - **Customer should confirm that spent media meets their local landfill requirements.**

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NSF Standard 53 Challenge Water for Arsenic

Data on the following slides was generated using the challenge water described in ANSI/NSF standard 53.

Mg	12 ppm	SiO2	20 ppm
SO4	50 ppm	PO4	0.04 ppm
NO3	2 ppm	Ca	40 ppm
F	1 ppm		

Challenge Water was designated by NSF to represent "typical water" and allow for "apples to apples" comparisons.

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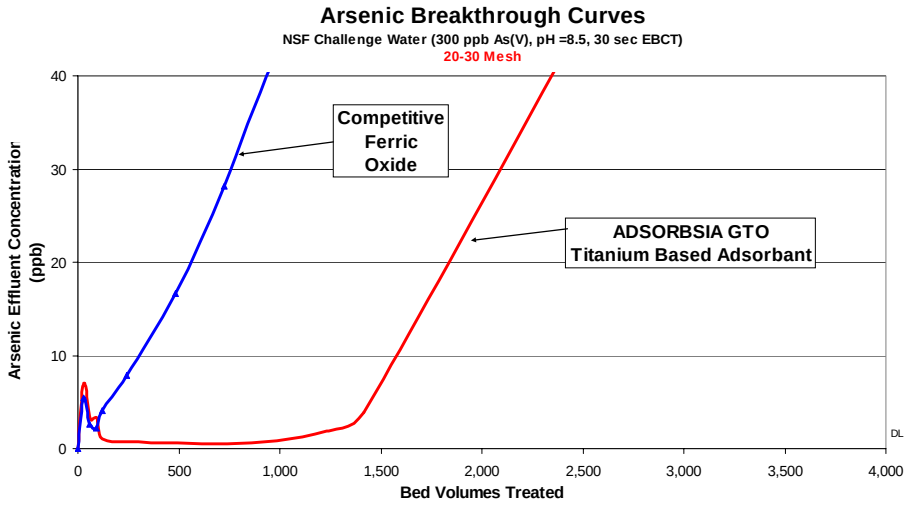
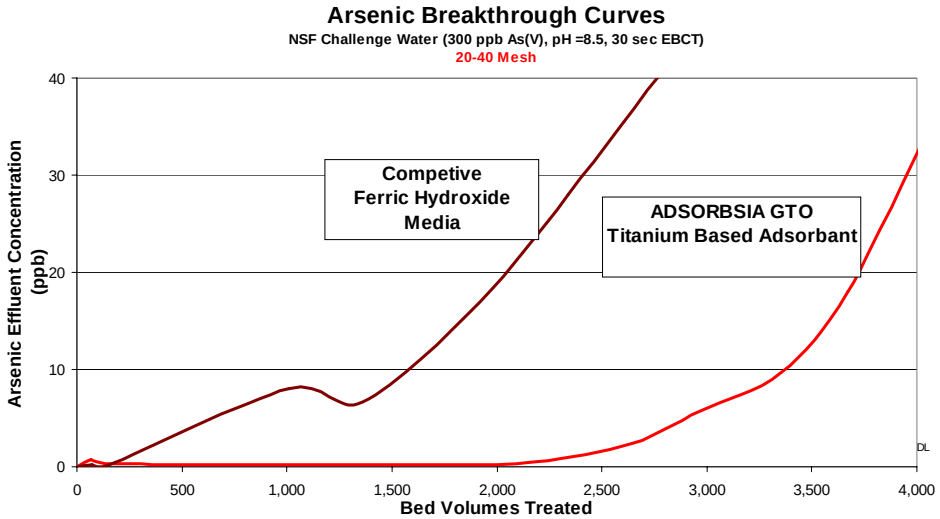
Fast Kinetics



Dow's proprietary granulation process combined with nanocrystalline technology provides the fastest kinetic performance available today.

The performance advantages of ADSORBSIA media are especially obvious under the most severe test conditions.



