

Acid Life Extension

**New York State Pollution Prevention
Institute**

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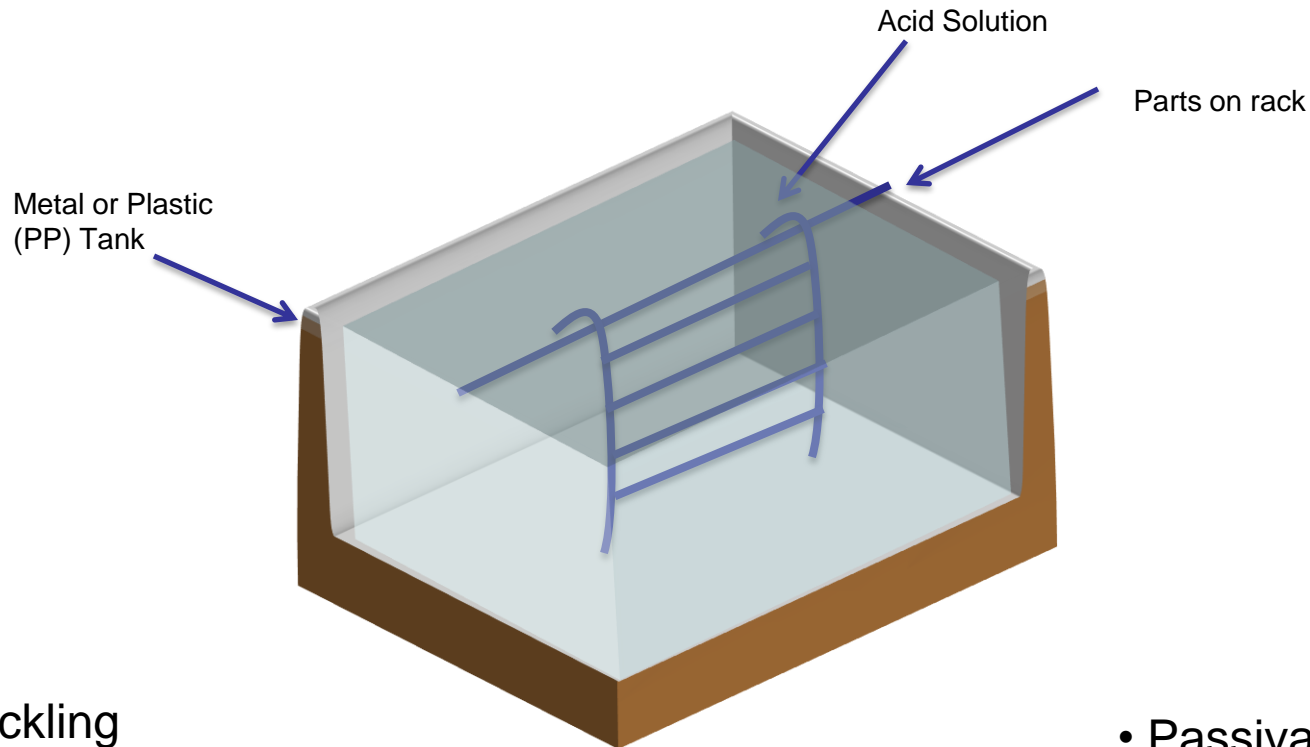
Acid Life Extension

- What is it?

Acid Life Extension involves increasing the usable life of an acid bath while reducing the amount of acid consumed, consequently reducing the number of times the acid bath is dumped and making the process more consistent, over a given time period.



