

ADSORPTION MEDIA FOR ARSENIC REMOVAL

Darren A. Lytle, Jeremy M. Payne, Thomas J. Sorg
U.S. Environmental Protection Agency
ORD, NRMRL, WSWRD, TTEB,
Cincinnati, Ohio 45268

Lytle.darren@epa.gov

Objective

- Introduce adsorption media used for arsenic removal
- List properties of arsenic adsorption media

History

- Aluminum
 - Activated Alumina in use past 20-30 years
- Fe minerals adsorb anions
 - Goethite, Hematite, Zero Valent Fe, etc.
- First iron based materials for arsenic removal emerged in the 1990's
- Materials are proprietary in nature
- Key - Produce a robust yet affordable material

Properties that Impact Arsenic Removal

- Mineralogy
- Surface Area
- Zeta Potential (Point Zero Charge)
- Crystal Size
- Additives

Fundamental Materials

- Alumina
 - Activated Alumina
 - Modified Alumina
- Iron
 - Iron Minerals
 - Iron Coated Materials
- TiO_2
- Modified Zeolite -
- Zirconium

Disclaimer

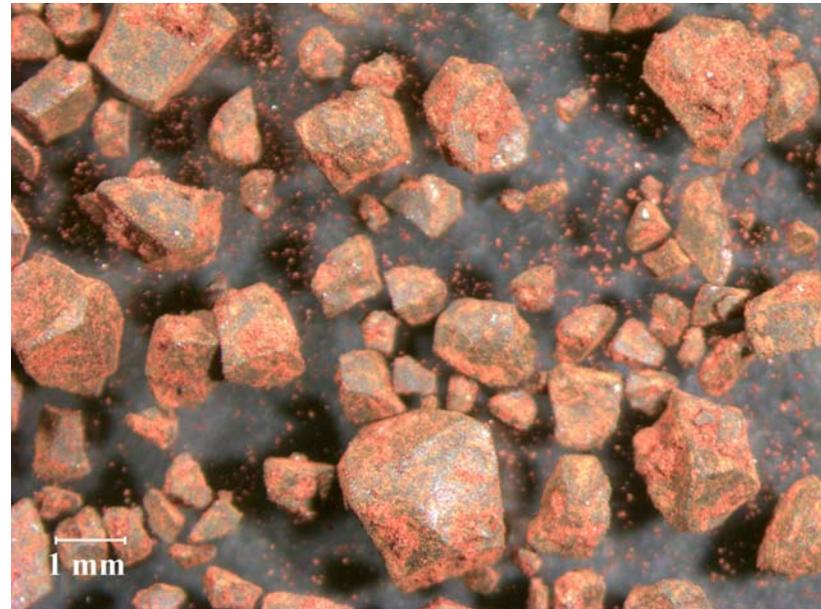
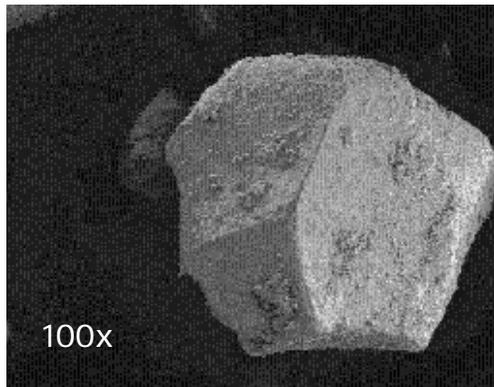
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Iron and Iron Coated Media

Product	Manufacturer	Material
GFH	GEH Wasserchemie GmbH and Co. (USFilter)	Fe(OH) ₃ and FeOOH Akagenéite (β - FeOOH)
Bayoxide E33	Bayer (Severn Trent, AdEdge)	90% α -FeOOH (Goethite)
Media G2	ADI	Ferric hydroxide coated diatomite
ARM 200	Engelhard	Iron Based (Hematite, α -Fe ₂ O ₃)
SMI-III	SMI	Sulfur modified iron