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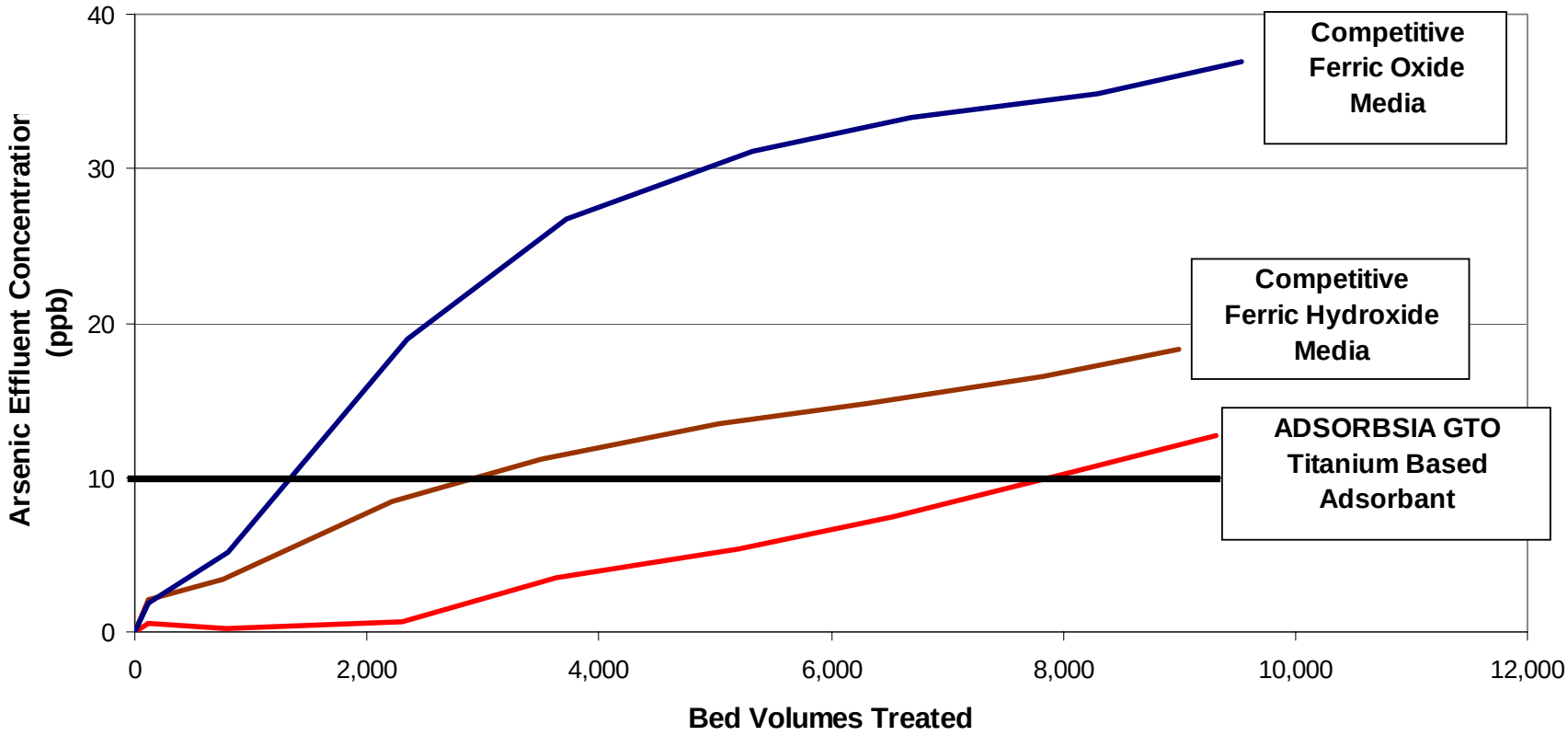
Highest Effective Arsenic Capacity

Arsenic Breakthrough Curves

NSF Challenge Water (50 ppb As(V), pH =8.5, 30 sec EBCT)



