Metal Finishing Workshop

March 4, 2010

Hosted by:

New York State Pollution Prevention Institute at

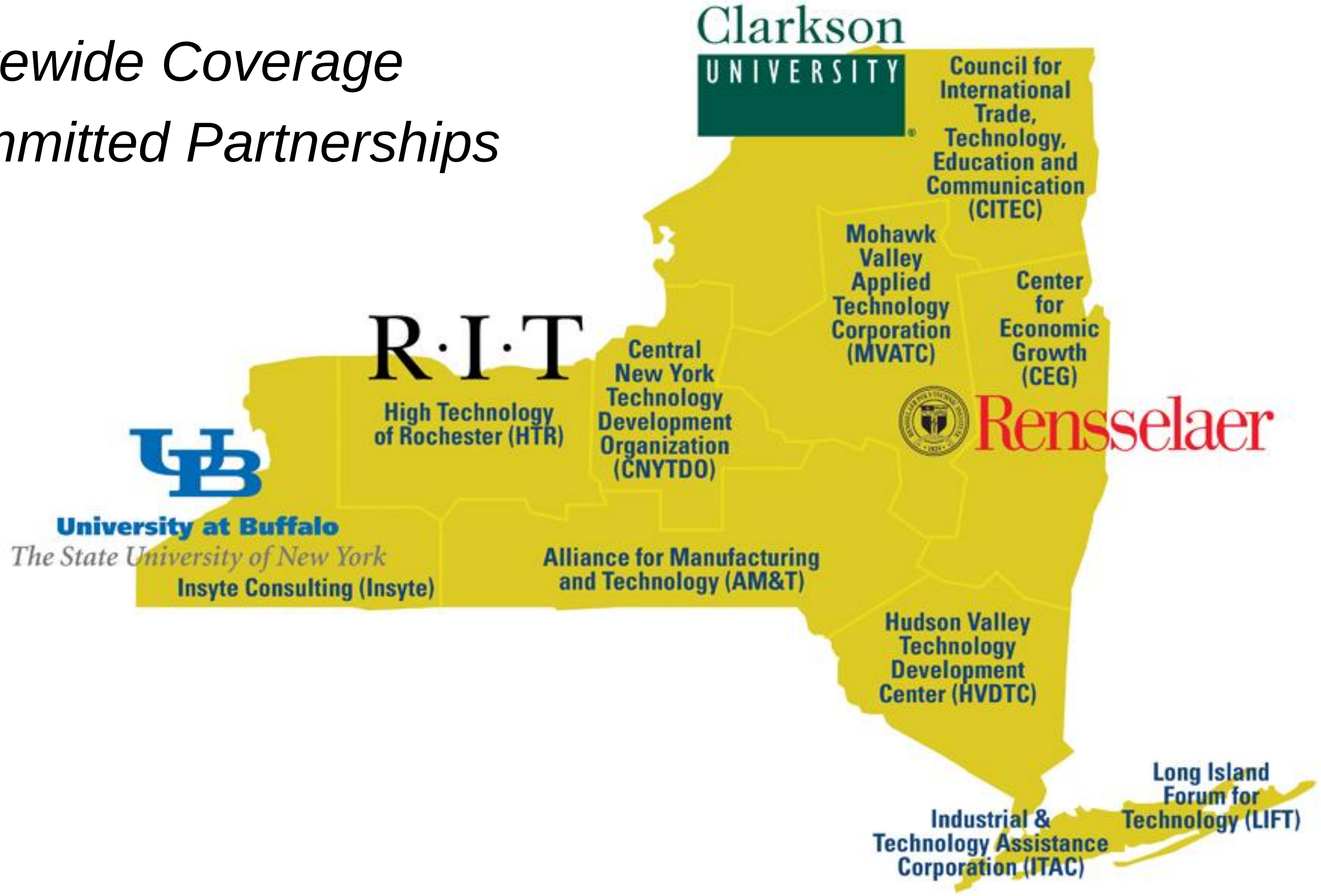
Rochester Institute of Technology

Who We Are

- Probably the best kept secret in town
- CIMS (Center for Integrated Manufacturing Studies)
  - NYSP2I
  - Mechanical testing
  - Reverse Engineering
  - Electronic Systems
  - Lean Training
  - Environment, Health, and Safety Training and Assessments
  - Ergonomics lab and training

NYS Pollution Prevention Institute

- *Statewide Coverage*
- *Committed Partnerships*



New York State Pollution Prevention Institute (NYS/P2I)

Vision & Mission

Vision:

The vision of the NYS P2I is to foster the transformation and development of sustainable businesses and organizations in New York State in a collaborative program committed to making the State a leader in environmental stewardship.