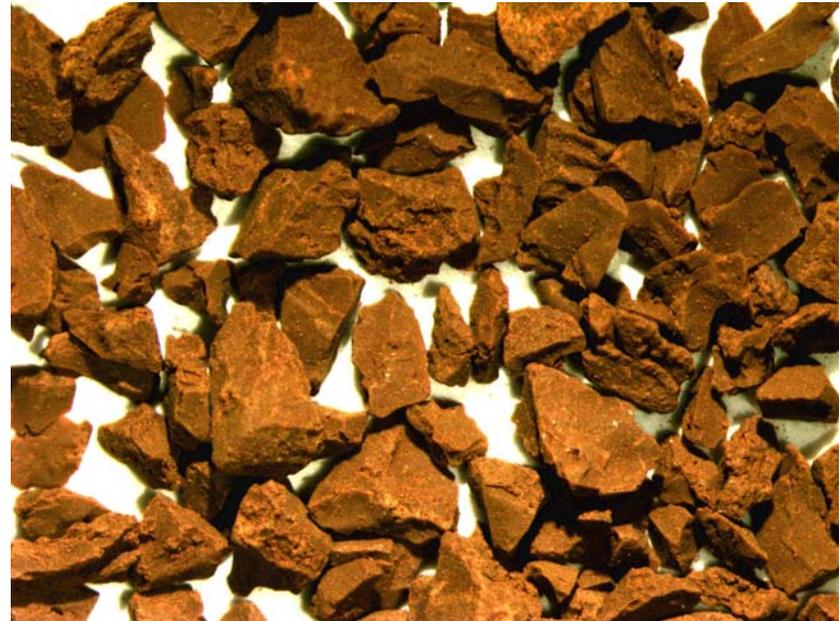
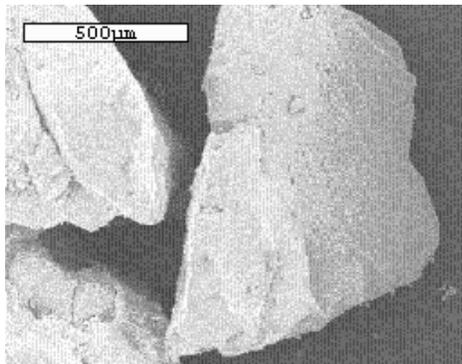
Granular Ferric Hydroxide (GFH)

- GEH Wasserchemie GmbH and Company (U.S. Filter)
- Akagenéite (β -FeOOH)
- Commercially available
- NSF approved
- Shipped wet



E33 Bayoxide

- Bayer (Severn Trent, AdEdge)
- Goethite (α -FeOOH)
- Commercially available
- NSF approved



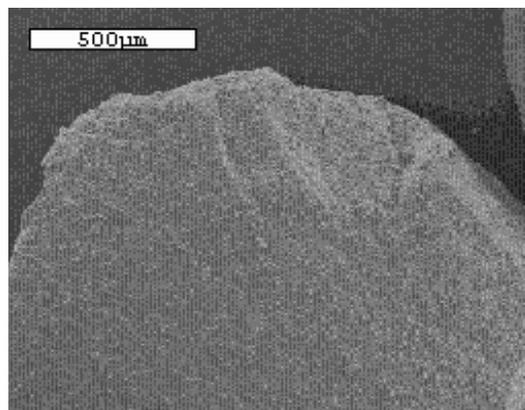
Media G2

- ADI International
- Ferric hydroxide coated calcined diatomite
- Commercially available
- NSF approved



ARM 200

- Engelhard Inc.
- Hematite, $\alpha\text{-Fe}_2\text{O}_3$
- Commercially available
- NSF approved



