

CEE 680: Water Chemistry

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

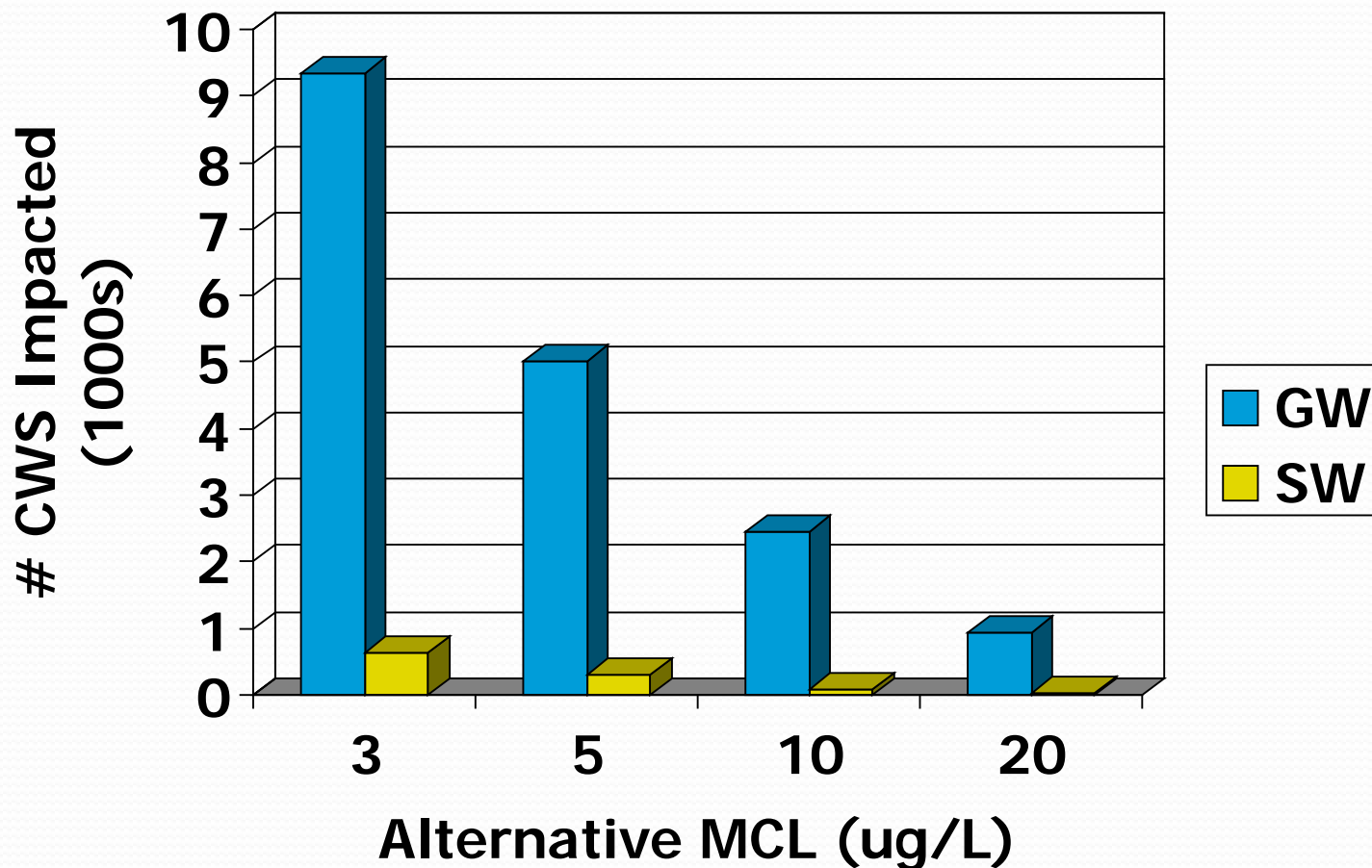
From presentation by Philip Brandhuber (2001)

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
- May 22, 2001, EPA Announces Delay Until February 22, 2002
- 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)

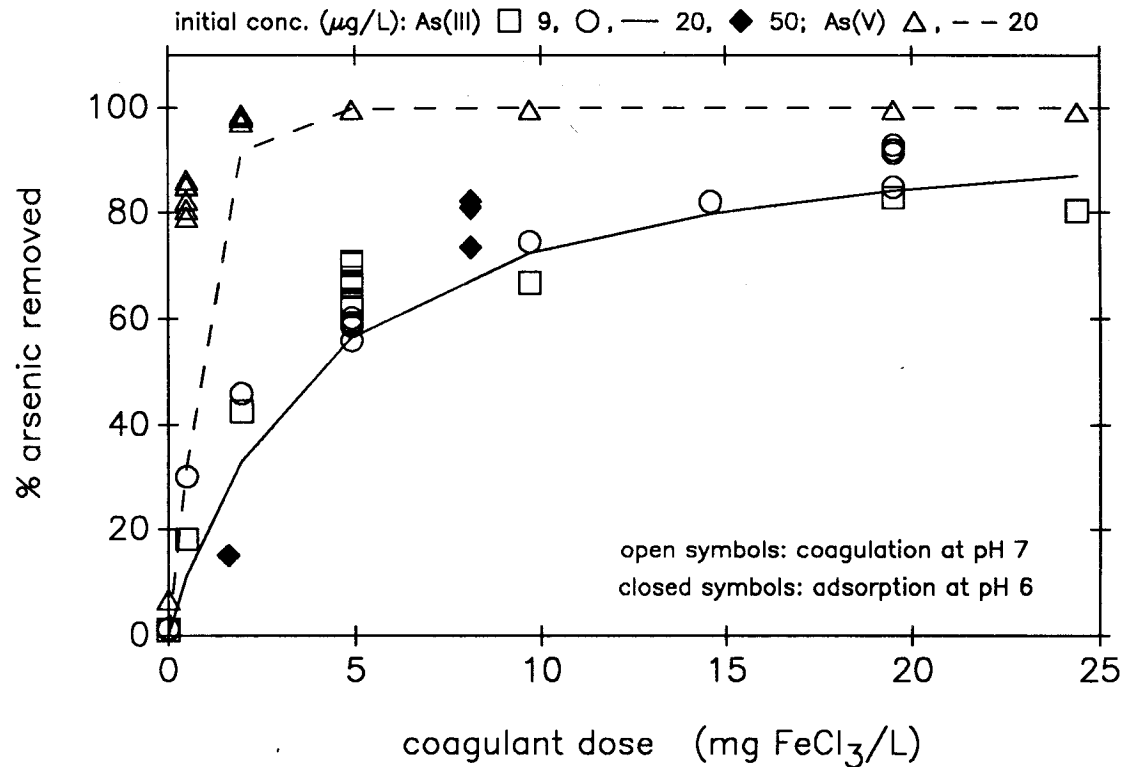
EPA: Federal Register 65(121):38888

- 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

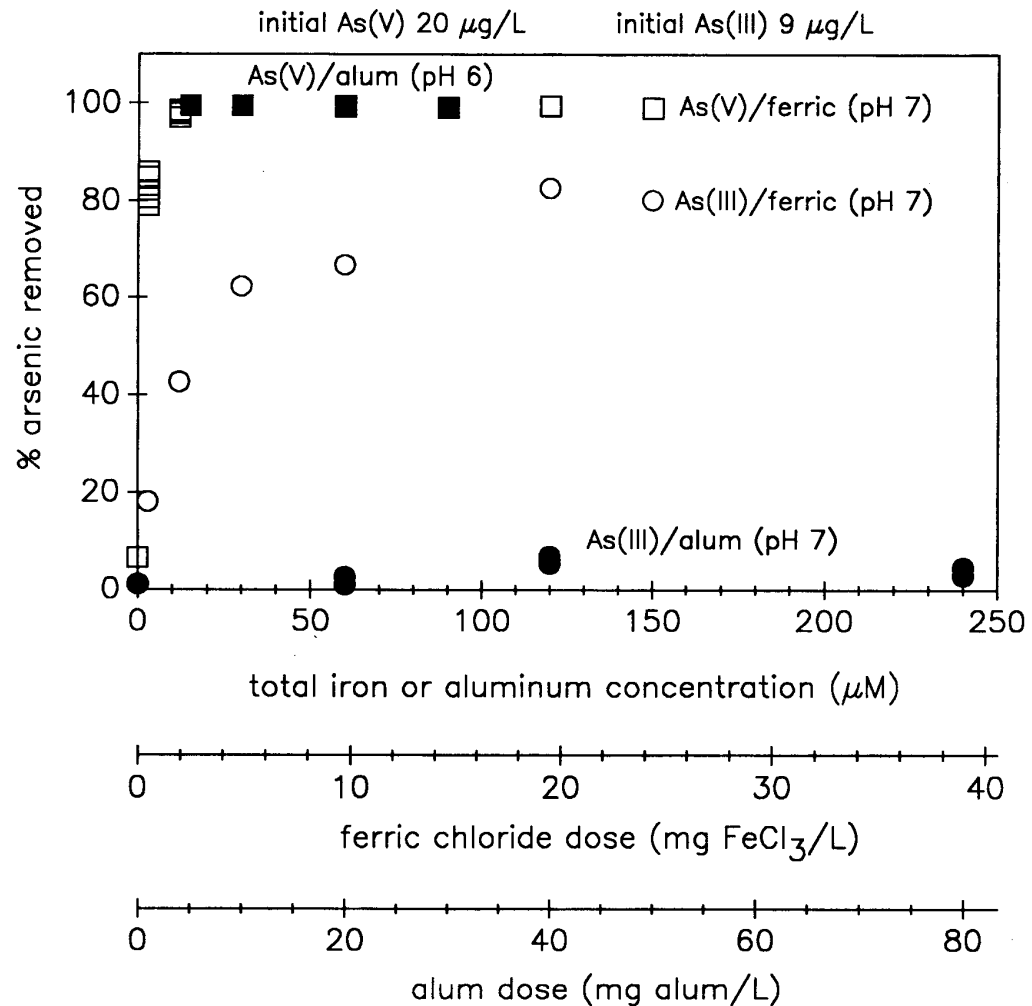
- As(V) is much better removed than As(III)



From: Hering &
Elimelech, 1996;
AWWARF Report

Coagulation

- Alum vs Ferric



From: Hering &
Elimelech, 1996;
AWWARF Report

- Oxidize

- - Cl_2 - MnO_4^- - O_3

- 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