Mission:

The mission of the Institute is to provide a high-impact, comprehensive and integrated program of technology research development and diffusion, outreach, training and education aimed at making New York State more sustainable for workers, the public, the environment and the economy through:

- reductions in toxic chemical use
- reductions in emissions to the environment and waste generation
- the efficient use of raw materials, energy and water

Workshop Agenda:

8:30am -9:00am Registration, Coffee & Bagels
9:00am - 9:55am Dave Fister: Plating line overview, Rinse water reduction techniques

9:55am - 10:05am Short Break

10:05am -11:00am Jim Hankinson: Energy use in the exhaust system
11:00am -11:55am Ray Graffia, Jr.: How to save money, improve parts' cleanliness, reduce waste hauling, & lower chemical usage – by extending the life of your aqueous cleaners

12:00pm - 1:00pm Lunch

1:00pm - 2:00pm Facility Tour and Filtration Demonstration (Arbortech)
2:00pm - 2:55pm Dave Fister: Water use reduction & recovery methods
Dave Fister: Energy savings in paint & powder coat curing

2:55 pm -3:05pm Short Break

3:05pm -4:00pm Newton Green and Rajiv Ramchandra: Acid bath management and acid life extension
4:00pm -4:30pm Questions and Answers

First Morning Session

9:00pm - 9:55pm

Dave Fister:

Metal Finishing 101,

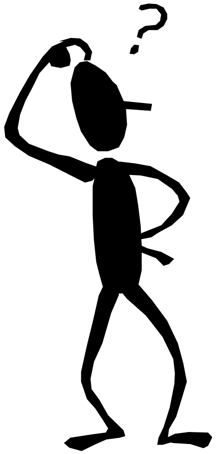
Stepping away from the process

Who Can Benefit

- Powder coaters: parts preparation
- Painters: parts preparation
- Platers
- Chemical conversion, phosphating
- Anodizers

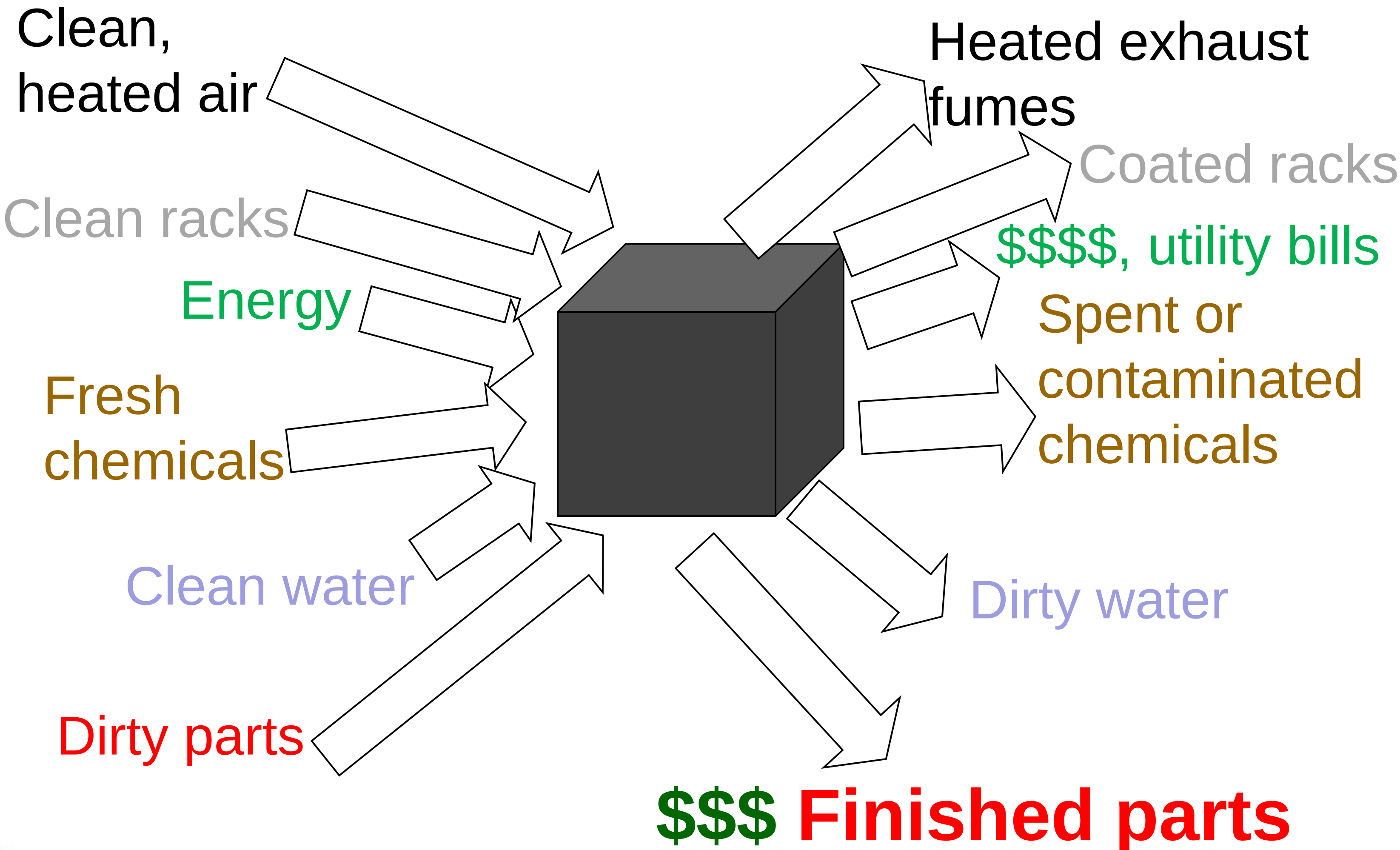
- All have similar process steps: cleaning and rinsing

The **Really** High Level



- What are we really trying to accomplish?
- Answer: Add some value to parts with some sort of quality coating for the least amount of money.