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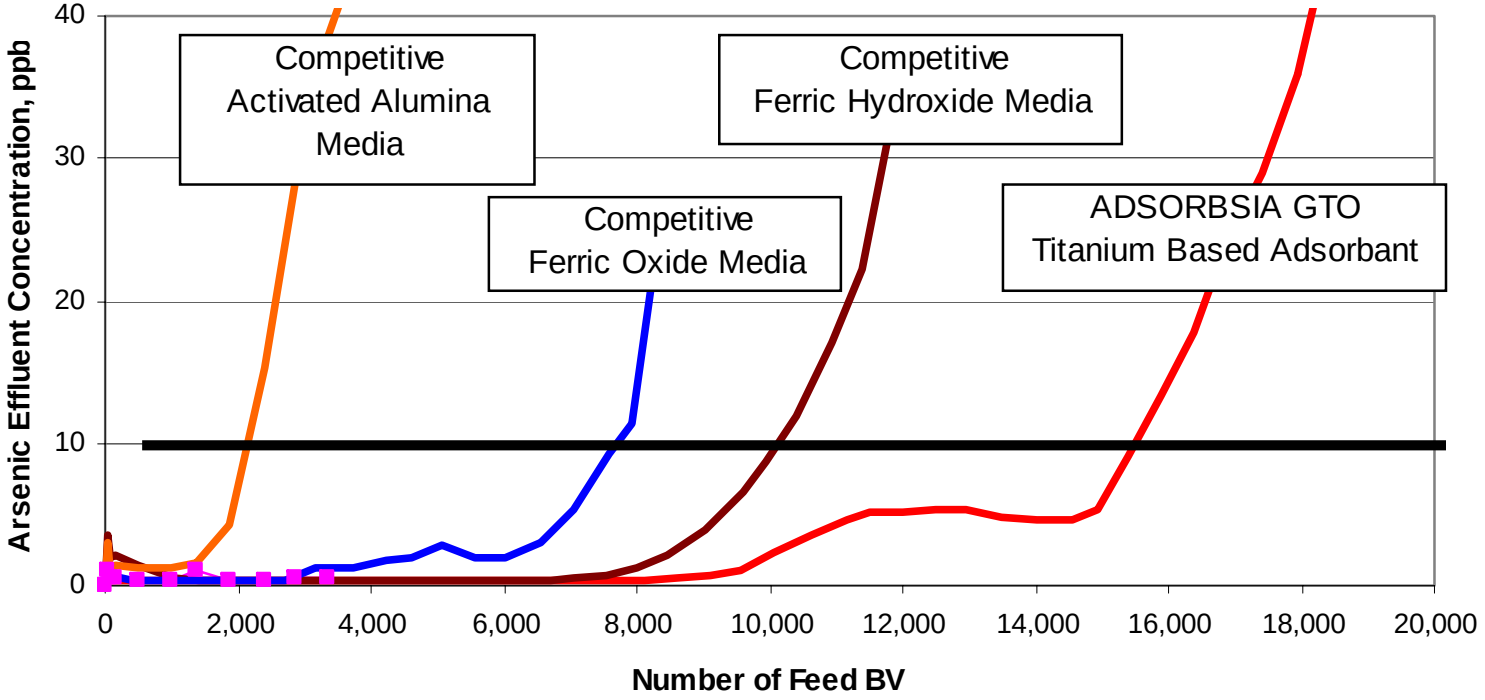
Highest Effective Arsenic Capacity

Arsenic Breakthrough Curves

NSF Challenge Water (300 ppb As(V), pH =7.5, 180 sec EBCT)
Low Silica (10ppm)