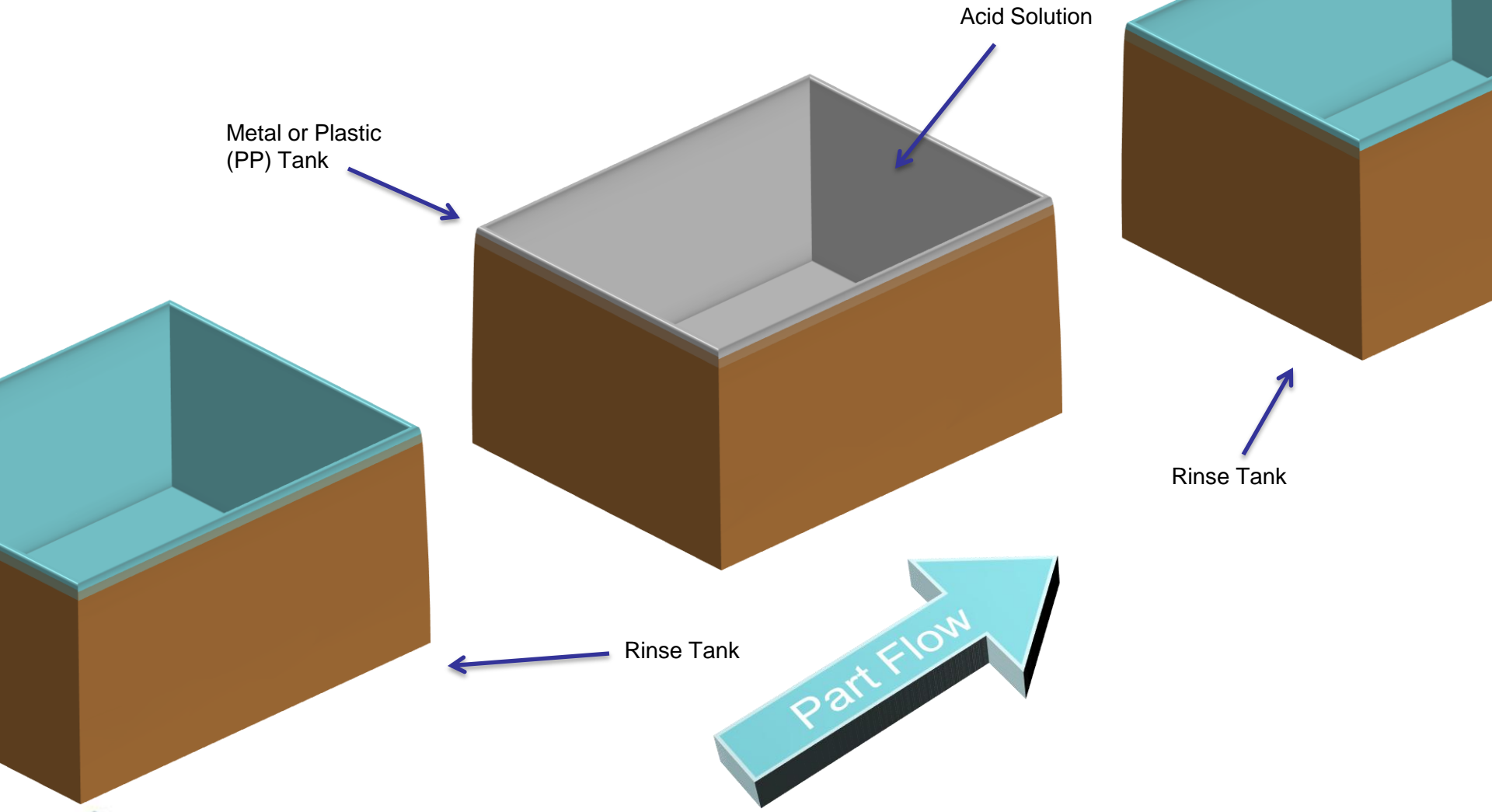
Acid Applications



- Acid Pickling
- Stripping baths
- Activation baths
- Deoxidizer

- Passivation baths
- Anodizing
- Electropolishing
- Etching

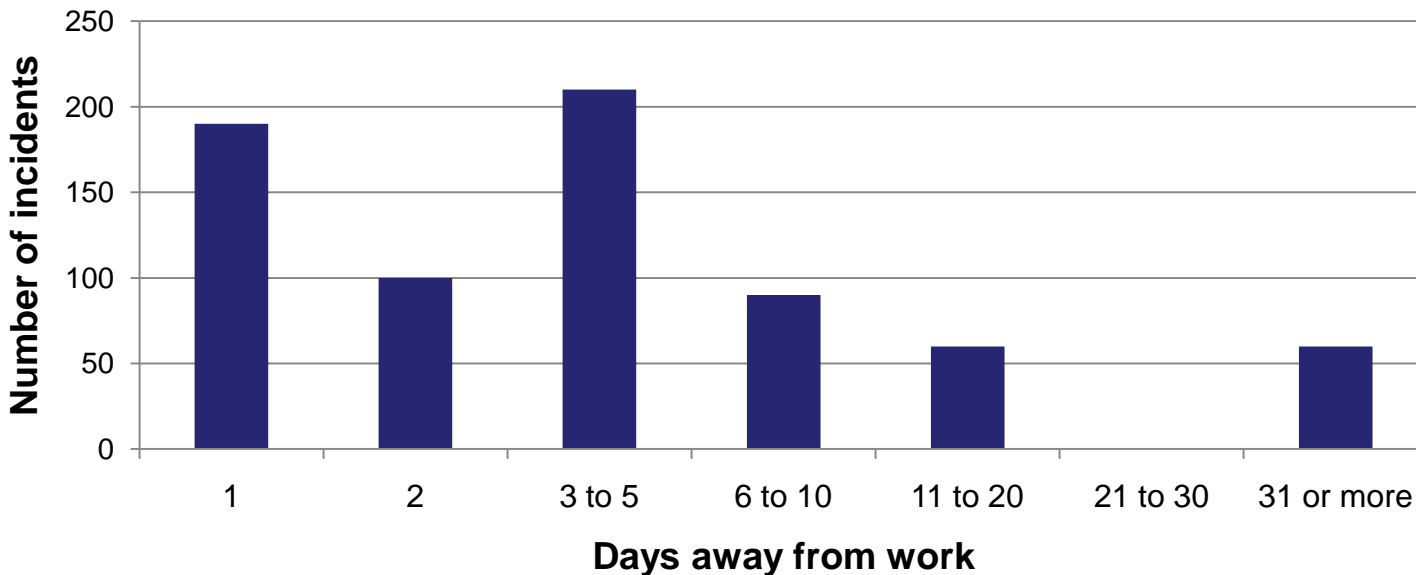
Acid Applications



Acid Use

1. Handling: It is a Hazardous Material

- In 2008, 710 incidents reported nationwide of nonfatal occupational injuries and illnesses involving days away from work related to acids



Source: Bureau of Labor Statistics, U.S. Department of Labor:
<http://www.bls.gov/iif/oshwc/osh/case/ostb2151.pdf>



Acid Use

2. Disposal:

- Waste Management Services
- Reporting requirements to TRI, RCRA

3. Costs:

- Purchase cost
- Disposal cost
- Cost of rework
- Labor costs



Acid Life Extension

PRO-pHx:

“PRO-pHx is a catalyzed formulation carried by a proprietary blend of soluble silicates. It effectively immobilizes soluble metals by reacting with them to form insoluble metal silicates.

[It] will also react with volatile and non-volatile organic compounds to produce a non-volatile, non-toxic, non-hazardous waste. The precipitate is then easily filtered.”

Information provided by PRO-pHx, Inc.