Alumina Based Media

Product	Manufacturer	Material
AA-400G	Alcan Chemicals	Activated Alumina
AA-FS50		Activated Alumina with proprietary additives <i>Boehmite, γ-(AlOOH)</i>
ARM-100	Engelhard Inc.	Alumina with proprietary promoters
CPN-AA	Alcoa	Activated Alumina
Aqua-Bind EP	Apyron Technologies	Activated Alumina
Aqua-Bind MP	Apyron Technologies	Metal Oxide composite

AAFS-50

- Alcan Chemicals
- Activated alumina
Boehmite, γ - $\text{AlO}(\text{OH})$
- Commercially available
- NSF approved

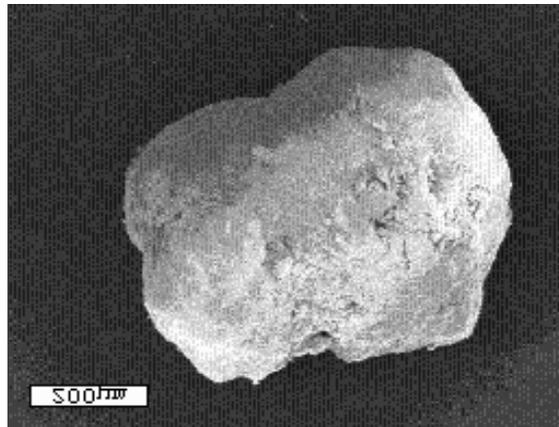


Other Media

Product	Manufacturer	Material
MetSorb	Hydroglobe	anatase (TiO ₂)
As:X ^{np}	McPhee Environmental	Porous polystyrene with iron based adsorbents
Z-33	Water Remediation Technology	Modified Zeolite
I solux	Magnesium Elekton	Zirconium Hydroxide

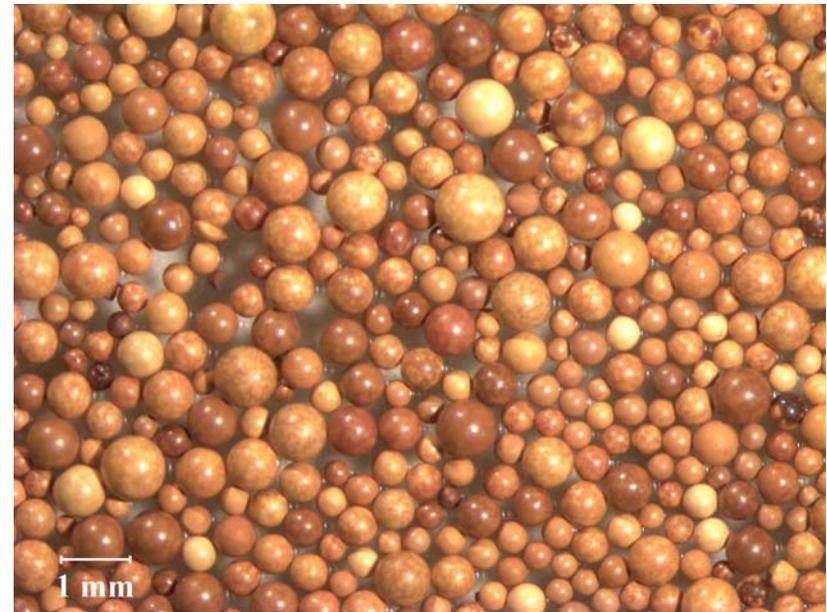
MetSorb

- Hydroglobe Inc.
- Microporous TiO_2
(Anatase)
- Commercially
available
- NSF approved



As:X^{np}

- Solometex (McPhee Environmental Supply)
- Porous polystyrene beads with iron oxide additives
- Commercially available
- NSF approved



