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COLLABORATION THAT WORKS

US EPA REGION 5 POLLUTION PREVENTION PROJECT:

P2 RESEARCH AND IMPLEMENTATION FOR MICHIGAN METAL FINISHERS

MAY 27, 2020

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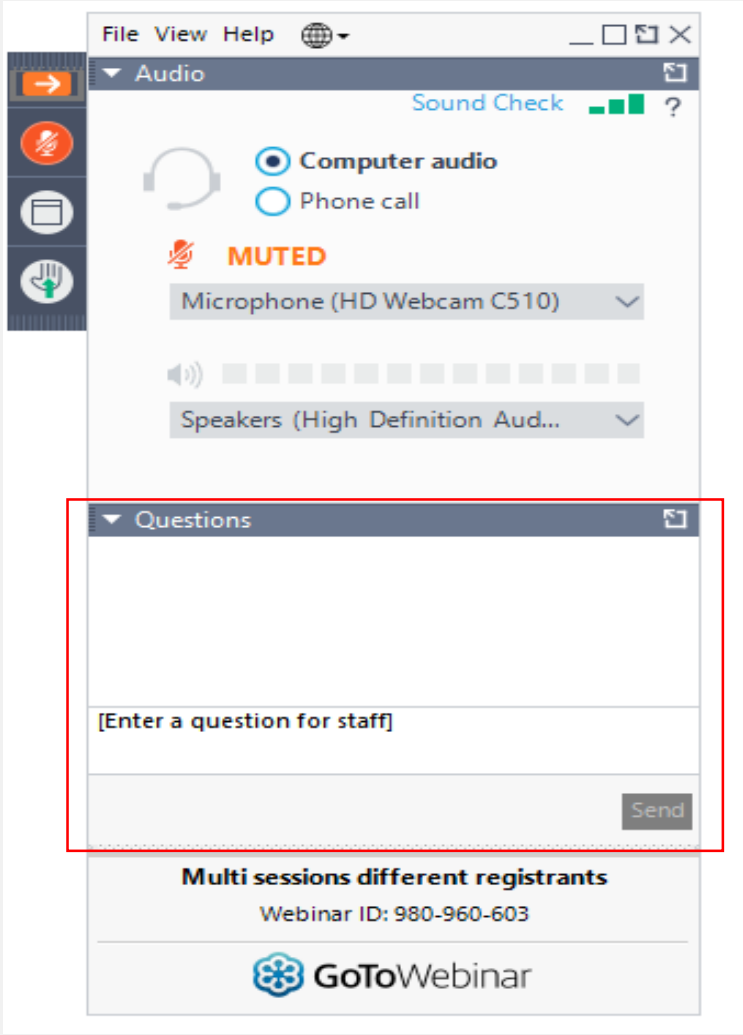

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P2 PROJECT RESULTS

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Why is P2 important to Metal Finishers? Look at Environmental-Related Spending*

Environmental Performance Tier*	Total Environmental Operating Costs, $/$MM Sales**
Top Environmental Performers	$83,510
Middle Environmental Performers	$96,320
Bottom Environmental Performers	$133,630

* Results shown are from previous NCMS study.