Application Guidelines

Application

- Add PRO-pHx at 1% to total tank volume
- Filter to produce 1 to 2 turnovers per hour
- 1-100 micron filtration

Measurement

- Track acid titration results & add (spike) acid to strength

Maintenance

- Filter as required (filtration may require *fine tuning*)
- Additions of acid and PRO-pHx are required
- Include PRO-pHx at 1% of required acid additions



Illustrations



← In-tank Filtration

Overflow Filtration →



Acid Life Extension

<u>Name</u>	<u>Concentration</u>	<u>Temperature</u>
Hydrochloric / Muratic	5% to 95% By Volume	55 to 160 F
Nitric	10% to 80% By Volume	60 to 120 F
Sulfuric	10% to 95% By Volume	34 to 190 F
Citric	7% to 15% By Volume	60 to 125 F
Phosphoric	7% to 15% By Volume	60 to 115 F
Nitric & Ammonium Bifluoride	40% to 70% By Volume	70 to 80 F
Acid Salts	7% to 15% By Volume	70 to 90 F
Nitric & Phosphoric	15% to 20% By Volume	105 to 115 F
Sulfuric & Oxalic	18% By Volume	Proprietary
Sulfuric & Phosphoric	18% By Volume	105 to 115 F
Hydrochloric & Acid Salts	15% to 20% By Weight	70 to 95 F
Nitric & Hydrofluoric	15% to 20% By Volume	70 to 115 F
Sulfuric & Hydrofluoric	20% By Volume	115 to 130 F