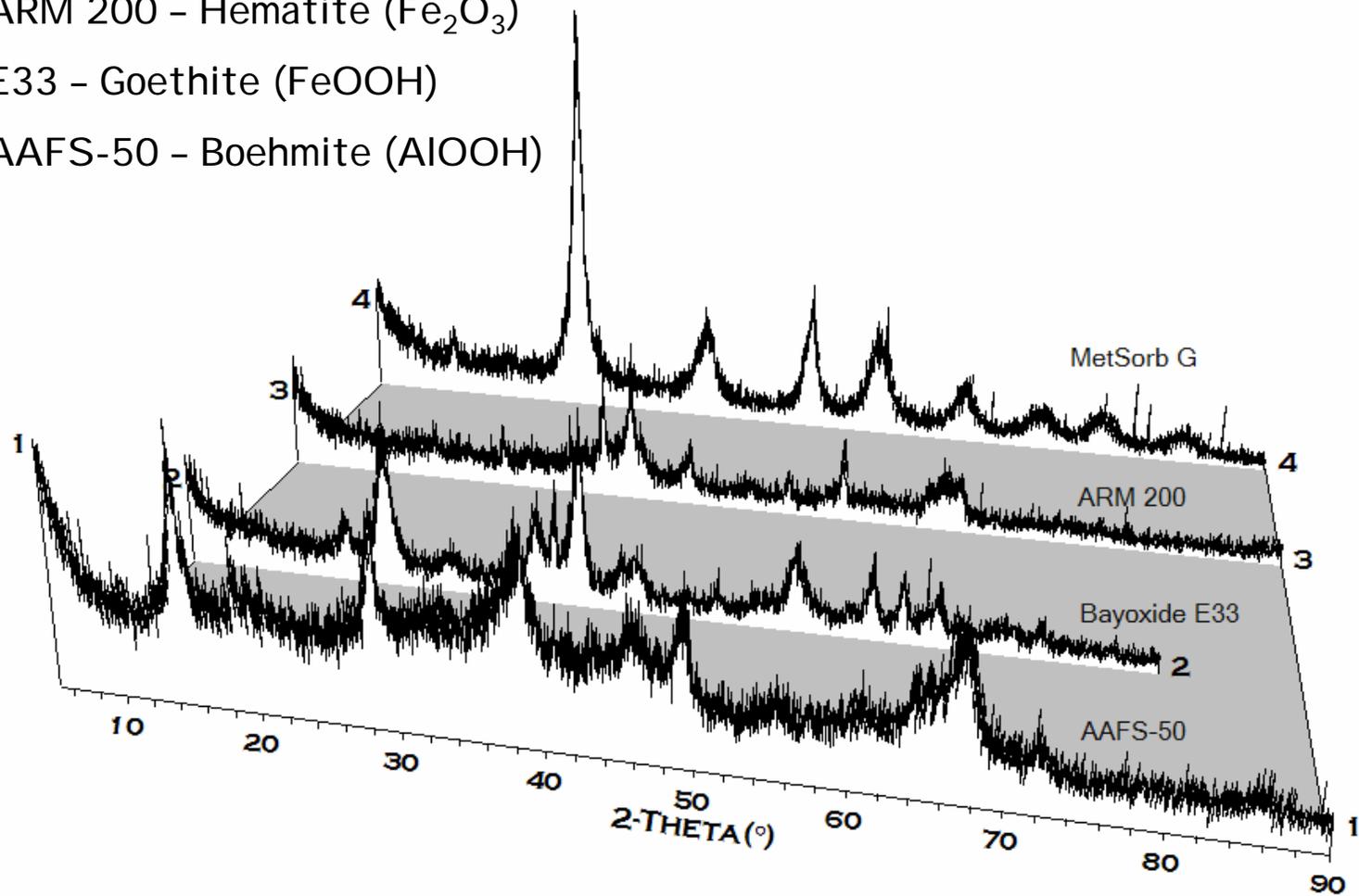
Mineralogy

MetSorb - Anatase (TiO_2)