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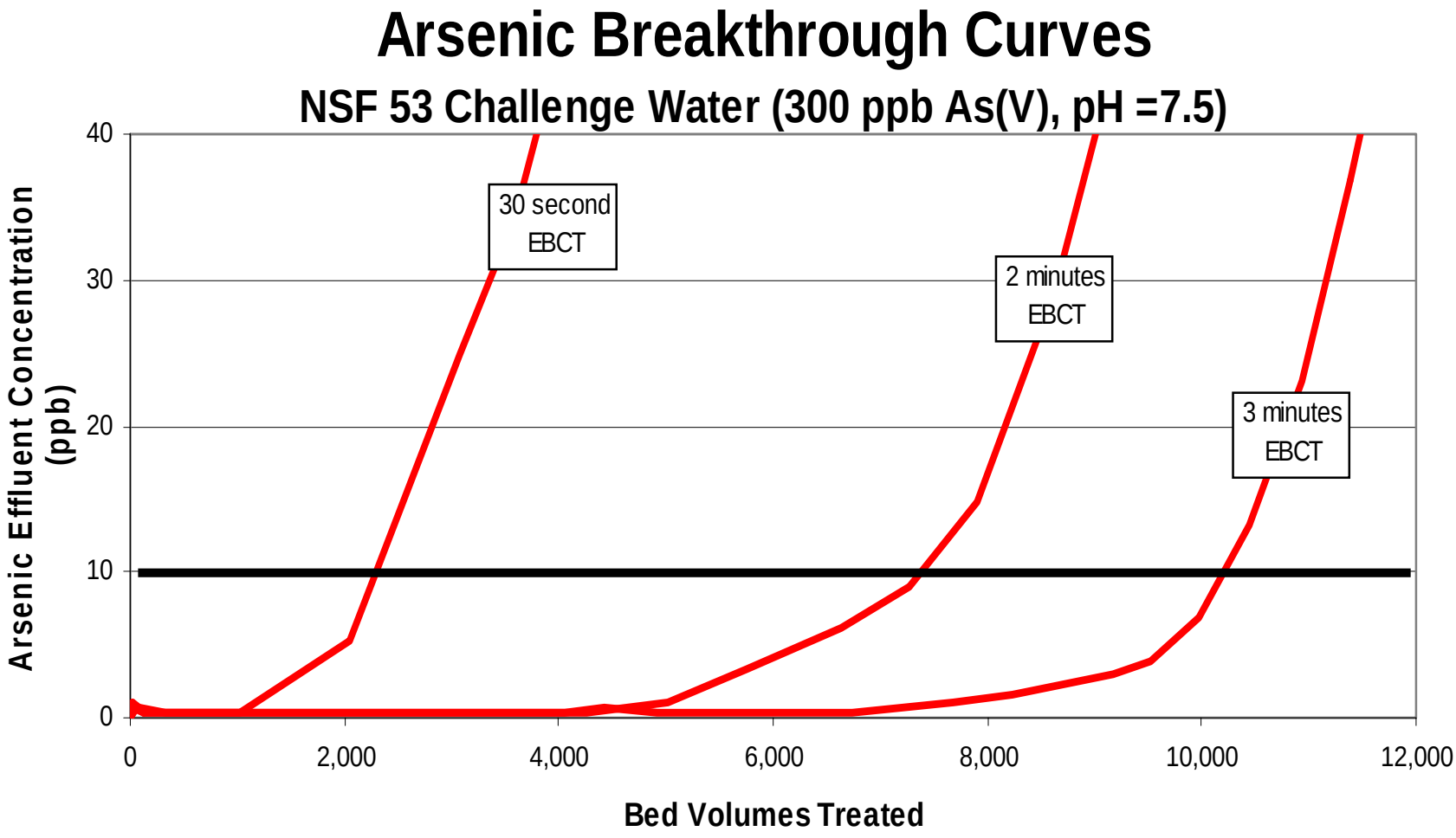
Fast Kinetics