- Hydrochloric, Sulfuric, Nitric, Citric, Phosphoric, Nitric / Hydrofluoric, Sulfuric Peroxide and Other Exotic Blends of Acid

Effective Metals Reduction Include

Iron, Zinc, Nickel, Copper, Aluminum, Cadmium, Trivalent and Hexavalent Chrome

Organics Are Eliminated



Acid life extension

- Benefits
 - Reduced acid use and reduced costs
 - Reduced disposal quantities and disposal cost
 - Lower material handling, reducing risk to human health
- Things to consider before implementation
 - Installation of filter pump and filter
 - Cost of PRO-pHx
 - Does not work with certain combinations of acids and metals (Ex: Ti, HF-HNO₃)



Ex: Coating Technologies, Inc.

- Metal finishing job-shop in Rochester, NY
- Conducted a 11-month study to assess the performance of PRO-pHx on Muriatic and Nitric acid tanks
- Parameters monitored:
 - Dissolved metals
 - Volume of acid added
 - # of manufacturing defects



Findings

- All baths remained functional through the course of the study
- All baths experienced an increase in life by at least 2x (with some going up to 20x)
- No defects were traceable to poor acid quality



Unexpected outcomes

- Metal concentration in many baths increased beyond typical operating ranges
- No effect on work-piece processing time or cleaning ability
- Hypothesis is that PRO-pHx material is acting the way a chelator works in an aqueous solution by tying up the metal and organic compounds making them 'invisible' to the acid



