Lecture #52

**Redox Chemistry:** Arsenic I, Intro and Treatment

*(Stumm & Morgan, Chapt.8)*

Benjamin; Chapter 9
Regulatory Dates I

- 1942, Public Health Service Establishes 50 ppb Standard
- 1975, EPA formalizes 50 ppb Standard
- 1989, EPA misses the First of Several Deadlines for Revising Rule
- June 22, 2000, EPA Proposes MCL of 5 ppb
- January 22, 2001, EPA Publishes Final Rule, MCL of 10 ppb
Regulatory Dates II

- March 20, 2001, EPA Announces it will “Reassess” Costs and Scientific Issues, Delay Rule 60 Days
- April 23, 2001, EPA Announces Additional Delay of Nine Months
- July 19, 2001, EPA Request Comment on MCL’s of 20, 5 and 3 as Alternative to 10 ppb
- October 31, 2001, EPA announces that As standard will be 10 ppb (effective 2006?)

From presentations by Brandhuber (2001) & Kempic (2001)
Impact to Utilities, Alternative MCL’s

From presentation by Philip Brandhuber (2001)

EPA: Federal Register 65(121): 38888
Key Features of Arsenic’s Chemistry in Water

- Present in two Oxidation States
- Behaves as an Acid

Arsenate (As(V))
- $\text{H}_3\text{AsO}_4 \Rightarrow \text{H}_2\text{AsO}_4^- \Rightarrow \text{HAsO}_4^{2-} \Rightarrow \text{AsO}_4^{3-}$

Arsenite (As(III))
- $\text{H}_3\text{AsO}_3 \Rightarrow \text{H}_2\text{AsO}_3^- \Rightarrow \text{HAsO}_3^{2-}$

From presentation by Philip Brandhuber (2001)
Coagulation

- As(V) is much better removed than As(III)

From: Hering & Elimelech, 1996; AWWARF Report
Coagulation

- Alum vs Ferric

From: Hering & Elimelech, 1996; AWWARF Report
• **Oxidize**
  - Cl₂ - MnO₄⁻ - O₃

• **Treat**
  - RO/NF - Coagulation/MF - Activated Alumina - Ion Exchange - Greensand - Iron media (GFH)

• **Dispose of Residual**
  - POTW - Dewater - Landfill

From presentation by Philip Brandhuber (2001)
• To next lecture