The Process


Clean, heated air
Clean racks
Energy
Fresh chemicals
Clean water
Dirty parts
Heated exhaust fumes
Coated racks
$$$$, utility bills
Spent or contaminated chemicals
Dirty water
$$$ Finished parts

Next, Treatment

- Waste chemicals need to be treated, $$
- Exhaust fumes may need to be scrubbed (scrubbing water needs to be treated), $$
- Fresh make-up air needs to be heated, $$
- Paint fumes, VOC’s, may need thermal oxidation, $$
- Dirty water may need to be treated, $$
- Treatment sludge needs to be hauled, $$
- Racks need to be stripped, $$

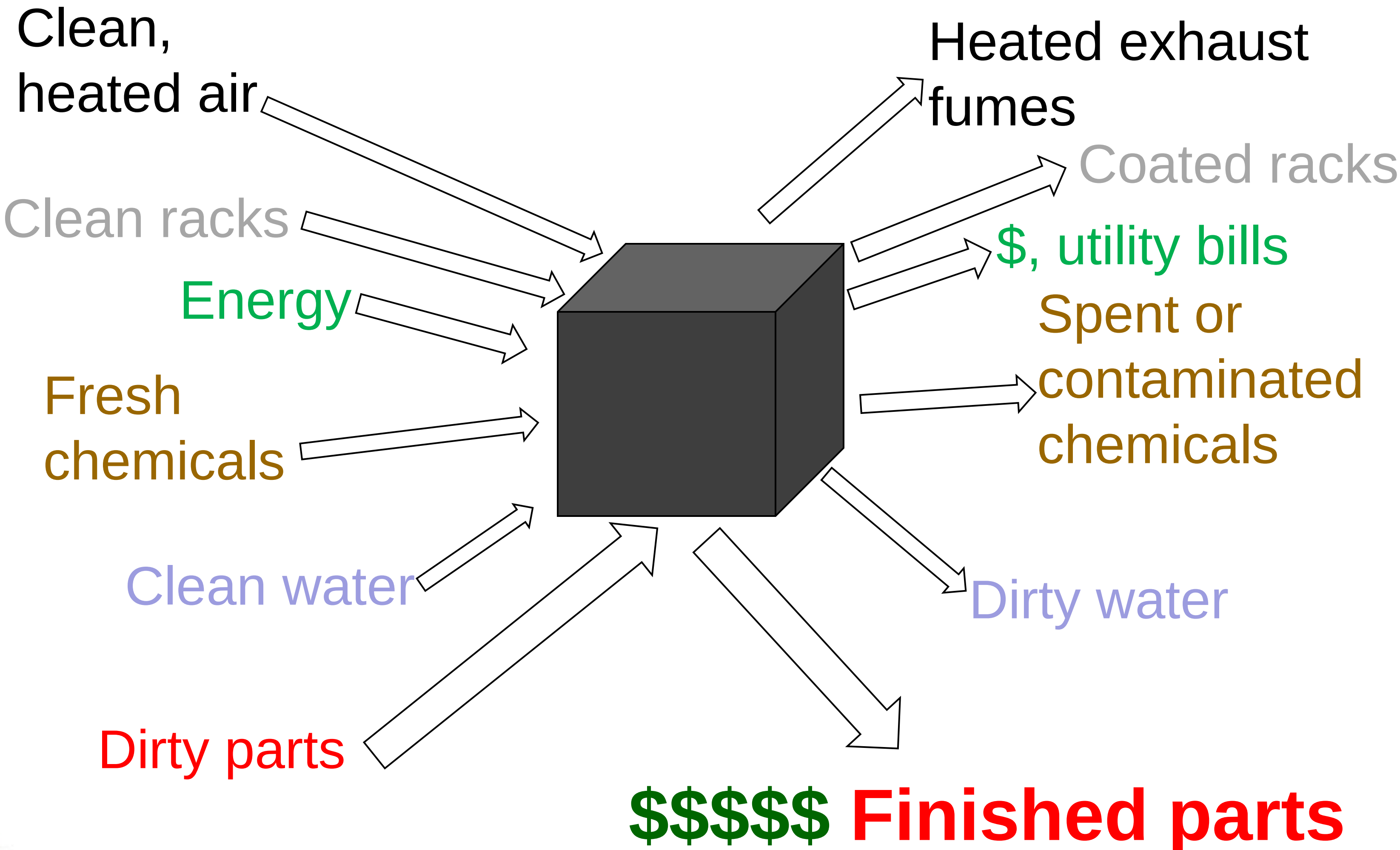
Develop a Baseline

- Water costs: include water purchase cost and water sewer cost (sometimes a tax item)
- Chemical costs: cleaners, acids, plating salts, etc.
- Waste treatment costs: chemicals, labor, sludge disposal, resin regeneration chemicals, etc.
- Ventilation system: blower motor size, natural gas cost or other heating fuel cost
- Electricity cost: pumps, blowers, compressors, hot air dryers, etc.

