

Leaching Study of Coated Wood Pilings in Saltwater

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DEPARTMENT OF
SUSTAINABLE BIOPRODUCTS



Wood Durability in Coastal Waters

- Wooden structural elements are used globally in tidal and subtidal coastal areas
- Timber structures are often preferred in these areas for aesthetic appeal, ease of repair, and flexibility of use
- Pressure treatment of marine piles helps to extend the use life
- Treatments are limited - chromated copper arsenate (CCA) is used in immersed products, framing, stringers and bracing
- CCA is not allowed for decking, rails, caps, and other above-water components.





Other factors in piling lifespan



Decay Fungi



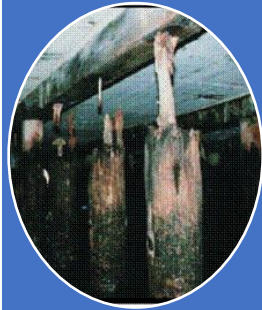
Wood Borers



Mechanical Stresses



Creep



High Impact Loading



Drying/Wetting



Metal sickness



Salt

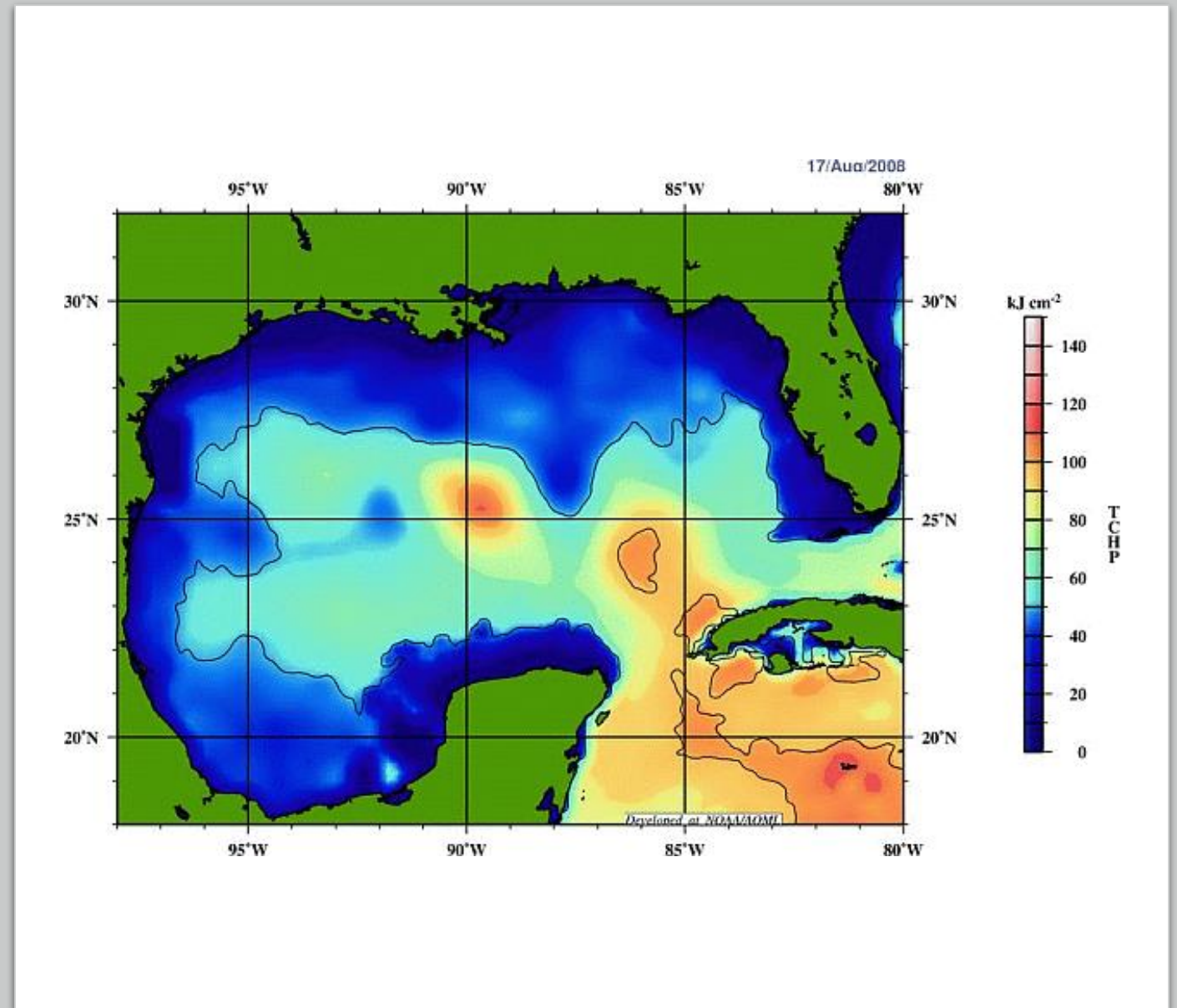


UV



Why focus on salinity first?

- Biological agents differ around the world by region
- Salinity is a constant – not only oceanic but also estuarine and marsh coastal areas
- Wooden structures are typically built in coastal environments
- 3 zones of salinity in US Gulf Coastal waters
 - Tidal Fresh = 0 – 0.5 parts per thousand (ppt)
 - Mixing – 0.5 – 25 parts per thousand (ppt)
 - Seawater Zone – 25 ppt or greater





Installation

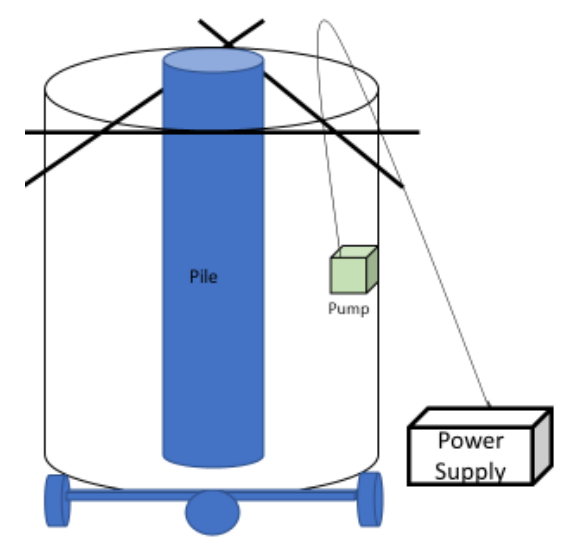
Pilings

- 8 in. diameter, 5 ft length SYP pilings were treated with CCA to 2.5 pcf by Lonza/Arxada
- Pilings were then coated with UL XP 6613 (A-side or B-side) from Ultimate Linings
- Pilings were delivered to the Dorman Lake Field Site testing facility at Mississippi State University and stored in controlled conditions in the Termite House until testing began



Experimental Plan

- 55-gallon drums were procured and placed on rolling drum dollies.
- Anchor holes were drilled at three points around the top of each drum
- The center of each drum lid was cut out, and each drum lid was placed into the lower portion of the drum to act as a support.
- Pilings were placed through the cut lid, and positioned in the center of each drum.
- A 36" zip tie was secured around each piling, and three zip ties were secured through it and through one of the three anchor points.
- Drums were labeled with the piling's number for identification



Experimental Plan

- Aqueon[®] 700 aquarium pumps were installed in each drum to ensure circulation with timer controls.
- Water was added to the 40-gallon mark.
- Based on previous experiments, a quantity of aquarium salt was added to each drum to create a salinity of approximately 15 ppt
- 15 mL water samples were collected from circulating water 1x/week for the first 4 weeks, and monthly for 6 months thereafter, ending in April 2022.