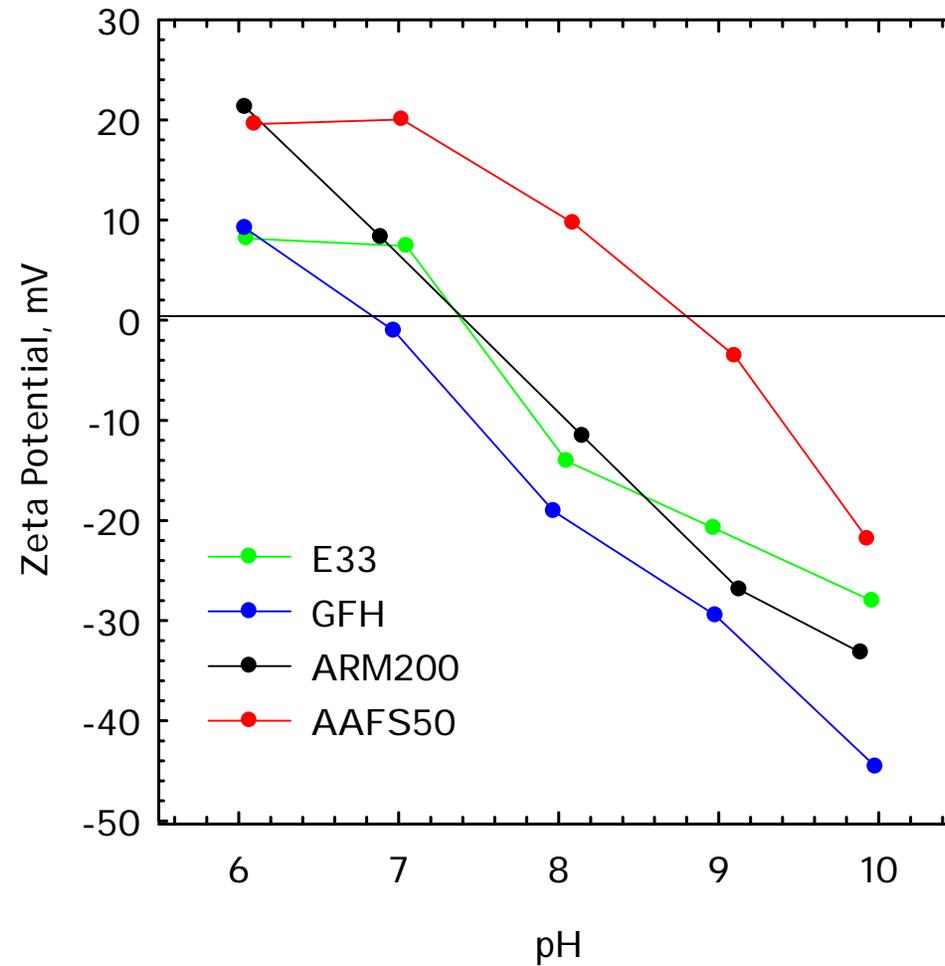
ARM 200 - Hematite (Fe_2O_3)

E33 - Goethite (FeOOH)

AAFS-50 - Boehmite (AlOOH)