Rochester Example

- Water use = 6,310,000 gpy = $32,900/yr. ($5.22/1000 gallons)
- Exhaust blower = 10,000 cfm = $7,899/yr. for 40 hours per week ($.09/kwh)
- Make-up air heating = 431 decatherms = $2,154 /yr. ($5/decatherm)
- Acid purchases (HCl) = $19,700 ($1.25 /gallon, 15,760 gallons)
- Caustic purchases (NaOH) = $6,400 ($2.10/lb, 3,048 lbs.)
- Sludge disposal = $15,600
- Total cost per year = $66,923/year

The Improved Process



Water Use Reduction: Rinse Water

- Measure the flow rate on each rinse tank to determine the rinse water use
  - Needed: ruler, tape measure, stop watch, small pump and hose
  - Pump the tank down 1-2” inches
  - Measure the time it takes for the water level to move some convenient amount (1/2”, 1”, etc.)
  - Measure the surface area of the tank (length, width)
  - Length x width x change in water level = volume in cubic inches (231 cubic inches =1 gallon)
  - Gallons/measured time gives the flow rate

Typical Cleaning Steps

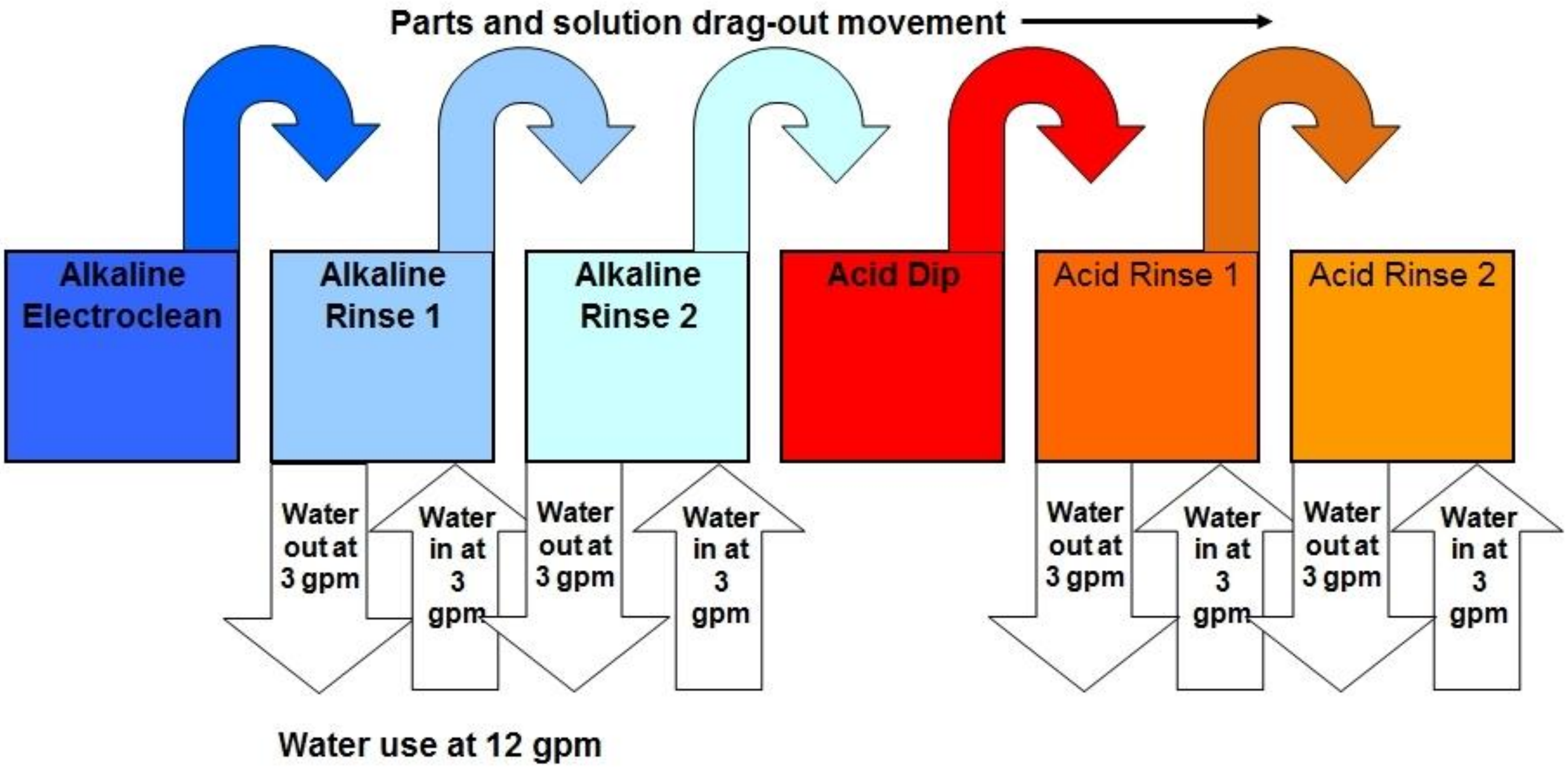
1. Alkaline cleaner, could include ultrasonics, agitation, or electrocleaning to assist the cleaning chemistry in contaminant removal. Contaminants are typically oil, dirt, buffing compound, fingerprints, etc.
2. Rinses (parts drag alkali into rinse water)
3. Acid etch, to remove light rust or oxides
4. Rinses (parts drag acid into rinse water)
5. Sometimes a repeat of the alkaline and acid steps including rinses