Metal Concentrations

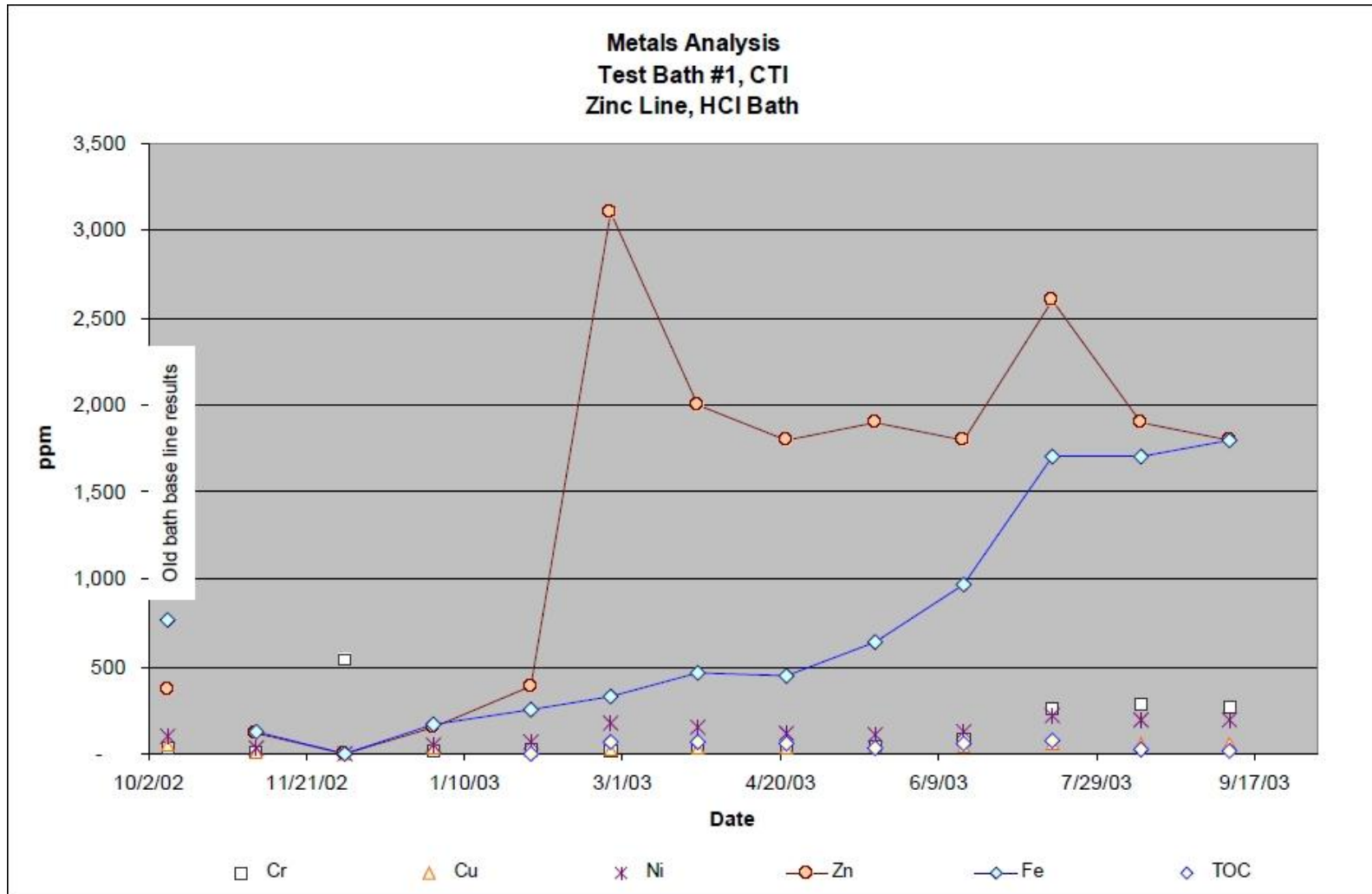


Figure 1



Metal Concentrations

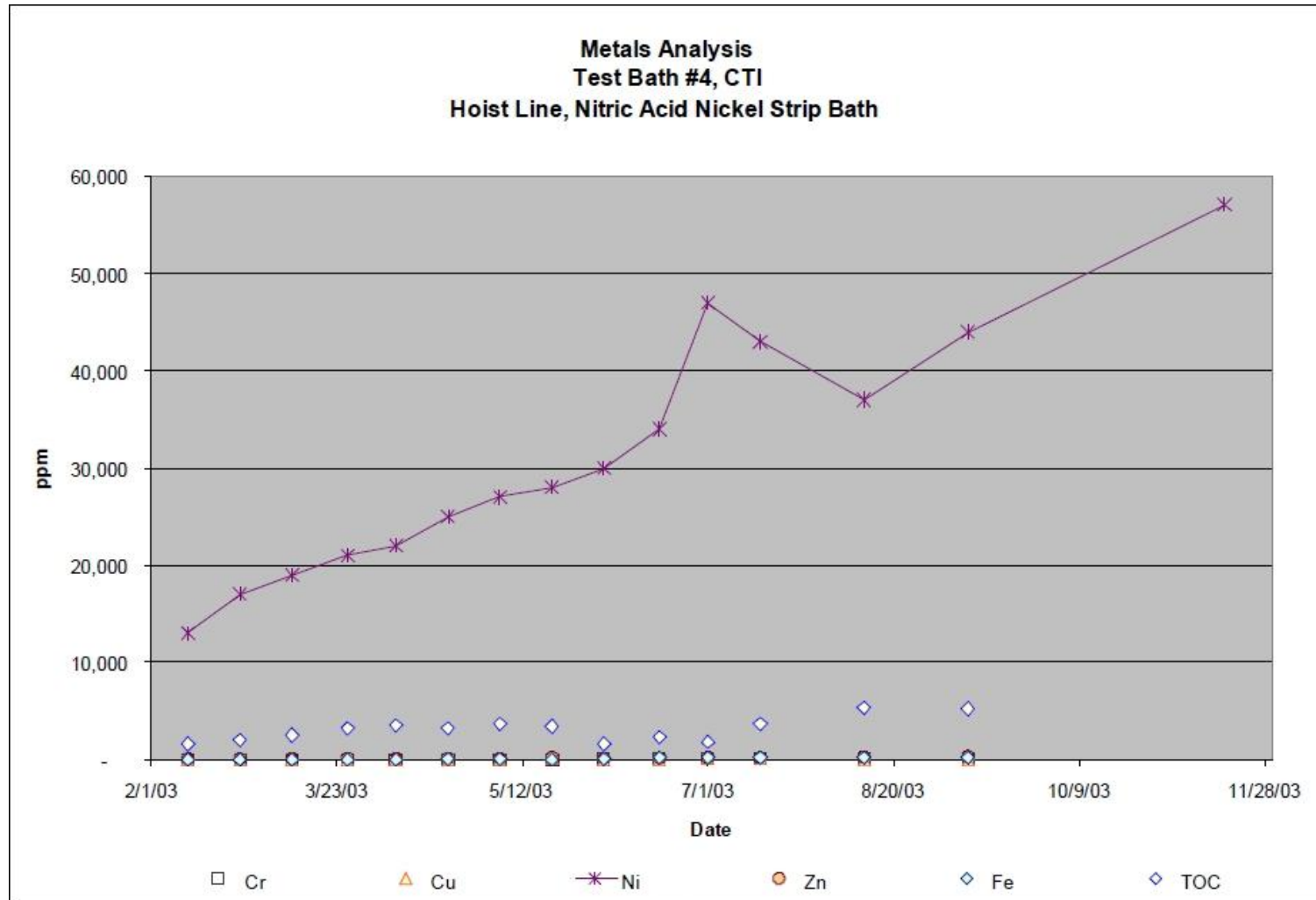


Figure 4



Economic Analysis

For Test Bath1; HCl tank; Dumped every 4 weeks; 250 gallons at 40%

Annualized Data

Before PRO-pHx:

	<u>quantity</u>	<u>\$/per</u>	<u>Total</u>
Acid used (gallons)	1430	\$ 1.44	\$ 2,059.20
Waste treatment (\$1.25 for every \$1)			\$ 2,574.00
Total			\$ 4,633.20

With PRO-pHx (first year)

Acid Used (make up)	110	\$ 1.44	\$ 158.40
PRO-pHx Used (make up)	2.5	\$ 60.00	\$ 150.00
Acid Used (replenishment)	683	\$ 1.44	\$ 983.52
PRO-pHx Used (replenishment)	23.89	\$ 60.00	\$ 1,433.40
Waste treatment (none required)			\$ -
Filters (2/week @ \$2.5 each)	104	\$ 2.50	\$ 260.00
Equipment: Filter Pump	1	\$ 370.00	\$ 370.00
Total			\$ 3,355.32

First Year Savings

\$ 1,277.88

28%



Environmental Results

Environmental Summary, CTI

Tank	Acid Gallons			Savings		Percents	
	With out PRO-pHx	With PRO-pHx		With PRO-pHx		With PRO-pHx	