Results – Coated Pilings

- After 3 months of collections, water remained mostly clear
- Checks, knots, and other pole defects were apparent through both coating types
- Although visible, defects do not seem to be causing an issue



Results – Uncoated Pilings

- After 3 months of collections, water in all containers had a green coloration
- Not algae – water was sampled to look for algal cells
- Discoloration present in ALL uncoated piling drums





Results – Coated and Uncoated 6 Months

- Strong discoloration of water in uncoated piling tanks
- Surface discoloration of uncoated pilings at water line
- Salt deposits most common on uncoated pilings

ICP-Mass Spectrometry Analysis



Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) platform used for trace metal analysis



Best for low detection limit – at or below 1 part per trillion (ppt)



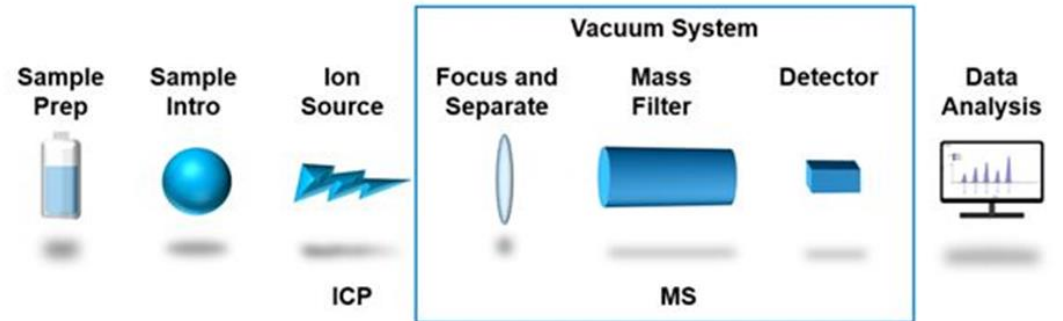
Working range is nine orders of magnitude



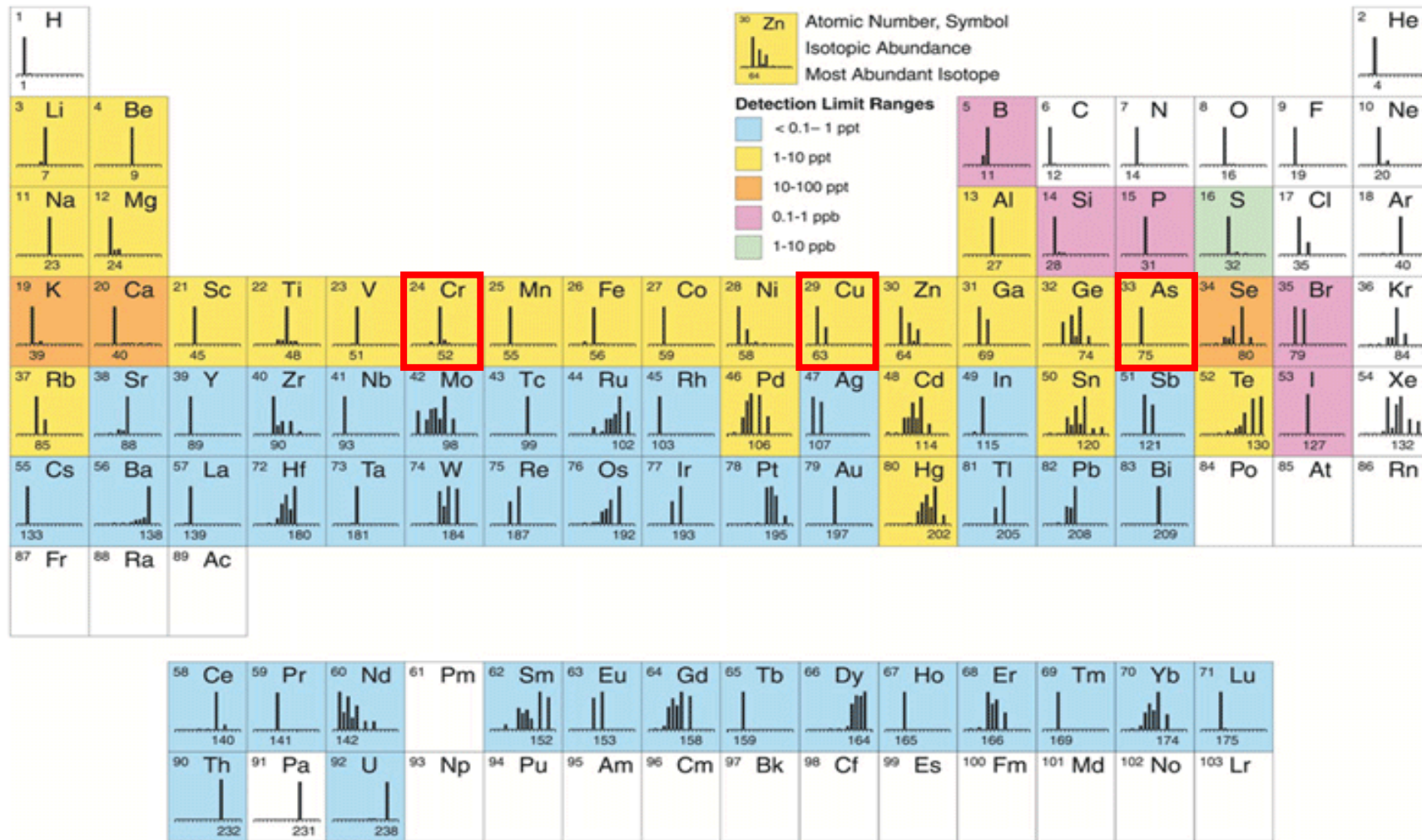
Counts per second (isotopes striking the detector) and concentration have a linear relationship