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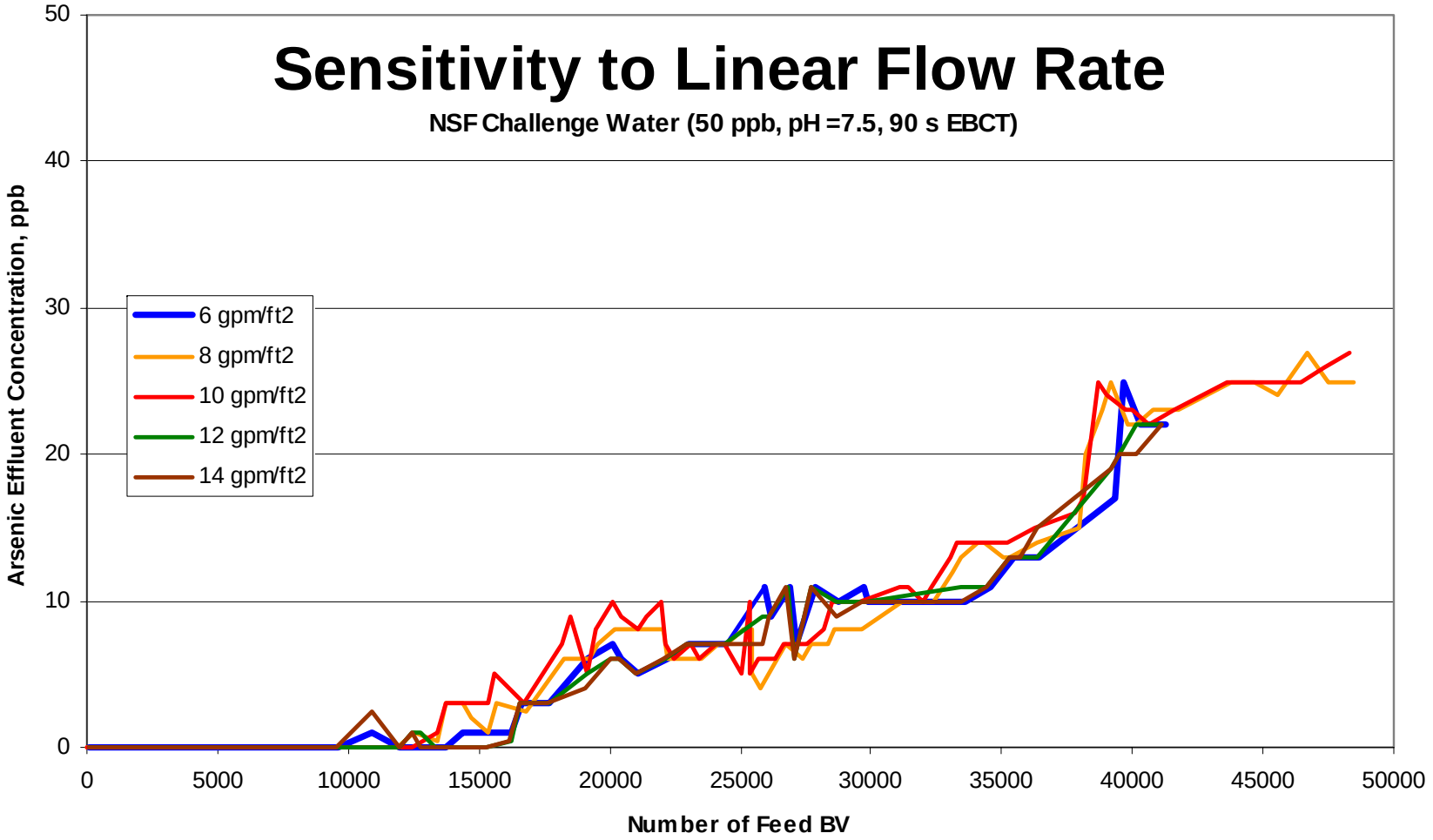
Effect of Linear Flow Rate