		First Year	Subsequent Years	First Year	Subsequent Years	First Year	Subsequent Years
Test Bath 1	1430	793	683	637	747	44.5%	52.2%
Test Bath 2	1907	506	396	1401	1511	73.5%	79.2%
Test Bath 3	480	166	126	314	354	65.4%	73.8%
Test Bath 4	240	234	194	6	46	2.5%	19.2%
Totals	4057	1699	1399	2358	2658	58.1%	65.5%

Tank	Caustic Gallons, estimated			Savings		Percents	
	With out PRO-pHx	With PRO-pHx		With PRO-pHx		With PRO-pHx	
		First Year	Subsequent Years	First Year	Subsequent Years	First Year	Subsequent Years
Test Bath 1	2860	1586	1366	1274	1494	44.5%	52.2%
Test Bath 2	3813	1012	792	2801	3021	73.5%	79.2%
Test Bath 3	960	332	252	628	708	65.4%	73.8%
Test Bath 4	480	468	388	12	92	2.5%	19.2%
Totals	8113	3398	2798	4715	5315	58.1%	65.5%



Sources

1.

PRO-pHx Acid Life Extender
Zero Acid Disposal

*Providing Environmentally Sustainable Technology
Eliminating Acid Disposal*
(Presentation)

2.

Research, Development & Demonstration Project Report:
Acid Life Extender Test Application At Coating Technology & Anoplate
(Final Report)



Questions

