

REINHOLD ENVIRONMENTAL Ltd.



## **2014 NO<sub>x</sub>-Combustion Round Table & Expo Presentations**

February 10 & 11, 2014, in Charlotte, NC / Hosted by Duke Energy

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# **DSI Impacts on Fly Ash**

## *Fly Ash Leaching Study*



Discovering what's possible with calcium

**NO<sub>x</sub> Conference – Charlotte NC**  
*February 10, 2014*

# Hydrated Lime

- Calcium hydroxide, in presence of water, reacts with pozzolan (siliceous/aluminous material) to form cementitious properties (ASTM 618)
- Coal ash components: Si, Al, Fe & Ca
  - Trace toxic metal: As, Hg, Se, etc
- Calcium stabilizes heavy metals in ash
  - Pozzolanic reaction reduces permeability
  - Calcium precipitation critical in minimizing As/Se leaching (Wang *et al*, 2009)

# Trona's Impact on Coal Ash

## Class F & Class C Fly Ash- Missouri Univ. S&T

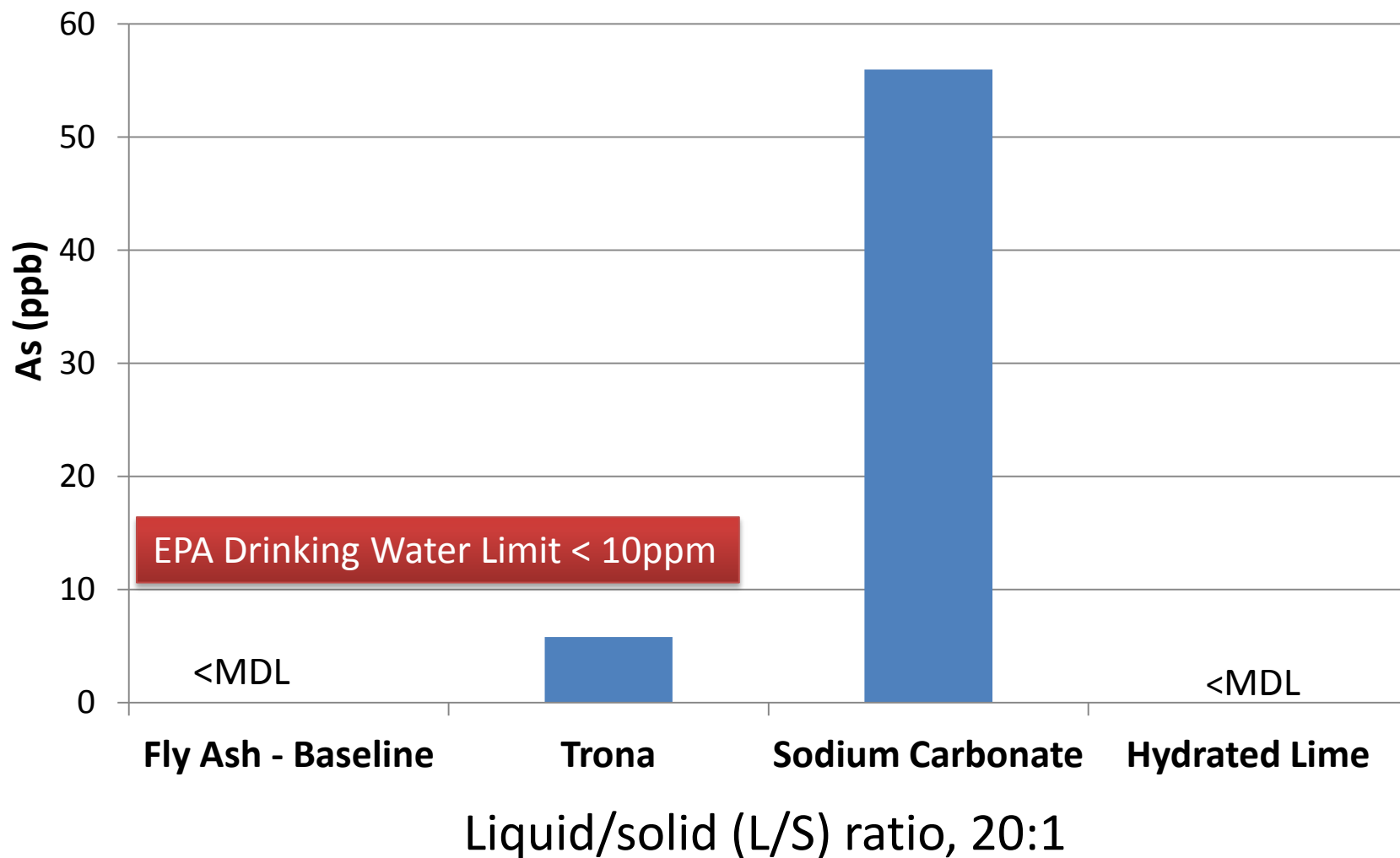
(Wang *et al*, 2011 & 2013; project funded EPPRI)