Purpose of Rinsing

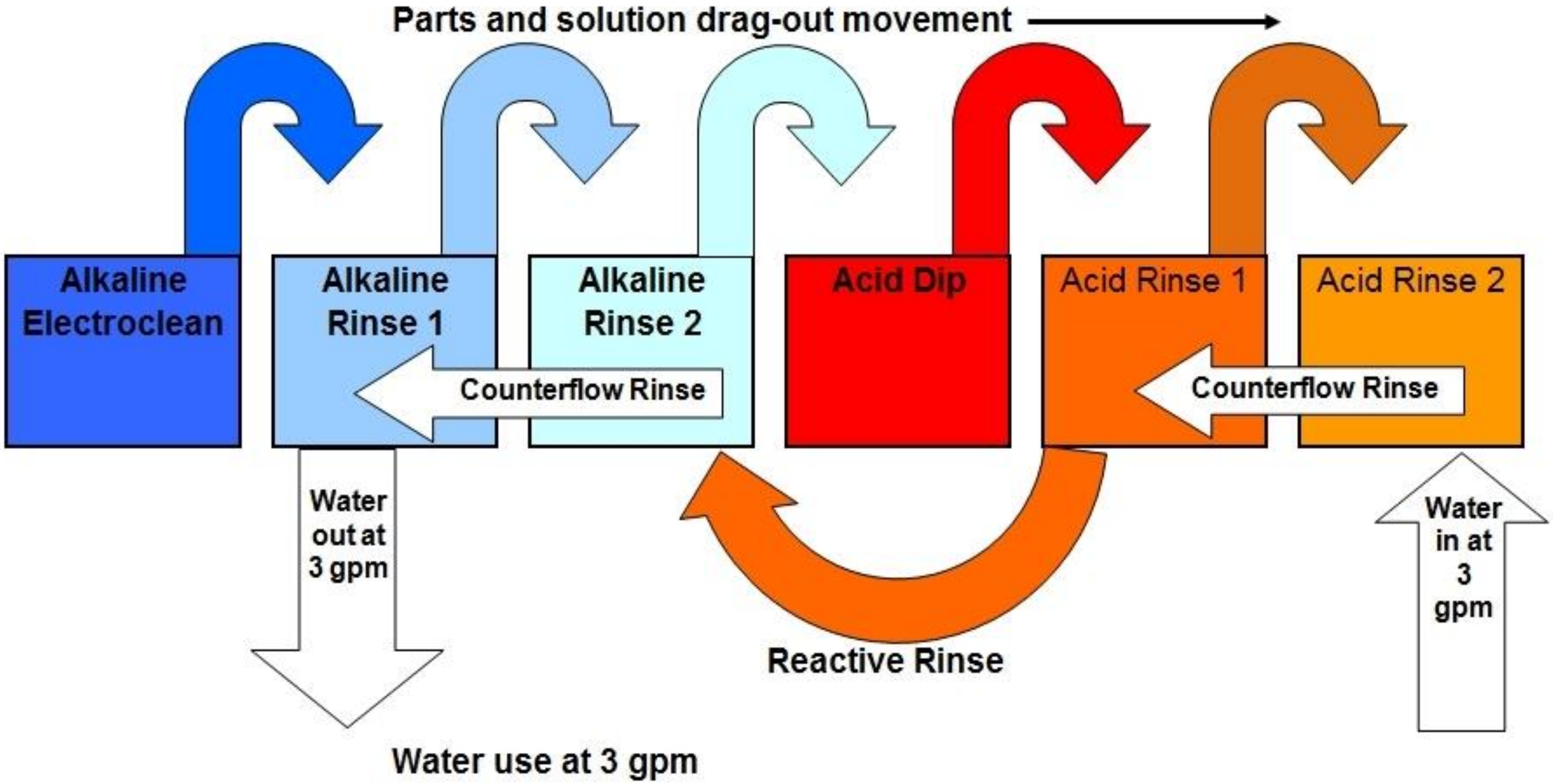
- First rinse tank
  - remove most of the previous tank's chemicals
  - Stop the chemical reaction from the previous tank
- Second rinse tank
  - Final rinse to remove additional chemicals
  - Minimize contamination of next chemical tank

If there was zero dragout of chemicals then there would be no need to rinse!!!