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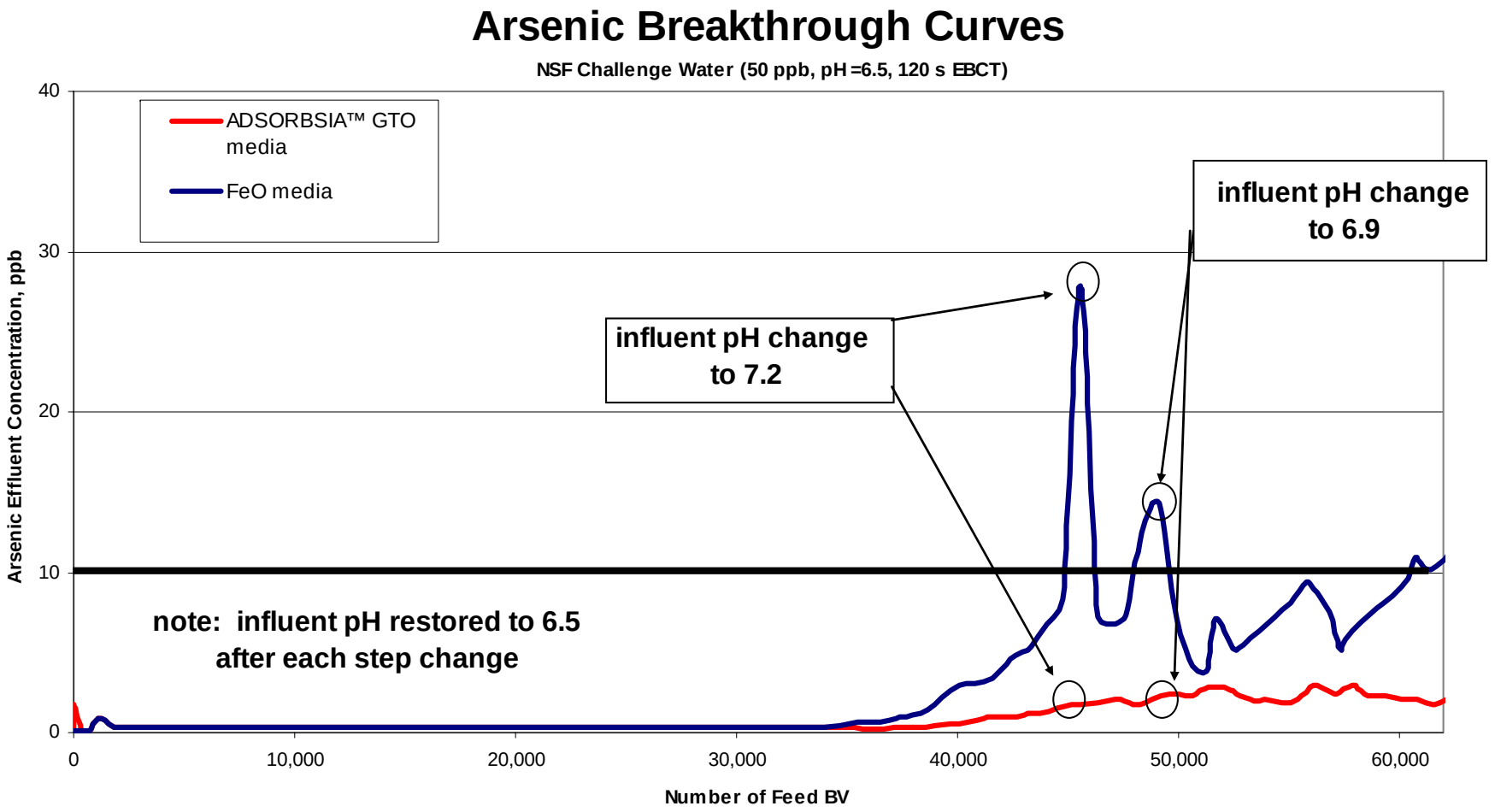
Best Over Wide Range of Water Conditions