- Trona introduced significant soluble sodium compounds
- Elevated the pH of ash
  - As and Se leaching increased as pH increased in trona-laden ash
- Reduced ash surface area
  - Less adsorption sites for toxic metal
- Greater leachability of As, Se, Mo & V

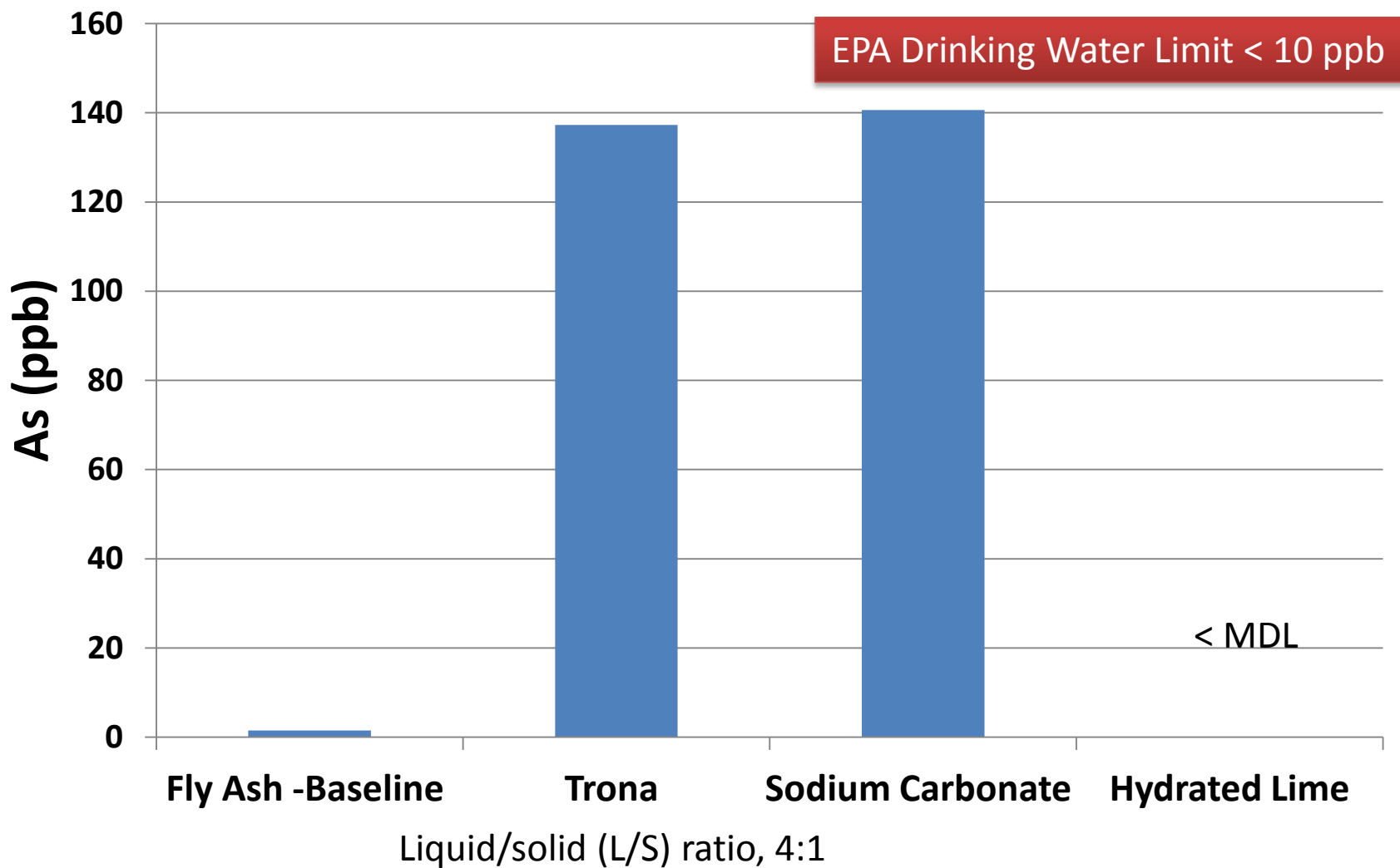
# Recent Fly Ash Leaching Study

- Synthetic precipitation leaching procedure (SPLP) per EPA Method 1212 adopted
  - Two liquid/solid ratios tested
    - 20:1 - SPLP, EPA Method 1312 with slight modifications
    - 4:1 - Modified SPLP
- Fly ash samples
  - Baseline, trona, and hydrate-based ash
    - Low sulfur PRB unit
    - Hydrate (HCl) and trona (SO<sub>2</sub>)
  - Sodium bicarbonate based ash
    - SO<sub>3</sub> control process
- Results obtained in early Feb 2014, additional programs planned
  - Presented here for example only (“Your actual mileage may vary”)
  - Work performed by Dr. H. Shi (Associate Res. Professor of Chemistry Dept.) & reviewed with Dr. J. Wang (Prof. of Environmental Eng.)