What does ICP-MS do?

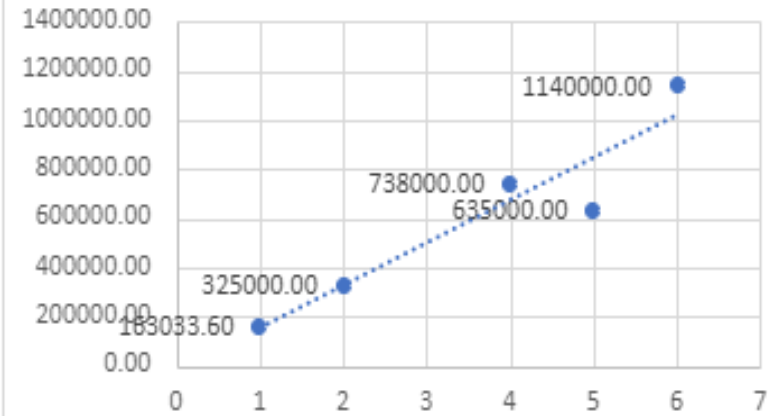
- Uses argon plasma to convert elements in an introduced sample to ions
- Focuses and separates ions from “other” signals
- Filters ions by mass
- Detects how many ions interact per second with detector
- Analyzes information, gives counts/second or concentration (mg/L)



