

Legislative Driven Drinking Water Standards

Hexavalent Chromium

WESTCAS Fall Conference

Tucson, Arizona

October 29, 2009



Parameter Based Legislation

- Moving away from SDWA approach
 - Arsenic
 - Radon
 - Perchlorate
- Legislator buffet
- State legislation
 - MTBE, perchlorate
 - Hexavalent chromium (Cr6)



Chromium in Water

- Sources
 - naturally leached from rock (chromic oxide)
 - industrial pollution (chromate)
- Groundwater occurrence
 - Cr³⁺ vs. Cr⁶⁺
 - CA: 2,500+ sources >1 ppb
- Surface water occurrence
- Water systems
 - Cl₂ oxidizes Cr³⁺ to Cr⁶⁺



Health Information

- Non-cancerous effects (Cr6>Cr3)
- Cr6 cancerous when inhaled
 - occupational exposure studies
- Ingestion carcinogenicity inconclusive (EPA, WHO)
- CA OEHHA exposure assumption
- Dietary Cr is essential (50-200 ug/day)
 - primary source is food (93-98%)



Dissolution & Precipitation Reactions

Chromate ions will stay soluble unless a particular reactant is present

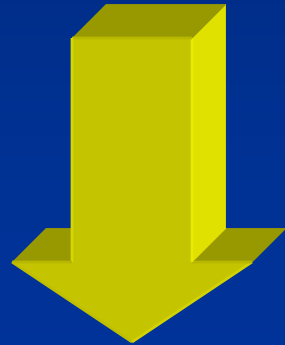
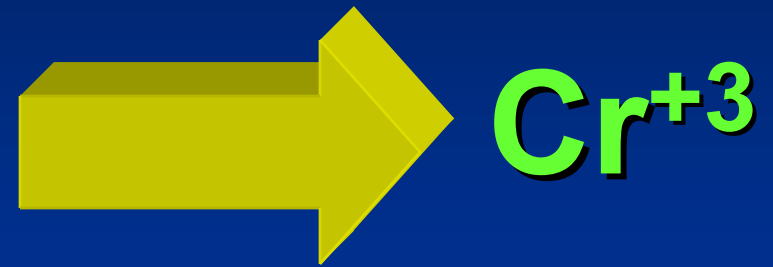
Chromium+3
Reacts with Water
to form
insoluble hydroxides

Low pH

$X^{+2} = \text{Ca, Fe, Al, Mg}$

Neutral pH

Reactions in Stomach



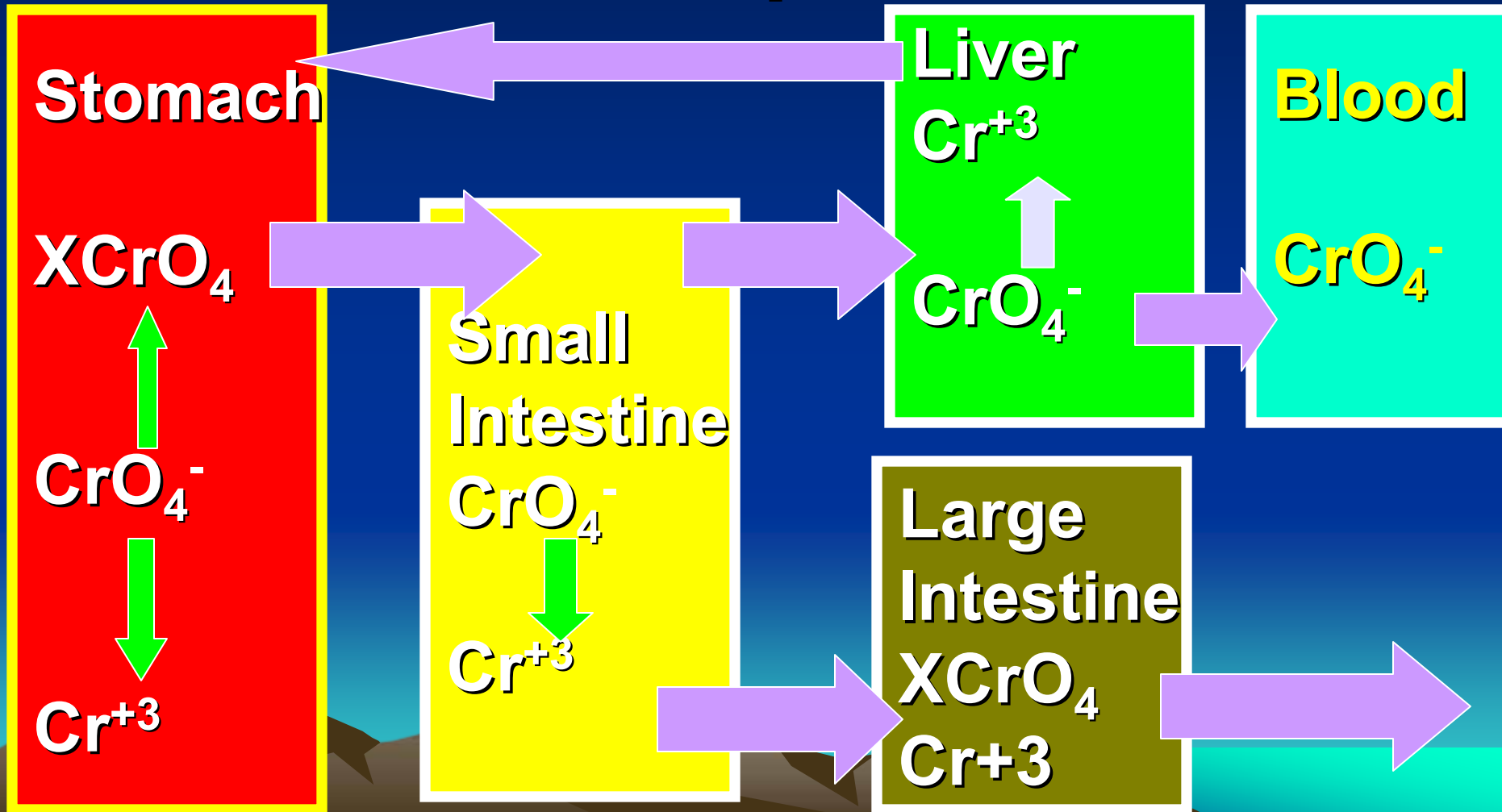
$\text{X} = \text{Ca, Fe, Al, Mg, Ba}$

Reduction vs.

Precipitation

NO Absorption

Gastrointestinal Reactions & Transport



Cr Regulation Timeline

- Existing MCLs (non-carcinogenic effects)
 - EPA MCL = 100 ppb (total Cr)
 - CA MCL = 50 ppb (total Cr)
- Mar 1999: OEHHA adopts 2.5 ppb PHG (total Cr)
- Mar 2000: Erin Brockovich
- Sept 2000: SB 2127 (Schiff) – Cr6 testing
- Sept 2001: UC expert panel report
- Oct 2001: SB 351 (Ortiz) – Cr6 MCL by 2004
- Nov 2001: OEHHA withdraws PHG
- April 2003: OEHHA fires back
- 2004: NTP study begins

NTP Study

- NIEHS used over 1,000 animals
 - F344/N Rats and B6C3F1 Mice
 - male & female study groups
- Groups exposed to 4 levels of Cr6
 - dosages: 5,000 – 180,000 ppb
- Levels at upper tolerance
 - low body weight & low water consumption
- Report published in July 2008



Survival Results

Test Group	Cr6 Drinking Water Exposure				
	Control	5,000 ppb	20,000 ppb (10,000 ppb)	60,000 ppb (30,000 ppb)	180,000 ppb (90,000 ppb)
Male Rats	28/50	30/50	30/49	36/50	29/49
Female Rat	33/50	32/50	32/50	36/50	31/50
(Male Mice)	33/50	35/50	35/50	38/50	32/50
Female Mice	37/50	39/50	45/50	42/50	42/50

Liver Inflammation (noncancerous effect)

Test Group	Cr6 Drinking Water Exposure				
	Control	5,000 ppb	20,000 ppb (10,000 ppb)	60,000 ppb (30,000 ppb)	180,000 ppb (90,000 ppb)
Male Rats	1/50	0/50	2/49	5/50	34/49
Female Rat	1/50	5/50	21/50	42/50	47/50
(Male Mice)	NA	NA	NA	NA	NA
Female Mice	2/49	15/50	23/50	32/50	45/50

Carcinoma Results*

Test Group	Cr6 Drinking Water Exposure				
	Control	5,000 ppb	20,000 ppb (10,000 ppb)	60,000 ppb (30,000 ppb)	180,000 ppb (90,000 ppb)
Male Rats	0/50	1/50	0/49	0/50	7/49
Female Rat	1/50	1/50	0/50	2/50	11/50
(Male Mice)	0/50	2/50	1/50	3/50	5/50
Female Mice	1/50	0/50	2/50	3/50	7/50

* Carcinomas found in Rats oral cavity or tongue & Mice small intestine

NTP Study - Clear Evidence or More Questions


- NIEHS: clear evidence of carcinogenic activity
 - M/F mice: small intestine carcinoma's
 - M/F rats: oral cavity carcinoma's
- Significant increase in carcinoma's only found at highest dose
 - stressed study group
- No excess cancers in low doses
 - supports carcinogenic threshold

Draft Cr6 PHG

- August 2009: PHG released for comments
- De minimus risk level = 0.06 ppb
- NTP study and Zhang & Li (1987)
 - Zhang & Li: 10,000 villagers, up to 2,600 ppb
 - Authors found no significant cancer increase
 - Reassessed by OEHHA (2008)
- Still uses flawed 1968 Borneff study
- Insignificant inhalation exposure in shower



Taking Action

- 10/19/09: PHG public hearing
 - 11/02/09: PHG initial comments due
 - Good science, expert peer review
 - Jan 2010?: final PHG comments
 - CA PWSs
 - Participate in PHG/MCL development
 - Treatment studies (City of Glendale: full-scale costs, ACWA: residuals disposal costs)
 - Other arid states
 - Cr6 occurrence
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Questions?

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