# Arsenic Leaching Results – 20:1 L/S Ratio

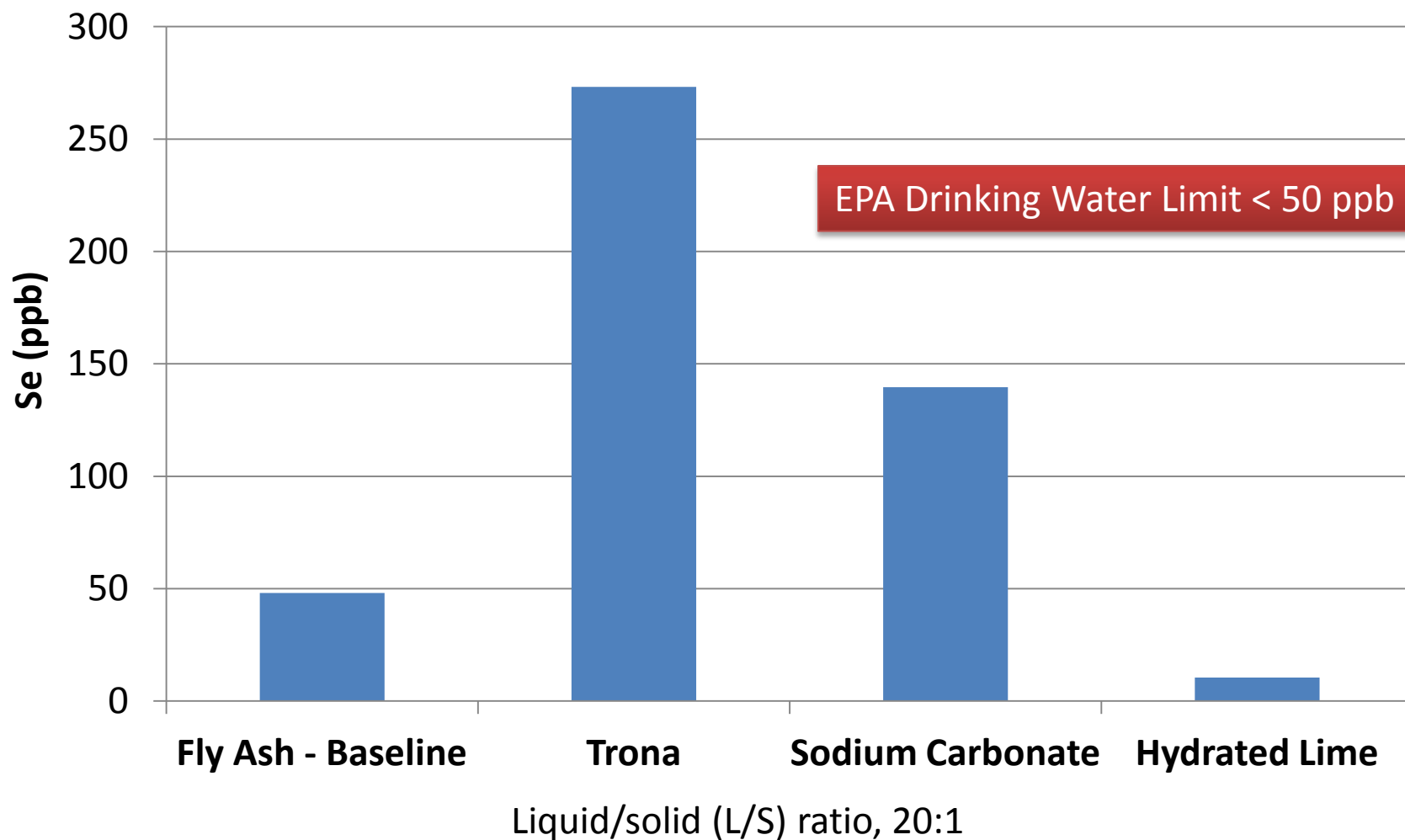


# Arsenic Leaching Results – 4:1 L/S Ratio

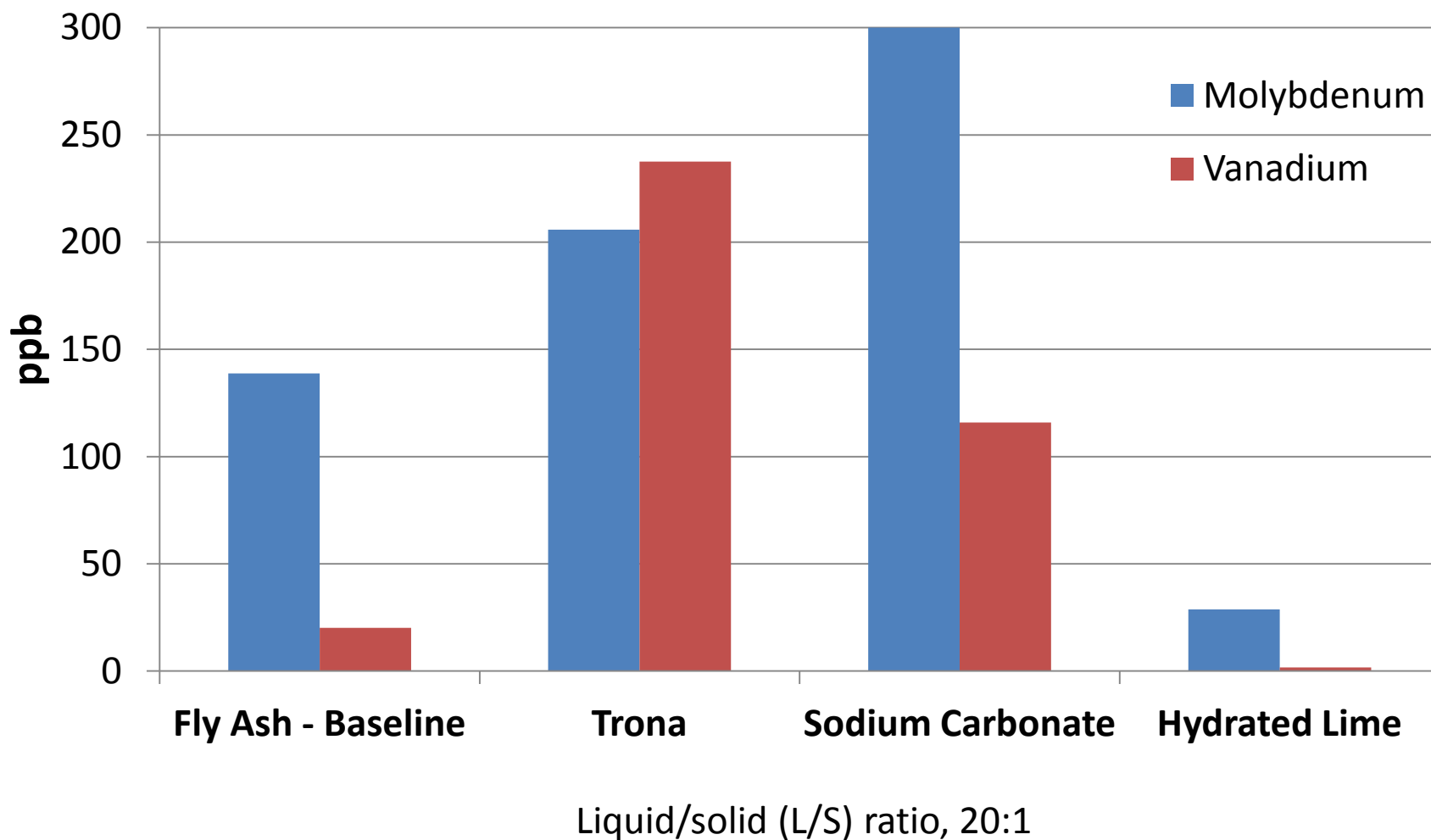


MDL: Method Detection Limit

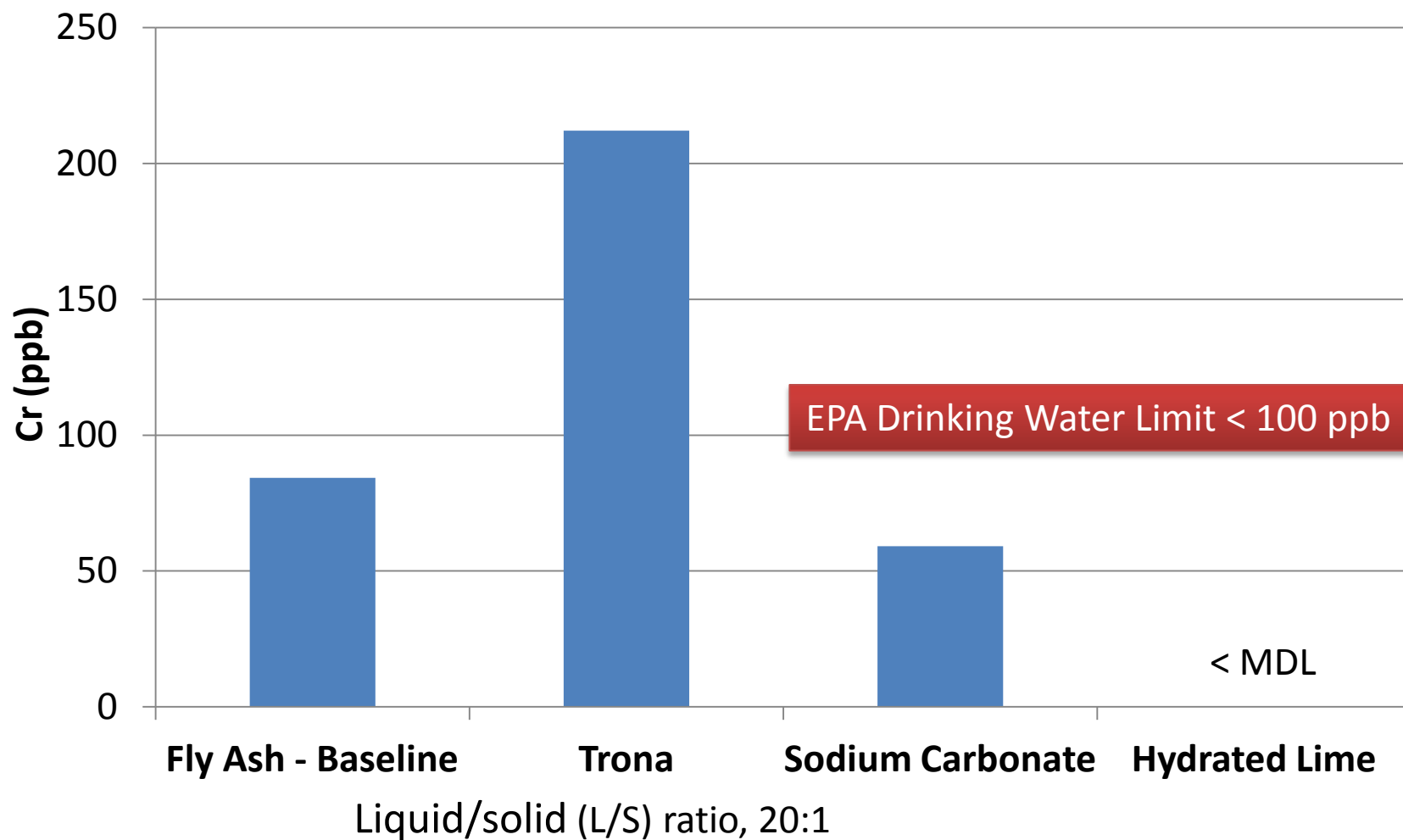
# Selenium Leaching Results



# Molybdenum & Vanadium Leaching



# Chromium Leaching



# Remarks on the Analysis

- Hydrated lime-based fly ash leached the lowest (some cases under detection limits) heavy metals in reference to EPA limit (MCL) for drinking water
- Sodium-based fly ash exhibited significant leaching of heavy metals
  - Selenium
  - Arsenic
  - Molybdenum
  - Vanadium
  - Chromium

# With DSI, be aware that

- Most existing DSI history is for systems aimed at mitigating  $\text{SO}_3$
- HCl and/or  $\text{SO}_2$  control is less efficient process
  - High pH ash due to excess Ca or Na from sorbent
  - Site management issues
    - Hydroveyor pluggage
    - Wet ash pond pH
    - Effects of water on dry ash with high pH
      - Calcium vs. Sodium

# Worried about DSI ash effects?

## *Use less sorbent: improve DSI system efficiency and reliability*

- Every sorbent type uses molar excess
  - Get that number ratio closer to 1:1
  - Maintain same (or better) pollutant(s) removal rate
- Consider mechanical and chemical issues

# Improving a DSI System can Reduce Fly Ash

- Better reliability (system OST) reduces sorbent usage
  - Keep lances clean
- Better flue gas coverage increases pollutant removal and improves sorbent utilization
- Next generation sorbents improve pollutant removal and offer better utilization

➤ **Less ash to the landfill**

# Questions

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