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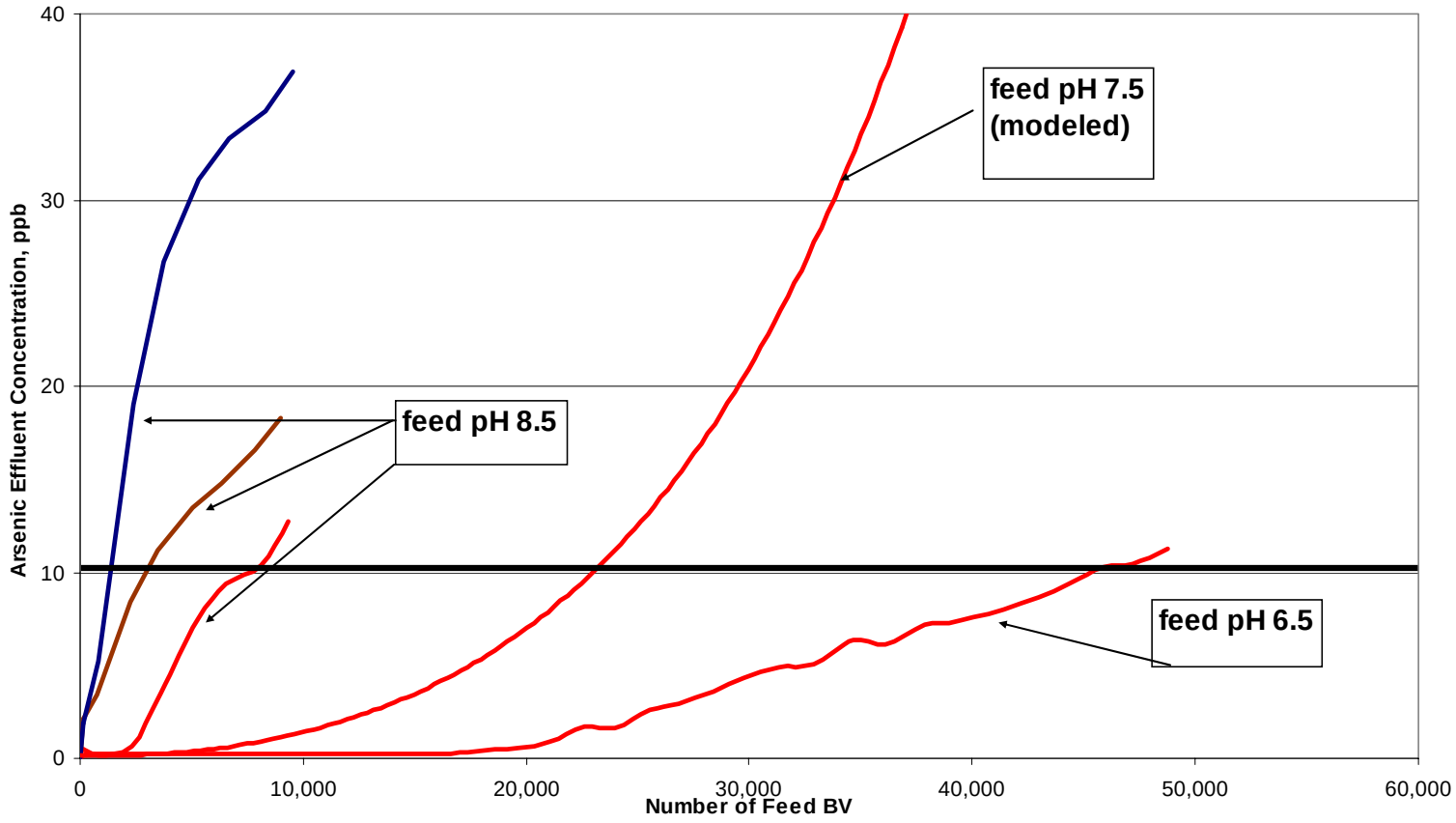
Best Over Wide Range of Water Conditions

ADSORBSIA GTO media Performance at various PH

NSF 53 Challenge Water (50 ppb As(V), 30 sec EBCT)