Typical Cleaning and Rinsing Layout



Optimized Cleaning and Rinsing Layout



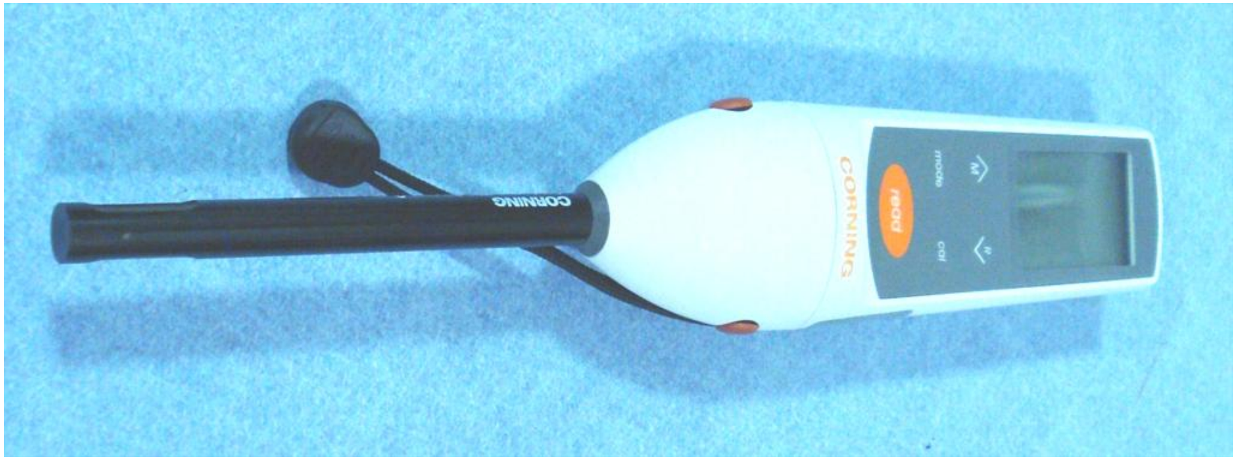
Monitoring the Rinse

- Rinse water contaminants (chemical solution dragout) are typically electrically conductive in solutions.
- As more solution gets dragged into a rinse tank the rinse conductivity goes up.
- As the rinse flow is increased the contamination level drops more rapidly due to dilution (and vice versa)

Note: Conductivity is directly related to total dissolved solids or TDS

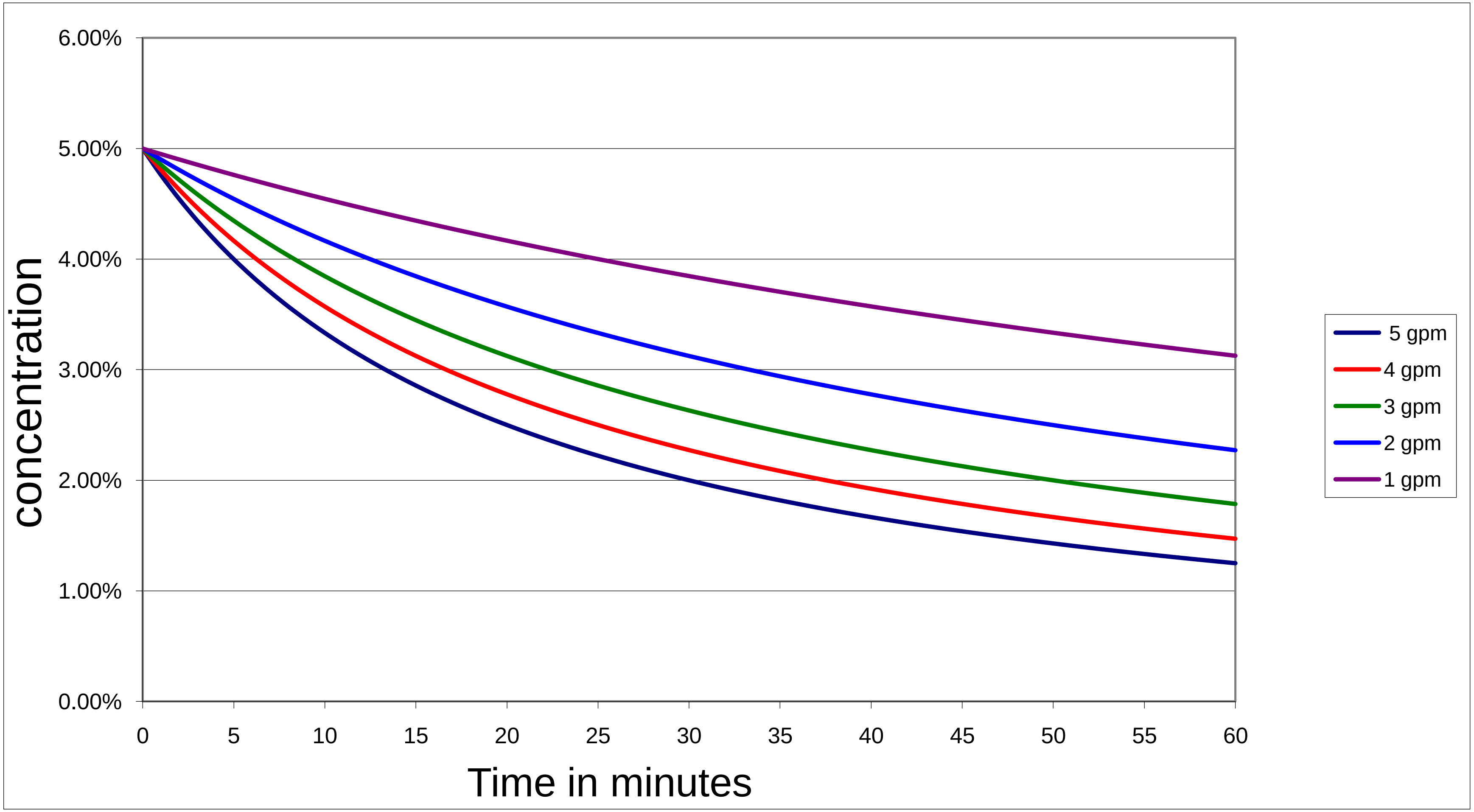
Flow vs. Concentration

- Measuring contamination in rinse water
  - Chemical analysis (slow and expensive)
  - Solution conductivity: start with a beaker, end with on-line rinse tank measurements