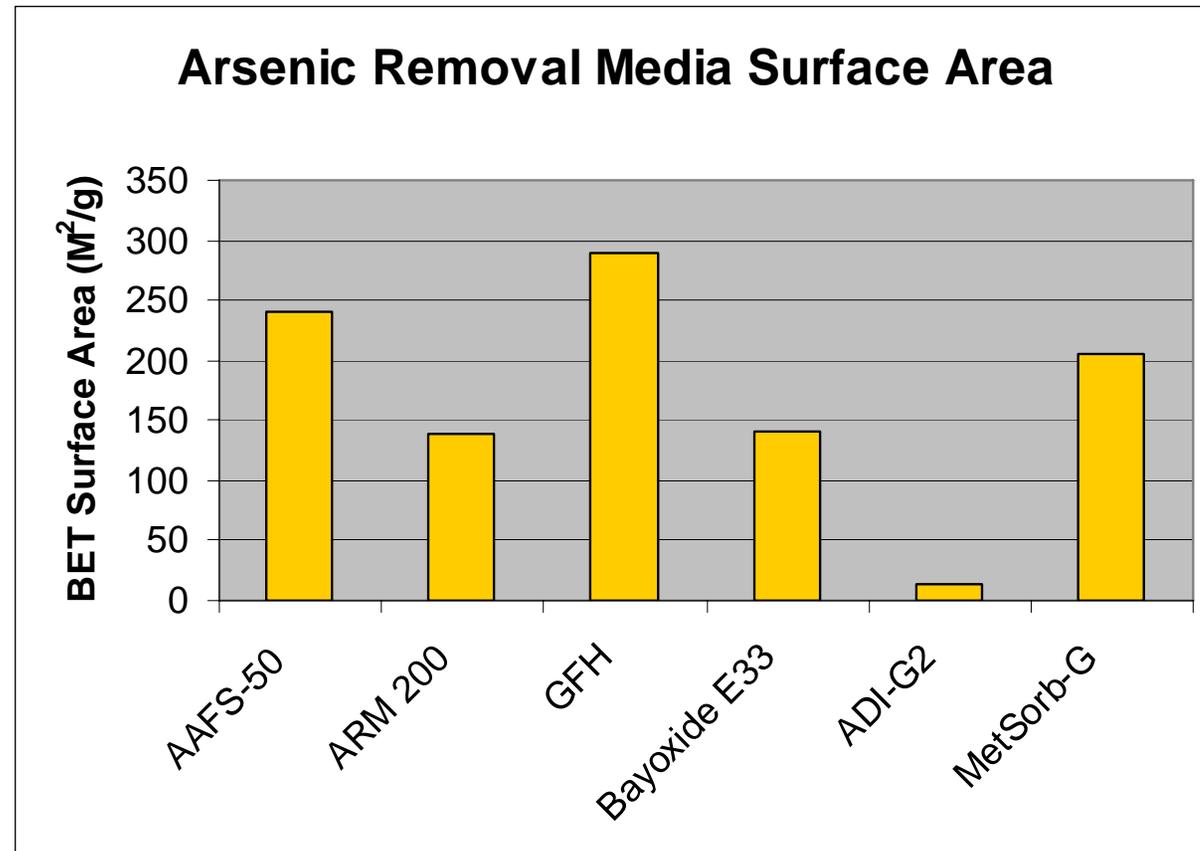
Zeta Potential



Surface Area

Product	Material	BET surface Area (M ² /g)	Bulk Density (g/cm ³)
GFH	β -FeOOH (akagenéite)	127 (290.2)	1.25
AAFS-50	γ -AlOOH (boehmite)	200-250 (240.4)	0.91
MetSorb G	TiO ₂ (Anatase)	(205.8)	0.75
E33	α -FeOOH (goethite)	142 (140.2)	0.45
ARM 200	α -Fe ₂ O ₃ (Hematite)	(138.0)	0.76
Media G2	Ferric hydroxide coated diatomite	27 (14.2)	0.75

Surface Area



Size

Product	Material	Effective or Mesh Size
GFH	β -FeOOH (akagenéite)	0.32 - 2mm
AAFS-50	γ -AlOOH (boehmite)	28x48
E33	α -FeOOH (goethite)	10x35
ARM 200	α -Fe ₂ O ₃ (Hematite)	40x80
Media G2	Ferric hydroxide coated diatomite	0.32 mm
Granular Activated Carbon (GAC)		8x30, 12x40
Anthracite		1.0 mm
Fine Silica Sand		0.4 -0.55mm

Evaluation Criteria

- Cost
- Ability to reduce arsenic
- As(III) vs. As(V)
- Bed Volumes before disposal/regeneration
- Competitive adsorption

Evaluating Media

- Literature review
- Comparing other sites
- Bench/Pilot tests

Conclusions

- Wide variety of base materials available
- Mineralogy, surface area, zeta potential differ
- Link between properties and arsenic removal are unclear
- Developing industry

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