

Adsorptive Media for Arsenic Removal

**Public Water System Compliance Using
POU and POE Treatment Technology**

NFS Conference

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Tom Sorg

U. S. Environmental Protection Agency

Adsorptive Media

What is it?

Media that has characteristics to attract the adsorbing material to its surface.

Adsorptive Media

How does it work?

Works on the principal of adhesion. The adsorbing materials adhere to the surface of the media by a combination of complex forces and chemical action

Adsorptive Media

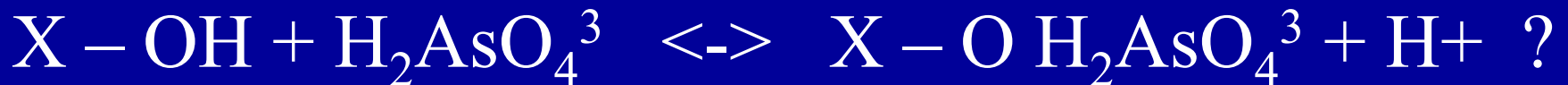
How does it work?

Chemisorption

Ligand (L) exchange



Surface Complexation



Adsorptive Media

Idea characteristics

- Arsenic selective (As III & As V)
- High removal percentage
- Fast adsorption kinetics
- Large removal capacity
- No impacts of water quality
- Good physical properties
- Low cost

Adsorptive Media

Do all media have the same characteristics?

No!

Differences exist between media that result in different capabilities:

Adsorption affinity

Adsorptive capacity

Physical properties

Adsorptive Media

for removal of arsenic from drinking water

Base Material

- Aluminum – AA, Modified AA
- Iron – Oxide, Hydroxide, Fe coated
- Other - Lanthanum Oxide, Zeolites, +

Adsorptive Media

Listed in NSF/ANSI Std 61

Base Material	Company	Material	Regeneration
Aluminum	Alcan (4)	AA, Mod AA	Yes
Aluminum	Alcoa (2)	AA	Yes
Aluminum	Apyron	AA	NA
Aluminum	Engelhard (2)	AA	Yes
Iron	ADI Inter	Fe Mod	Yes
Iron	SMI	Fe/S	NA
Iron	U.S. Filter	Fe Hydroxide	No
Iron	Bayer AG	Fe oxide	No
Zeolite	WRT	Zeolite Mod	No

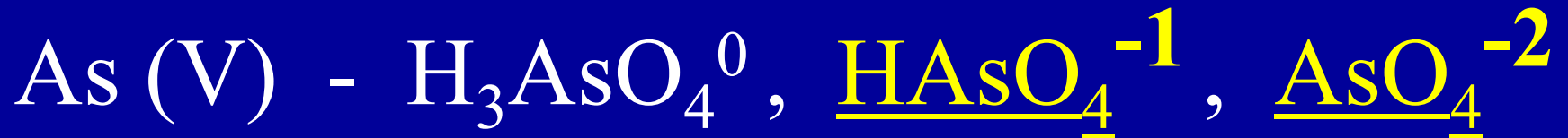
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Arsenic Chemistry

Arsenic Species



Activated Alumina Media

Selectivity - pH 5.5 – 8.5

From Clifford, AWWA, WQ&T 5th ed



Iron based media and other materials (?)
(Silica and phosphate)

Arsenic Occurrence (ug/L)

Untreated Ground Water

<u>Location/Source</u>	<u>Total</u>	<u>As III</u>	<u>As V</u>	<u>% As V</u>
Morton, IL	23	20	3	13
Holly, MI	35	31	4	11
Lewisburg, OH	81	76	5	6
Lewisburg, OH	117	87	30	27
Buxton, ME	42	>1	41+	98
Barnstead, NH	50	7	43	86
Oasis, CA	128	105	23	18

Arsenic Occurrence (ug/L)

Community Water Supply

Chlorinated Water – As V

Likely to be > 50 ug/L

NSF Testing Protocol

Separate Reduction Claims for

As III

As V

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Adsorption Processes

Processes

Removal

Activated Alumina

90+ %

Iron Media

90+ %

Arsenic Removal (%) Required to Achieve 10 ug/L MCL

Well	As Conc. ug/L	% removal required
1	25	60
2	52	81
3	77	87
4	125	92
5	225	95.6
6	498	98

NSF Testing Protocol

Two As Reduction Claims

<u>Challenge Level</u>	<u>% Reduction Required</u>
50 ug/L	80
300 ug/L	96.7

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Adsorption Media Kinetics

Media	EBCT (Min)
AA	5
Iron based	3 - 10

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Adsorptive Media

Water quality factors that
impact arsenic removal capacity

pH of source water

Competitive ligands such as Si, PO₄, etc.

Concentration of As and other ligands

Adsorption Capacity

Media	Capacity - BV's	Source
AA - pH 9.0, As 90 ug/L	800	Rubel, 1987
AA - pH 5.5, As 90 ug/L	10,000	Rubel, 1987
AA/Modified - pH 7.5, As 22 ug/L	12,000	Simms & Azizian, 1998
AA/Modified - pH 6.5, As 22 ug/L	57,000	Simms & Azizian, 1998
Iron – pH 7.6, As 18 ug/L	80,000	Dreihaus, et al. ,1998
Iron - pH 7.8, As 21 ug/L	37,000	Dreihaus, et al. ,1998

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Adsorption Media

Media Cost

Media	Cost \$/lb
AA	1 to 3
Iron	3 - 4

Summary

- Variety of media products currently exist.
- None have ideal characteristics.
- Media products have different capabilities.
- Important to select the right product for specific site conditions.

Tom Sorg

USEPA

Cincinnati, OH 45268

513-569-7370

sorg.thomas@epa.gov