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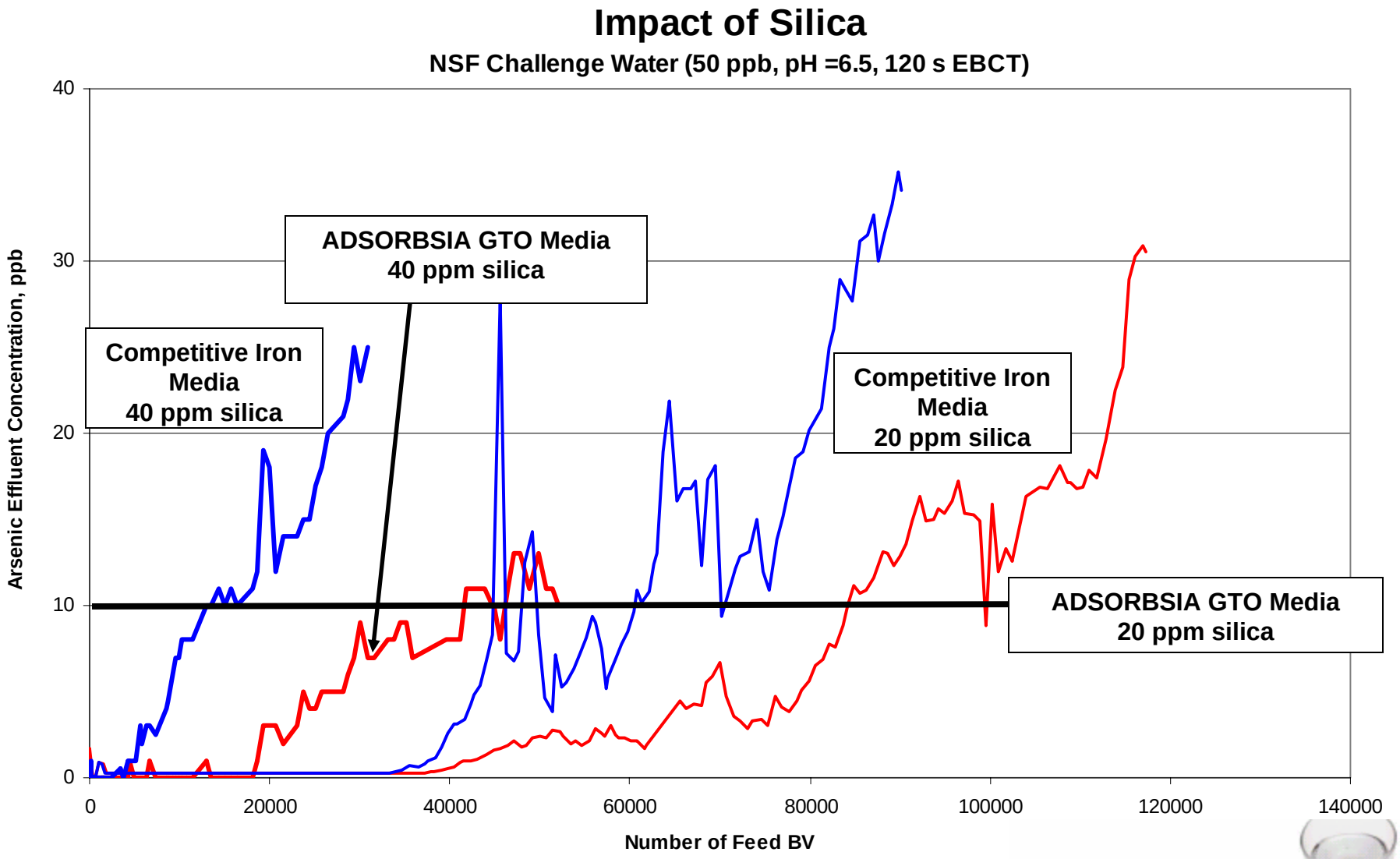
Best Over Wide Range of Conditions



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Best Over Wide Range of Water Conditions

Competing Ion Effects

- Sulfate
  - No impact on performance
- Phosphate
  - Appears to have little or no impact on capacity
- Vanadium
  - High capacity for Vanadium
  - Low levels (<10ppb) do not appear to have a significant impact on capacity
  - Impact on higher levels yet to be determined
- Iron
  - Soluble iron has not been shown to impact performance
  - Non-Soluble iron is filtered by the bed (backwashing required)
  - Non-soluble iron will adsorb arsenic and can effectively increase capacity

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Don't Take it From Us…

Third Party Validations

- Westerhoff (Arizona State University)
  - Kinetics >10X faster than iron media
- AWwaRF (analyzed earlier version of ADSORBSIA media)
  - Titanium based media hold arsenic better after pH change by an order of magnitude
  - Titanium based media best capacity for Arsenic (V)
  - Titanium based media least sensitive to competitive anions (sulfate, phosphate, silica, etc…)

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Logistics

- ADSORBSIA GTO arsenic removal media is available in several package sizes
  - Samples: 1L bottle
  - 1 cubic foot cardboard pack
  - 5 cubic foot fiber pack
- 30-60 day typical lead time for quantities <200 ft^3
- 60-90 day typical lead time for quantities >200ft^3
- Dow standard terms and conditions

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