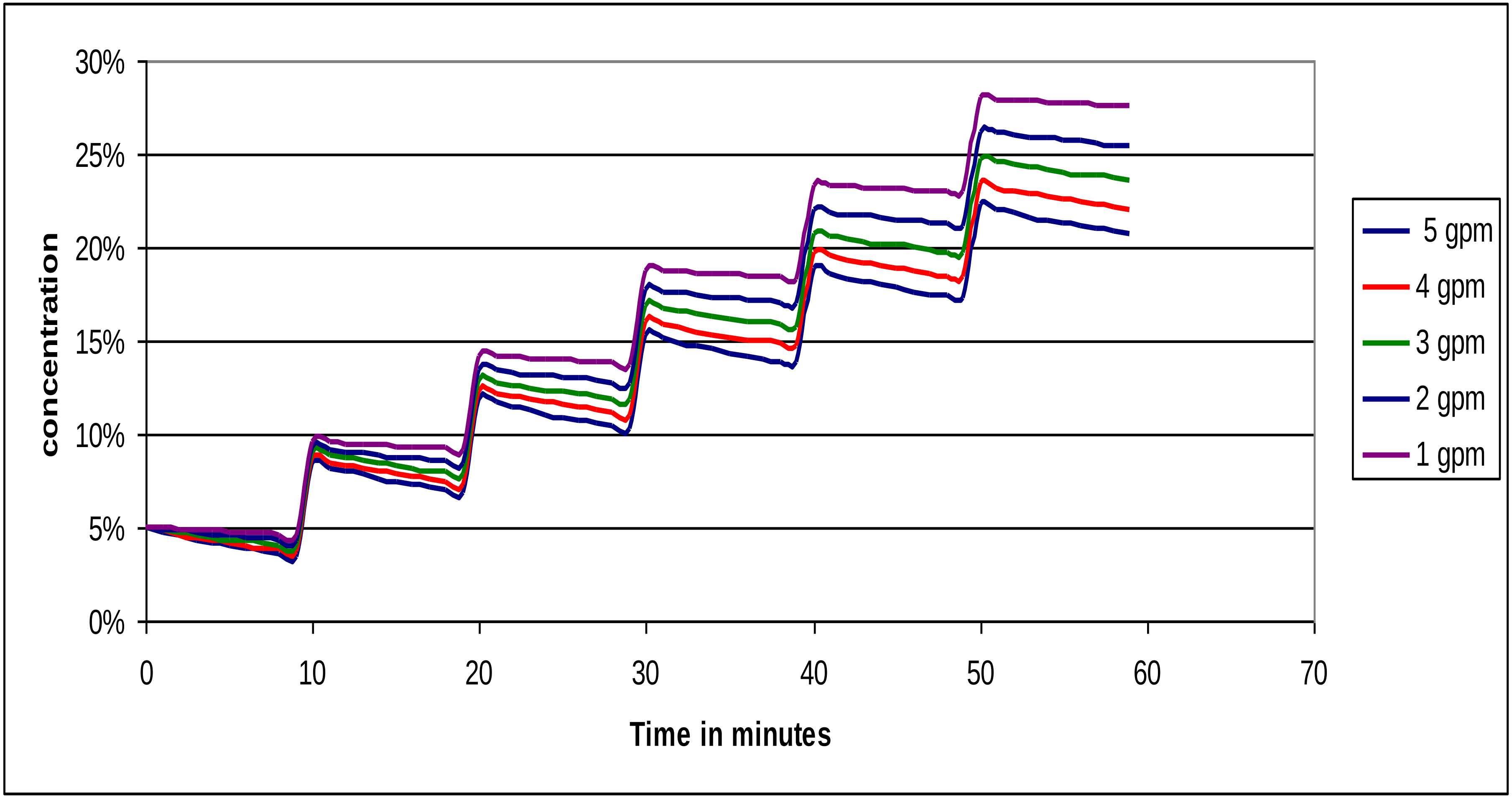
Conductivity/TDS meters cost from $140-$900

Simple Rinse Dilution Model



100 gallon tank, .05 gal. dragout, 100 gm/gallon in dragout

Real World Rinse Dilution Model



Immersion Rinse

- Conclusion: Based on the rate of dilution in even a small tank (100 gallons), it is very difficult to obtain good rinsing with a single rinse tank. Even relatively high flow rates of 5 gpm cannot keep up with the contamination loading from parts dragout.
- Therefore, there really needs to be a second rinse tank for critical rinsing.
- And……it becomes very important to determine your real rinse tank dynamics by measuring flow and conductivity/TDS

Flow Controls in Immersion Rinsing

- In-line flow restrictors: the hand operated valve has an aperture to restrict the flow to some maximum value at maximum valve opening.
- Conductivity controls: rinse valve opens and closes based on TDS value of rinse tank

From: www.freshwatersystems.com

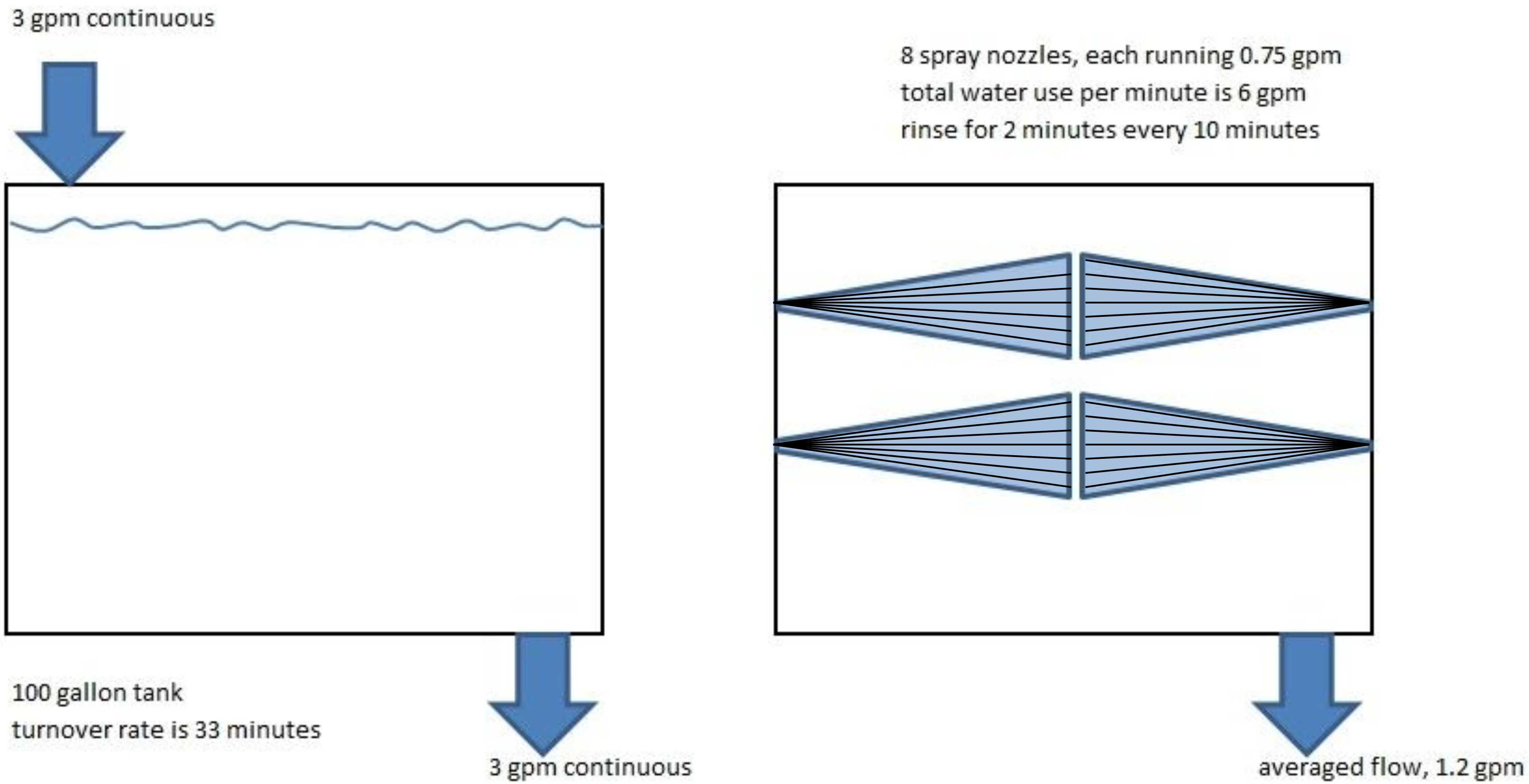
From: Myron L Company, Controlstik Systems

Conductivity/TDS Controls

Finding the best TDS setpoints (valve opens when water reaches maximum TDS setpoint, valve closes when water reaches minimum TDS setpoint)

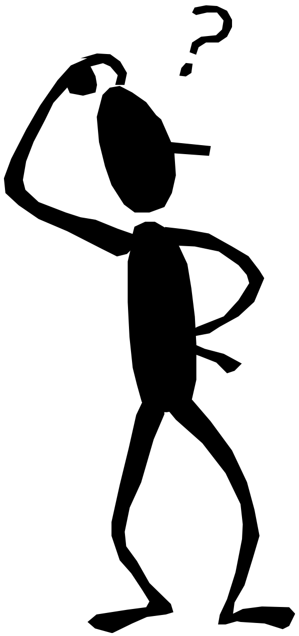
- Measure the TDS with a meter in the critical rinse tanks. Knowing the existing flow rate also helps.

Immersion vs. Spray Rinsing



Other tricks with spray rinsing

- If part geometry is difficult to rinse with fixed spray, if the line is a manual line then the operator can use a manual spray rinse to reach the hard-to-rinse areas of the parts
- If the chemistry is difficult to rinse with cold water, set up an in-line heater for the spray water supply or have a pre-heated supply tank



Questions?