**Includes water/sewer, electricity, sludge disposal, and environmental labor.

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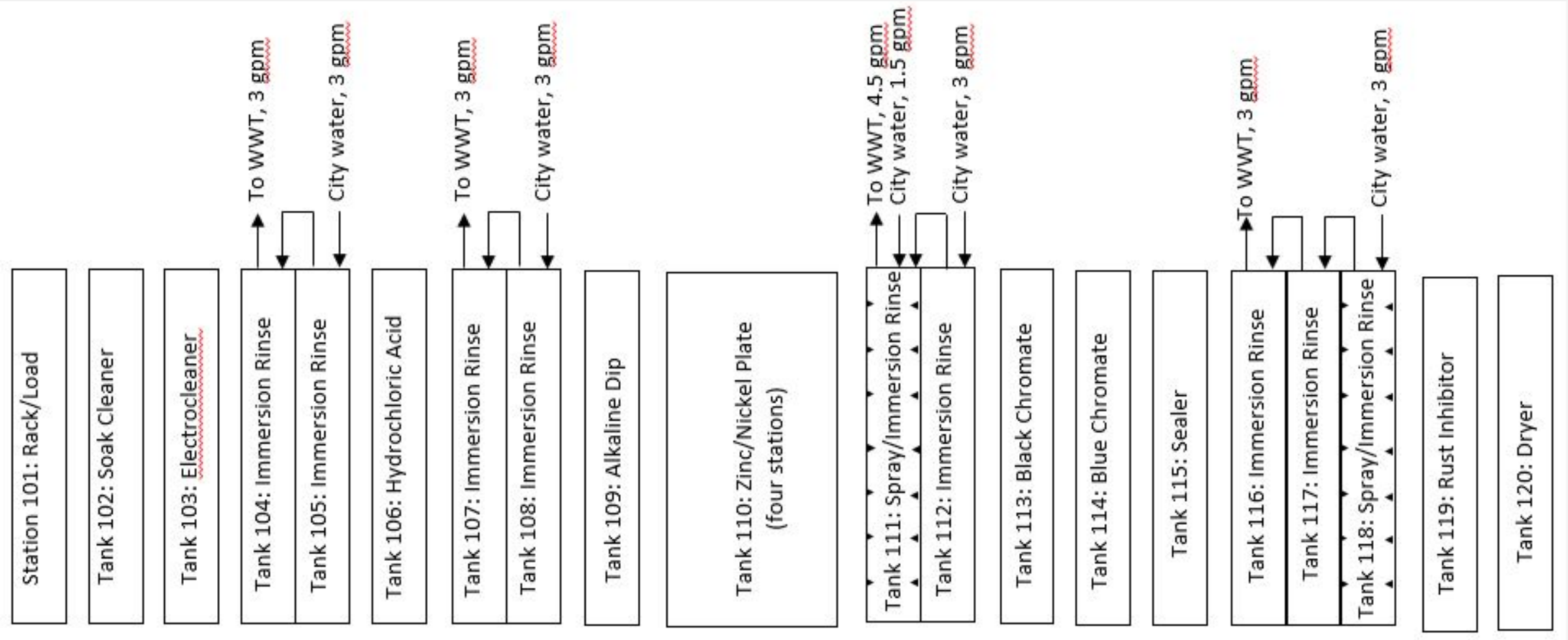

Automated Zinc/Nickel Rack Line

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Annual Cost of Zn/Ni Dragout

(0.21 gal/rack set = 25 gal/day)

- Replacement Chemicals: $27,900
- Water/Sewer/Waste Treatment: $46,947
- Hazardous Sludge Disposal: $62,493

Total: $137,340

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Conductivity Meters

CONDUCTIVITY IN RINSE TANK

Acceptable Limits (avg. from literature)

Function	Conductivity (microseimens/cm)
Alkaline Cleaner	1,700
Hydrochloric Acid	5,000
Functional Plating	600
Bright Plating	<100

Actual Data Zn/Ni Line

Function	Conductivity (microseimens/cm) Rinse 1/Rinse 2
Alkaline Cleaner	1,386/281
Hydrochloric Acid	9,320/411
Functional Plating	3,620/356

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RINSING EFFECTIVENESS

Rinsing Effectiveness = Conductivity of Rinse Water on Parts/Conductivity in Rinse Tank

Method:

1. Collect sample of drips coming off rack/parts (C1)
2. Collect sample of water from rinse tank (C2)
3. Calculate: Rinsing effectiveness = C1/C2

Expected:

C1/C2 = 1

Typical:

C1/C2 = 1.5 to 5

Good Practice:

C1/C2 = 1.5 to 3.0

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IMPROVING RINSING EFFECTIVENESS

1. Complete mixing
   - Rinse tank design
   - Air agitation
2. Improve drag-out removal
   - Spray rinse supplement
   - Double dip

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IMPACT OF AIR AGITATION

Level of Air Agitation	Rinse Effectiveness (C1/C2)	Improvement Over None
None	3.5	
Moderate	3.0	14%
Good	2.6	26%

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IMPACT OF SPRAY RINSE

Spray Effectiveness (C1/C2) = 4.0

This value is higher than C1/C2 with good air agitation.

Why?

The spray is impinging on the surface of the part and removing chemical film that is not being removed by simple immersion.

SPRAY RINSE WATER USE

Six seconds of activation per load:
14 nozzles * 0.061 gal/load/nozzle * 118 loads/day = 101 gpd

Overall water use for this rinse system is 4,421 gpd.

Therefore, the spray rinse is only 2% of total water use, but it is doing nearly as much work as the immersion rinse.

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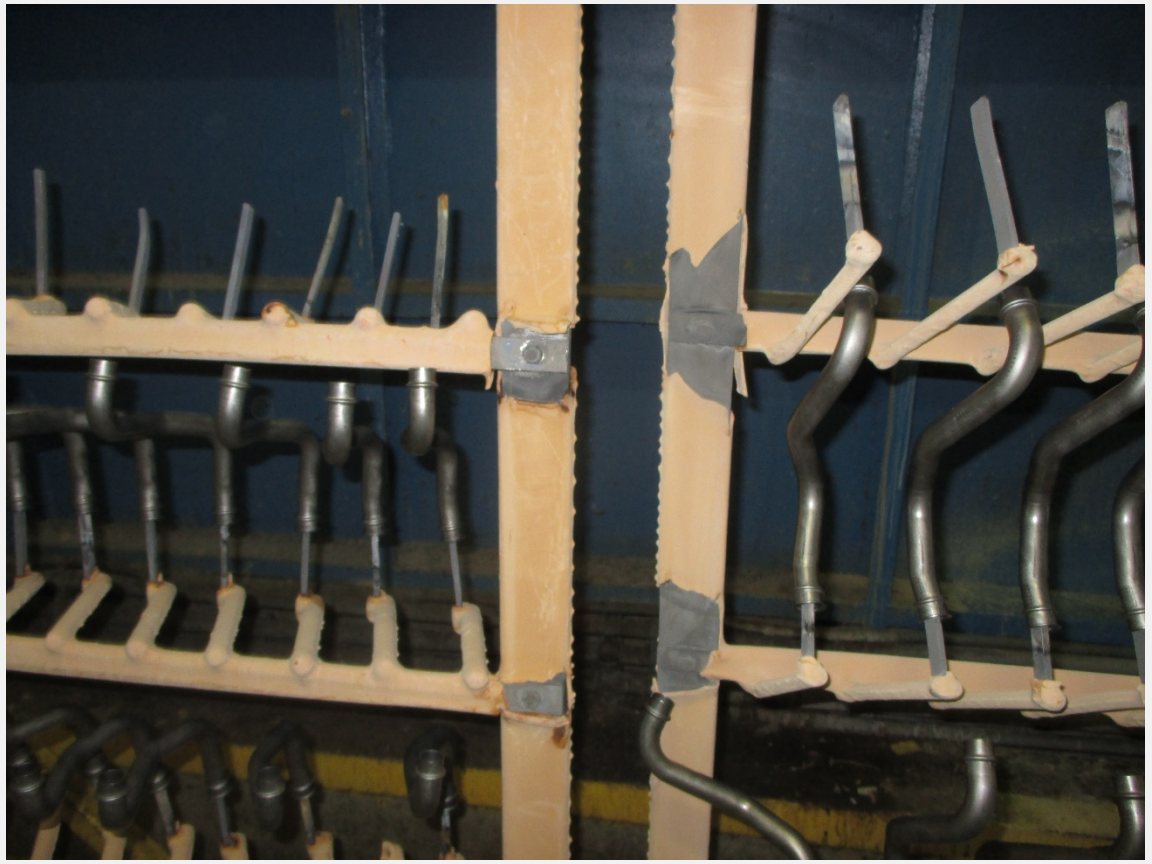
REDUCING DRAG-OUT

1. Design/maintenance of racks
2. Drain boards
3. Increase drain time over process tank

DESIGN/MAINTENANCE OF RACKS

Conductivity of rinse tank dragout (C1) for racks with damaged coatings were several times higher than for other racks.



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DRAIN BOARD NEEDED

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Estimating Potential Dragout Reduction from Extended Drip Time

- Very little actual data to be found in literature, but –
- Beckman Instruments had published a dragout curve in a 1950's manual
- Curve was reproduced in an EPA guidance document from the 1980's (still available on line)

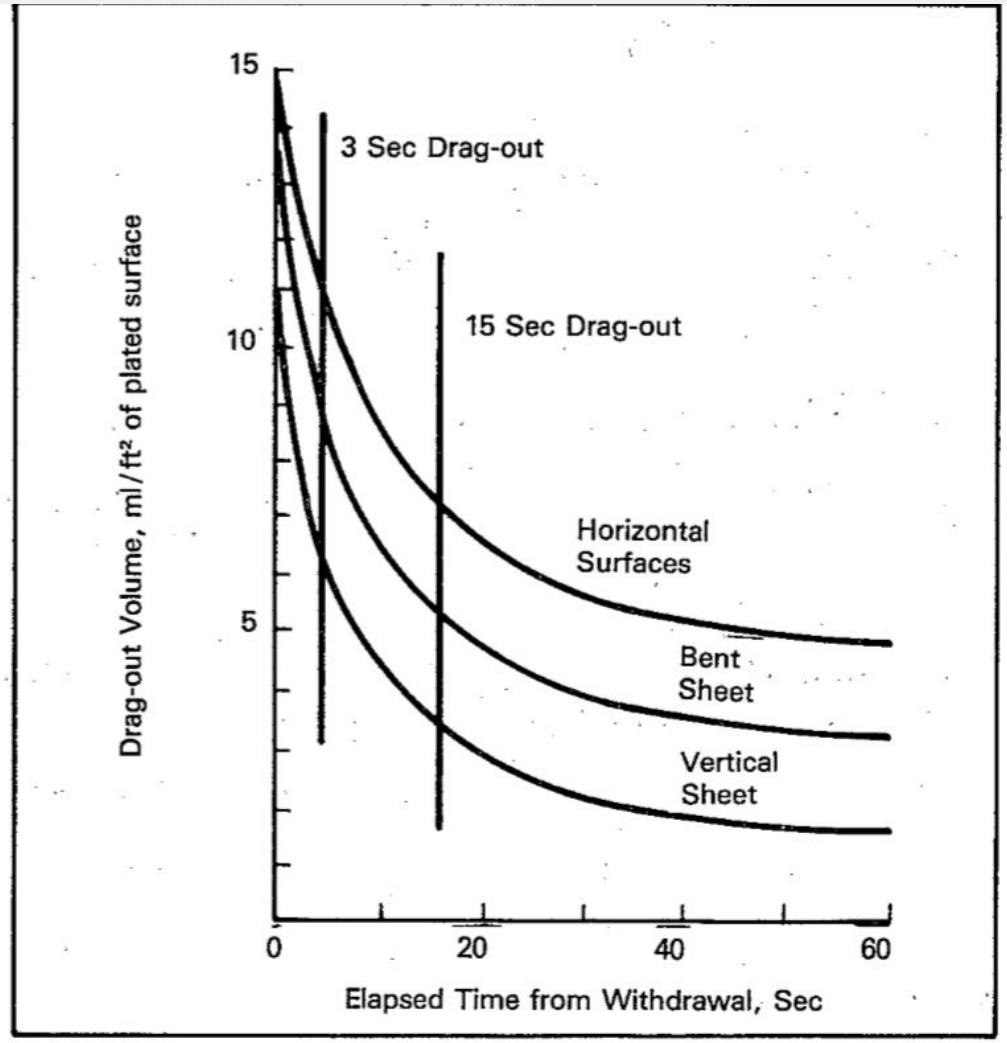

Figure 8.1. Typical drag-out drainage rates (from Beckman Rinse Tank Control Handbook).

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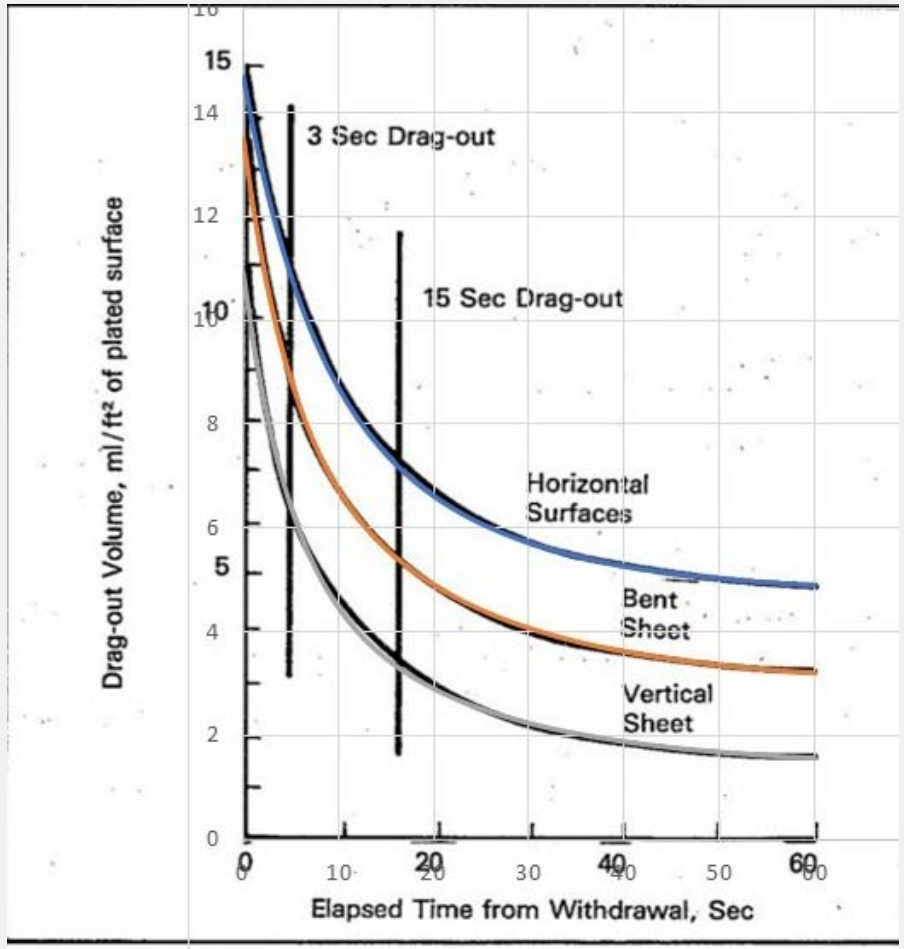
Beckman Rinse Tank Control Handbook Graph

- Looks like exponential decay, but –
- Can't fit both ends with one simple exponential decay curve
- But adding ***two*** exponential decay curves (with different decay constants) fits curve very closely, as shown in this picture



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Using Model to Estimate Dragout Reduction

- Model can be used to predict the drip curve from any tank that can be sampled in production
- When the model has been scaled for viscosity, only two measurements are necessary:
  - as soon as a rack is withdrawn from a plating rack, a slotted tube held under the rack collects the dripping solution for several seconds
  - a second sample is taken after the rack has moved over the first rinse tank, before the rack is lowered
- With this input, the tool presents a graph of dragout remaining on rack versus time
- Tool also shows the user the estimated reduction in dragout, in percent, for any selected drip time

Go to: Drip Calculator Tool

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RECOMMENDATIONS FOR MICHIGAN SHOP/SAVINGS

1. Clean out rinse tanks on a scheduled basis
2. Add another air blower to improve agitation
3. Repair rack coatings
4. Add additional spray rinses
5. Double dip rinse
6. Increase drain time
7. Add drain board

Projected Savings:

- Reduce drag-out by 25%
- Reduce WWT sludge generation by 25%
- Reduce water use by 30%
- Savings over $75K/yr
- Improve work quality

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THANK YOU