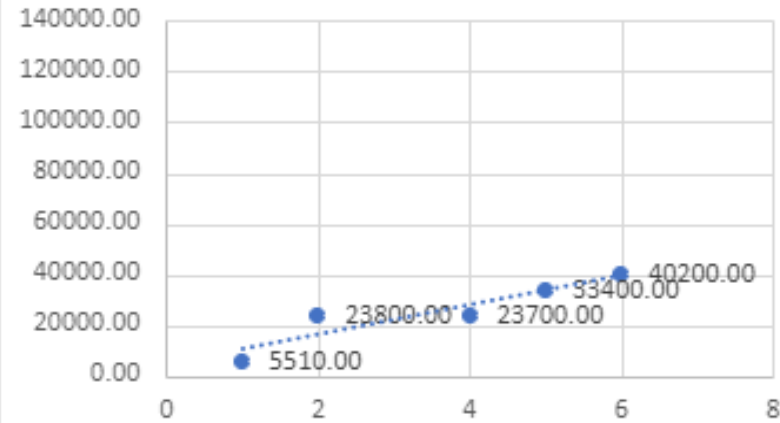
Measuring CCA



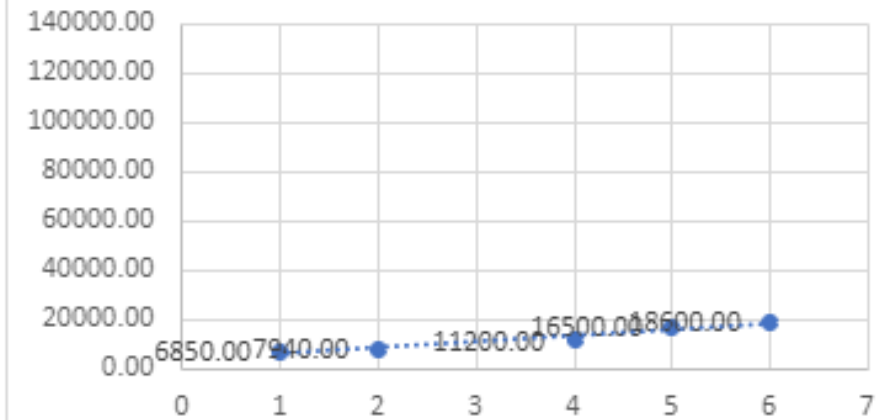
Control Cr52



Thin Cr52

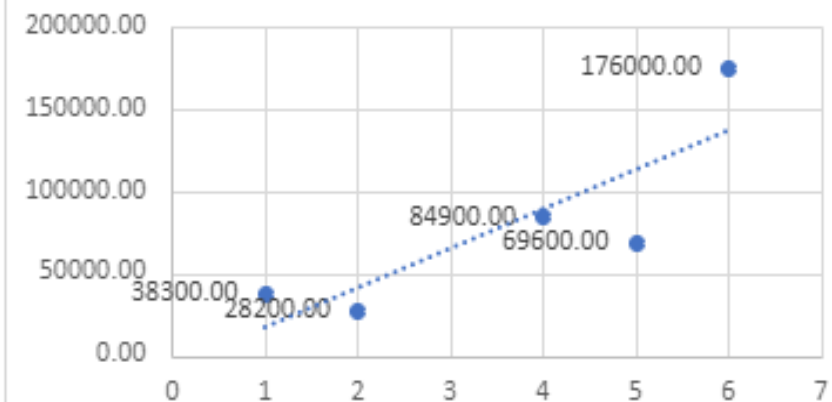


Thick Cr52

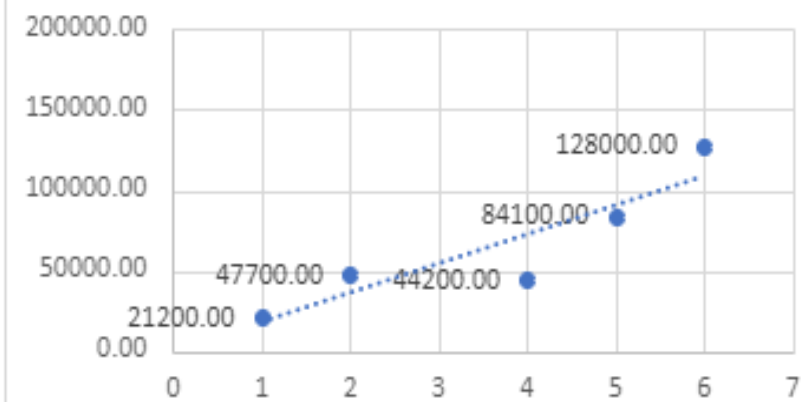


ICP-MS Data - Chromium

Control Cu63



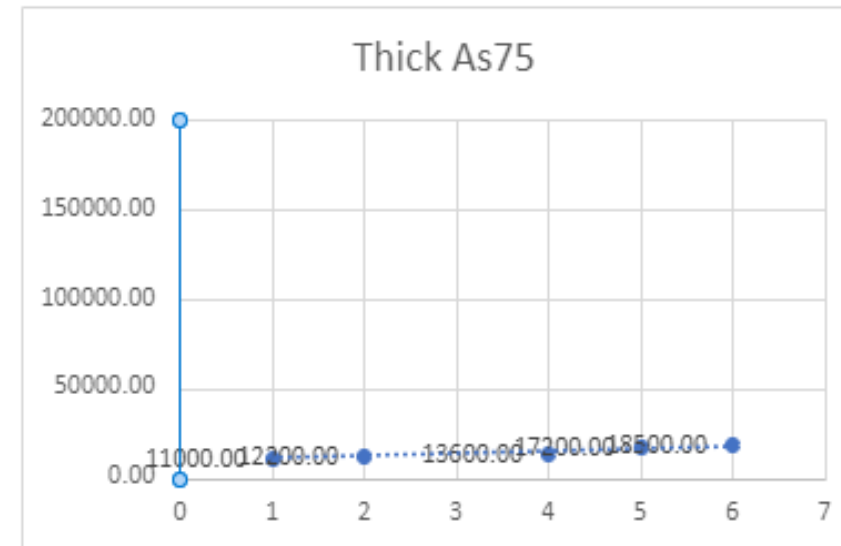
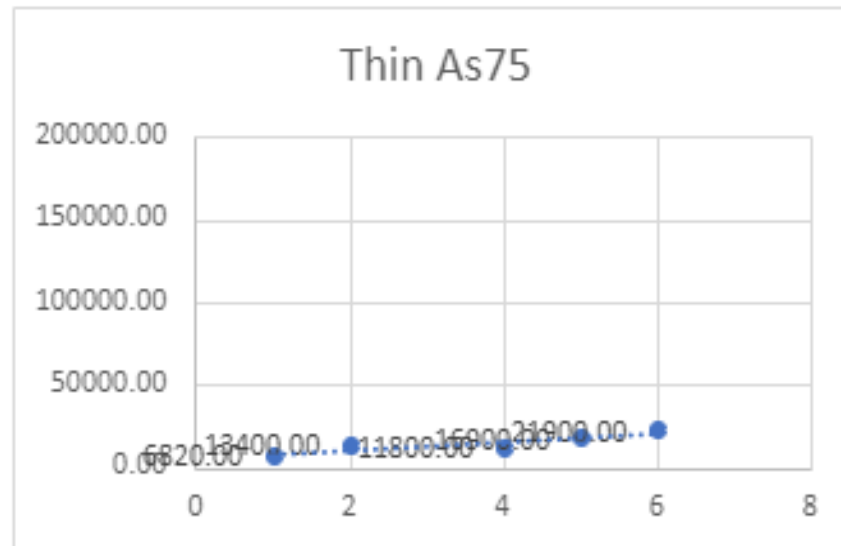
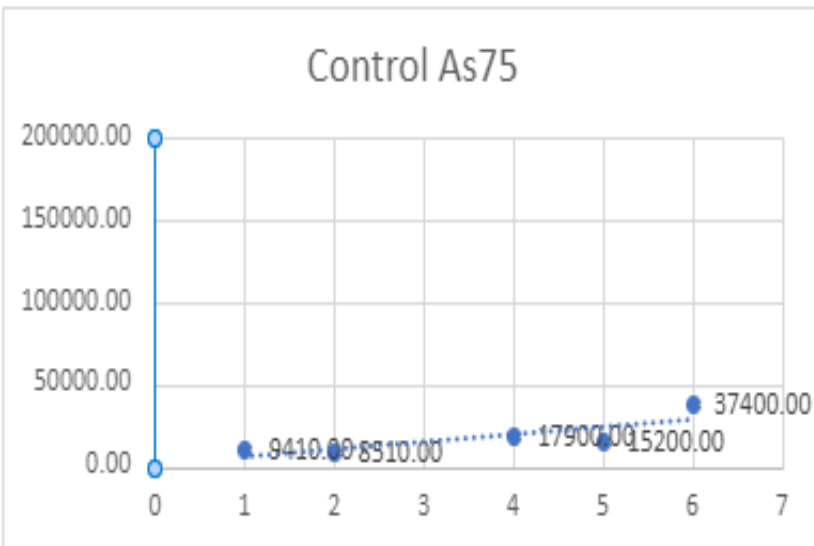
Thin Cu63



Thick Cu63



ICP-MS Data - Copper



ICP-MS Data - Arsenic

Conclusions...for now

- Water samples from uncoated control samples increased in chromium content an order of magnitude more rapidly than coated samples.
- Water samples from coating group A are increasing in chromium content slightly more than water samples from coating group B.
- Last three readings of ICP-MS produced inconclusive data
 - MS State Chemical Lab will repeat analysis
- Levels of chromium, copper, and arsenic are low in water samples but still higher than EPA recommended acute limits
- Project will continue with updates/modifications

Thank you!

Sponsorship of project:



Sponsorship of student researcher:

