INDUSTRIAL WASTEWATER DISCHARGE COMPLIANCE

FEBRUARY **26, 1998**

WORKSHOP 1

ENVIRONMENTAL TRAINING WORKSHOPS FOR METAL FINISHERS

SPONSORED BY:

U.S. EPA

SURFACE TECHNOLOGY ASSOCIATION

Industrial Wastewater Discharge Compliance

Workshop 1
February 26, 1998

EPA/STA Pollution Prevention Technical Assistance Project

- **Training -**
  - **Workshop Series (series of 6)**
  - **Operator Training Series (given multiple times)**
- Mini-Assessments
  - **5 facilities already selected**
  - **5 more will be selected later this spring (Apply Now!)**

Training -- Workshop Series

Workshop Title	Date and Time
Industrial Wastewater Discharge Compliance	Today
Hazardous Waste Compliance	March 25, 4-8 pm
Pollution Prevention Through Process Control	April 22 ,4-8 pm
Air Regulations and Compliance	June 10, 4-8 pm
Pollution Prevention Technologies	July 22, 4-8 pm
Enviro. Mgmt. System Approaches to P2	August 12, 4-8 pm

Wastewater Compliance Strategies and Standards

Greg Arthur

Environmental Engineer

US EPA, Clean Water Act Compliance Officer

Wastewater Discharge Standards and Limits for Metal Finishers

- general storm water permit requirements
- federal standards for sewer discharges
- local sewer limits
- upcoming regulatory changes

Surface Technology Association
Environmental Training Workshops for Metal Finishers
Fremont, California, February 26, 1998

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- Prohibits the discharge of process wastewaters into the storm sewers without an NPDES permit.

  Process wastewaters include plant & equipment washdown, cooling water, process-contaminated run-off, chemical storage area run-off, deminer-alizer brines, product rinsing and drum washing.

- Requires limited self-monitoring for the pollutants that could run-off the site.

- Regional Water Quality Control Boards issue municipal storm water permits to local agencies (usually counties) which administer General Storm Water permits. Some administrative tasks like inspections are delegated to other agencies (cities or sewer districts). Enforcement remains with the RWQCBs.

Federal Standards for Sewer Discharges

Metal finishers are regulated under one of the following 4 different sets of Federal categorical standards depending on the type and age of facility.

- **New Source Metal Finishing**
  40 CFR 433.17

- **Existing Source Metal Finishing**
  40 CFR 433.15

- **Existing Source Job-shop Electroplating Discharging >10,000 gpd**
  40 CFR 413.x4(c)(g)(h)

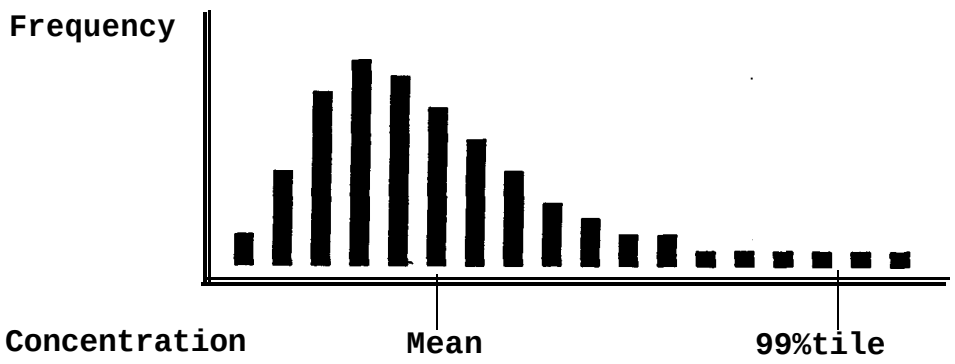
- **Existing Source Job-shop Electroplating Discharging <10,000 gpd**
  40 CFR 413.x4(b)(f)(h)

Wastewater Discharge Standards and Limits for Metal Finishers

Federal Standards for Sewer Discharges

The Federal categorical standards were derived from the statistical performance of actual metal finishers with the following Best Available Technology ("BAT").

Hexavalent Chromium Reduction – Alkaline Chlorination of Cyanide – No Discharge of Cadmium – Metals Hydroxide Precipitation – Settling -- Soilds Handling – Toxic Organics Source Controls



The standards were set where statistically the metal finishers with BAT can comply 99 out of 100 times.

Wastewater Discharge Standards and Limits for Metal Finishers

Federal Standards for Sewer Discharges

Metal finishers are also regulated under a number of other general Federal rules that apply either to all industrial users or to all categorical industrial users.

- **Prohibition Against Dilution as a Substitute for Treatment**
  40 CFR 403.6(d)

- **General Prohibitions** against causing pass-through, interference, or sludge contamination
  40 CFR 4035(a)

- **Specific Prohibitions** against causing a fire or explosive hazard, corrosive structural damage pH<5, excessive heat >104^{o}F, obstructions, oily conditions, or worker hazards from toxic fumes
  CFR 403.5(b)

- **Specific Prohibition** against truck hauling of pollutants to the sewers
  40 CFR 403.5(b)(8)

Wastewater Discharge Standards and Limits for Metal Finishers

Federal Standards for Sewer Discharges

40 CFR 433 New Sources
For: All new metal finishing operations

Pollutant (mg/l)	Month-Av	Daily-Max
Cadmium	0.07	0.11
Chromium	1.71	2.77
Copper	2.07	3.38
Lead	0.43	0.69
Nickel	2.38	3.98
Silver	0.24	0.43
Zinc	1.48	2.61
Total Cyanide	0.65	1.20
Amenable Cyanide	0.32	0.86
Total Toxic Organics		2.13

- Statistics derived from the “full” 1982 data set.
- Cadmium standards are “statistically zero” based on BAT treatment of no cadmium-bearing flows.
- Cyanide standards adjust downward to account for “dilution” from non-cyanide bearing flows.

Wastewater Discharge. Standards and Limits for Metal Finishers

Federal Standards for Sewer Discharges

40 CFR 433 Existing Sources
For: Old captive metal finishing operations

Pollutant (mg/l)	Month-Av	Daily-Max
Cadmium	0.26	0.69
Chromium	1.71	2.77
Copper	2.07	3.38
Lead	0.43	0.69
Nickel	2.38	3.98
Silver	0.24	0.43
Zinc	1.48	2.61
Total Cyanide	0.65	1.20
Amenable Cyanide	0.32	0.86
Total Toxic Organics		2.13

- Statistics derived from the “full” 1982 data set.
- Cadmium standards are based on BAT treatment of cadmium-bearing flows.
- Cyanide standards adjust downward to account for “dilution” from non-cyanide bearing flows.

Wastewater Discharge Standards and Limits for Metal Finishers

Federal Standards for Sewer Discharges

40 CFR 413 >10,000 gpd
For: Old metal finishing job-shops with peak (not average) discharges over 10,000 gpd.

Pollutant (mg/l)	4day-Av	Daily-Max	Month-Av*
Cadmium	0.7	1.2	0.5
Chromium	4.0	7.0	2.5
Copper	2.7	4.5	1.8
Lead	0.4	0.6	0.3
Nickel	2.6	4.1	1.8
Silver	0.7	1.2	0.5
Zinc	2.6	4.2	1.8
Total Cyanide	1.9	1.0	0.55
Total Metals	6.8	10.5	5.0
Toxic Organics		2.13	

- Statistics derived from a limited 1979 data set.
- Cadmium standards are based on treatment of cadmium-bearing flows.
- Non-cyanide bearing flows do not cause the downward adjustment of the cyanide standards.

Wastewater Discharge Standards and Limits for Metal Finishers

40 CFR 413 <10,000 gpd
For: Old metal finishing job-shops with discharges always under 10,000 gpd

Pollutant (mg/l)	4day-Av	Daily-Max	Month-Av*
Cadmium	0.7	1.2	0.5
Lead	0.4	0.6	0.3
Amena Cyanide	2.7	5.0	1.5
Toxic Organics		2.13	

- Old "Mom-n-Pop" job-shops exempted **from** BAT-based standards for copper, chromium, nickel, silver, zinc and cyanide (but not cadmium, lead and toxic organics).
- Statistics derived from a limited 1979 data set.
- Cadmium standards are based-on treatment of cadmium-bearing flows.
- Non-cyanide bearing flows do not cause the downward adjustment of the cyanide standards.

Q: **What is a job-shop?**

A: 40 CFR 433.11(c) - The term “job-shop” shall mean a facility which owns not more than 50% of the materials undergoing metal finishing.

Q: **What is a new source?**

A: 40 CFR 403.3(k) - A new source is “any building, structure, facility or installation” constructed after the publication of the proposed Federal rule,

- If it is on a site with no existing sources,
- Or it entirely replaces the processes which cause the discharge from an existing source,
- Or it is substantially independent of existing sources.

Q: When is new construction a "modification of an existing source" and not a new source?

A: 40 CFR 403.3(k) - New construction is considered a modification of an existing source and not a new source,

- When it does not entirely replace the processes which cause a discharge from an existing source,
- And it is engaged in the same general type of activity as an existing source.

Q: When was the publication data of the proposed rule for metal finishing?

A: August 31, 1982.

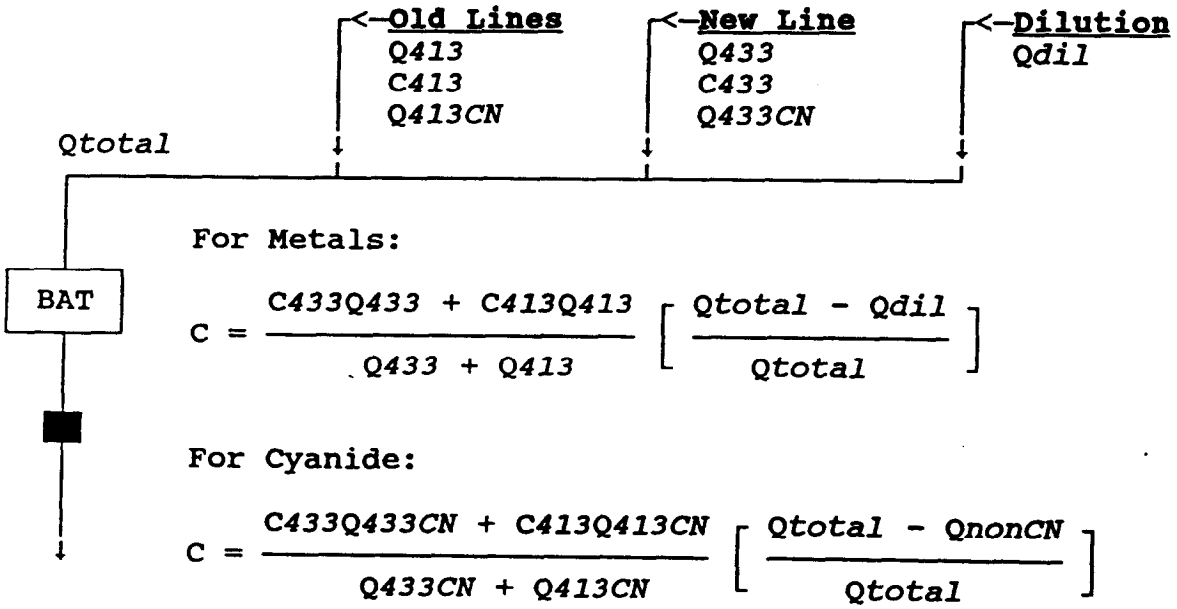
Q: New or Existing?

- A job-shop electroplater that moves anodizing from one side of the building to the other.
- A job-shop electroplater that rebuilds an existing anodizing line destroyed by fire.
- A job-shop electroplater that replaces alkaline prep steps in its anodizing line.
- A job-shop electroplater that increases production by adding anodizing tanks.
- A job-shop electroplater that increases production by adding a new anodizing line.

A: In concept, new source standards apply to a new source of pollutants when there is a chance to upgrade pollution controls (ie: repipe).

Q: What Federal standards apply to an old job-shop metal finishing shop which adds a new metal finishing line?

A: The 433 New Source metal finishing standards would apply to discharges from the new line and the 413 job-shop electroplating standards would apply to the discharges from the lines operating before August 1982.



Prohibition Against Dilution As A Substitute for Treatment

40 CFR 403.6(d)

No industrial user shall ever. . .dilute a discharge as a partial or complete substitute for adequate treatment to achieve compliance. . .

Dilution flows handled through adjustment of standards with CFW or alternate sample points:

- boiler blowdown
- non-contact cooling waters
- storm water
- demineralizer brines (RO reject / DI regen)
- domestic sewage
- weak-strength unregulated process flows

Prohibition Against Dilution As A Substitute for Treatment

Dilution flows handled through the narrative prohibition against dilution as a substitute for treatment.

- excessive rinses

Flows not considered dilution:

- fume scrubber blowdown

40 CFR 403.6(c)

Each POTW. . .shall develop and enforce specific limits to implement the (general and specific Federal prohibitions) . . .shall continue to develop these limits as necessary. . .

This means:

Local Limits are derived by the local sewer disctrict to protect its sewer system from pass-through, interference, sludge contamination, explosive and worker safety hazards, obstruction and structural damage.

The first step is a technically-based evaluation of the maximum pollutant levels that the sewer district can accept and still meet its requirements.

The second step is the allocation of the maximum pollutant levels to the sewer system users.

What this really means:

Local Limits are greatly effected by changes in State water quality standards promulgated to protect the receiving waters, because they result in changes in the NPDES permit for the sewage treatment plant.

Local Limits for toxic pollutants are not comparable between sewer districts; although limits for protection of the sewers (like pH or O&G) are often the same.

Local Limits for toxic pollutants are actually mass loading allowances first allocated to uncontrollable sources (domestic and infiltration/inflow) and then to controllable sources (industrial and commercial).

Local Limits are greatly effected by the method of allocation (uniform, BMPs, contributory).

California Toxics Rule

New water quality standards for California's inland surface waters will significantly change some NPDES permits beginning in 1998.

- Ocean Dischargers - No effect.
- San Francisco Bay Dischargers - Little effect. New NPDES permits limits would not be much different than the existing permits.
- Central Valley Dischargers - New NPDES permits will have standards for a number of toxics for the first time, which will greatly change the local limits. Some sewer districts will have local limits for the first time.

MP&M Standards

New Federal standards should be proposed October 2000 and promulgated December 2002.

MP&M standards will be based on the same BAT as metal finishing 433 plus:

- Countercurrent rinsing
- Flow restrictors
- Conductivity-controlled rinsing
- Solution bath maintenance
- Machining coolant recycling
- Paint curtain reuse

This means it will be hard to meet Federal standards in the future without

Treatment + Pollution Prevention + Water Conservation

wastewater Discharge Standards and Limits for Metal Finishers

Pretreatment Streamlining Rule

New Federal rules effecting the regulation of categorical industrial users should be proposed July 1998 and promulgated July 1999.

- **Deminimus** - Would allow categorical industrial users discharging less than 100 gpd to no longer self-monitor. (No concentrated wastewaters.)

- **Mass-based Standards** - Would allow conversion of Federal standards to mass-based as long as there is a demonstration of BAT equivalence.

- **pH Relaxation** - Would allow acidic wastewater discharges (pH below 5.0) as long as there is a demonstration of no ill-effects.

- **Monitor of Pollutants Present** - Would limit monitoring to just the pollutants in the discharge.

Wastewater Discharge Standards and Limits for Metal Finishers

Wastewater Compliance Strategies for Metal Finishers

- statistical performance
- controlling the mean
- controlling effluent variability

Surface Technology Association
Environmental Training Workshops for Metal Finishers
Fremont, California, February 26, 1998

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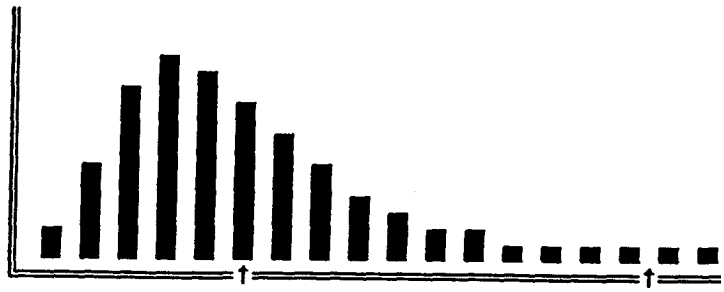
Statistical Performance

Federal categorical standards were derived from the statistical performance of model treatment units and source controls (Best Available Technology "BAT").

The standards were set where statistically the metal finishers with BAT can comply 99 out of 100 times.



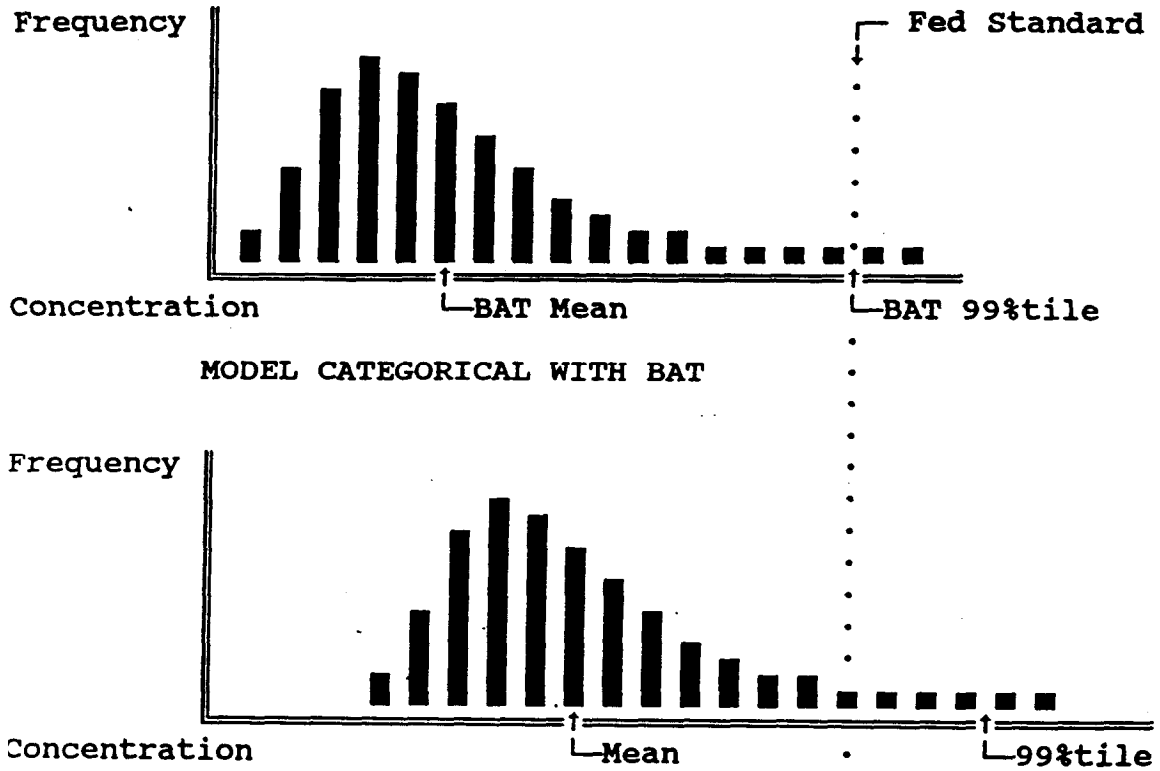
Concentration	Mean	99%tile
Cadmium	0.011 mg/l	0.11 mg/l
Chromium	0.572 mg/l	2.77 mg/l
Copper	0.815 mg/l	3.38 mg/l
Nickel	0.942 mg/l	3.98 mg/l
Lead	0.051 mg/l	0.69 mg/l
Silver	0.096 mg/l	0.43 mg/l
Zinc	0.549 mg/l	2.61 mg/l
Cyanide	0.180 mg/l	1.20 mg/l

So. . . this means BAT defines a level of performance based on the control of both **the mean** and **the variability** around the mean.

Wastewater Compliance Strategies

Compliance Strategy No.1

Operate BAT to meet the mean daily-maximum concentrations (well below the Federal standards which define the 99th percentile event).



Higher mean concentrations likely result in a greater frequency of exceeding the Federal standards.

SELF TEST: Are average daily-maximum concentrations near the BAT-derived means or are they closer to the Federal standards?

What Could Cause Higher Means?

- Treatment and controls that are not statistically equivalent in performance to BAT.

  Examples: aluminum chip precipitation, filter press or centrifuge precipitate removal, limited ion exchange, untreated rinses or regenerants, source controls.

- Operational instabilities which interfere with treatment unit processes.

  Examples: complexing, incomplete reaction end-points, amphoteric back reactions, floe shearing, pump surging.

What Could Lower the Means?

- **Treatment and controls that** exceed the statistical performance of BAT.

  Examples: sulfide precipitation, settling followed by media filtration, final ion exchange or reverse osmosis, distillation, source control that eliminate pollutants altogether.

- Separated first-stage treatment of segregated wastewaters in order to minimize interference.

  Examples: electrowinning, electrodialysis or dechelation of complexed metals, ultrafiltration or dissolved air flotation of organics, hydrocycloning or ultrafiltration of suspended solids.

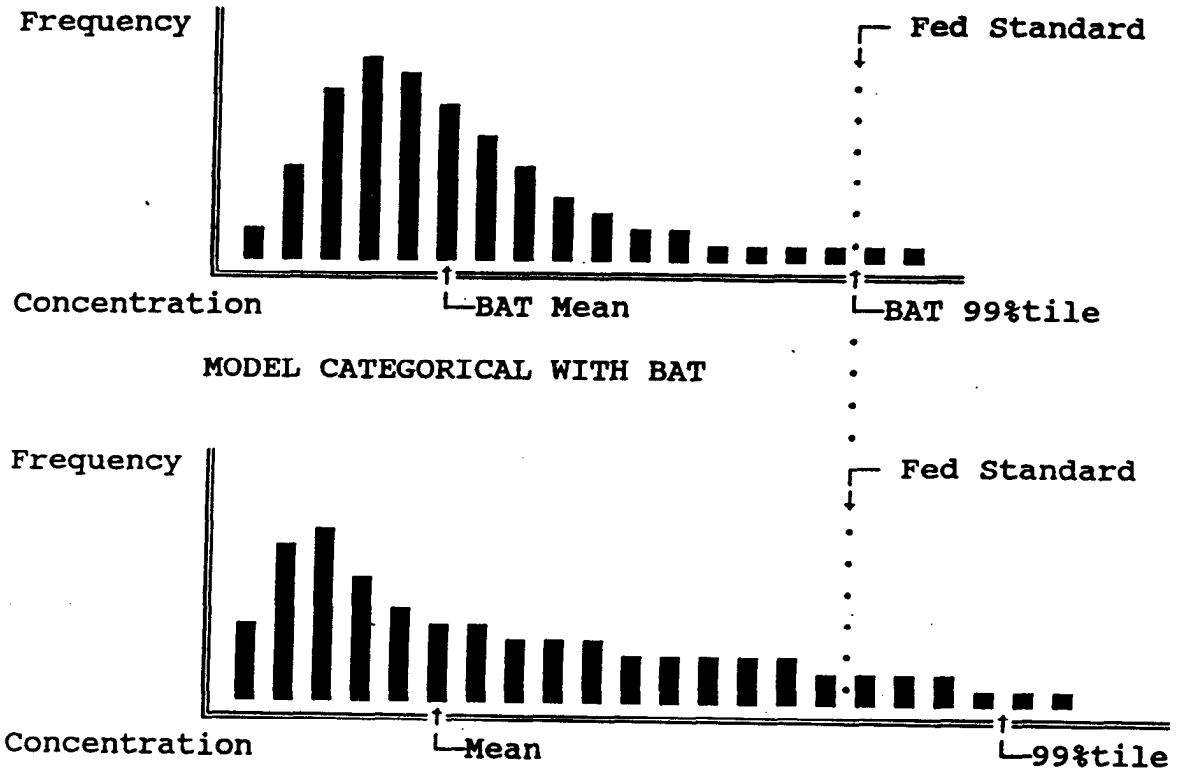
- Ceasing discharge altogether or at least of all wastes bearing pollutants which interfere with treatment (complexes, oils, suspended solids).

BAT defines a level of performance based not only on the control of the mean but also particularly in the control of the variability around the mean.

- BAT reduces the variability in effluent quality first by reducing concentrations.
- More importantly, the operational needs of BAT provide other significant reductions in the variability in the effluent quality. Effective operation of BAT requires control of the three main sources of variability: influent quality, treatment unit, method of discharge.
- A number of variability controls can be designed into the treatment and source controls. Many of them are assumed included BAT.
- Source controls without BAT need to compensate for the variability controls provided by BAT.

Compliance Strategy No.2

Control the variability in effluent quality attributable to variabilities in the influent, treatment and discharge, at least to the degree that it is controlled by BAT.



Higher effluent variability results in a greater frequency of exceeding the Federal standards.

SELF TEST: Are the compliance rates with Federal daily-maximum standards below 99% (no more than 1 violation in 100 samples)?

What Could Raise Effluent Variability?

- Source controls, since they add variability due to operator error but often do not incorporate the variability controls needed to run BAT-treatment. An example would be untreated wastewaters without loading and flow equalization.

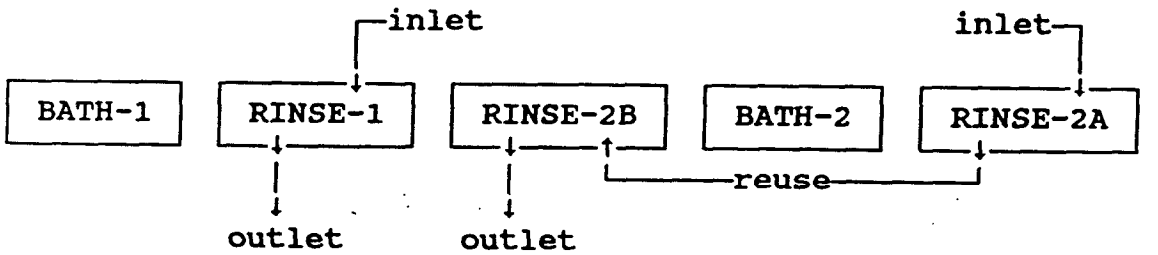
- Operational instabilities, like complexing, floc shearing, incomplete and amphoteric reactions or pump surging, which interfere with treatment.

EPA's 1994 Model IU study found compliance rates of ≥ 99% at ~65% of the metal finishers with BAT and ≥ 92% (≤ 1 violation in 12 samples) at another -15%.

What Influent Controls Could Lower Effluent Variability?

- Treatment and **controls that reduce and** equalize pollutant loadings into treatment.

  Examples: separate batch treatment of spents, equalization and metering of spents, deactivation rinses to extend bath life, first-stage drag-out rinses, bath purification, water supply preconditioning to reduce bath contamination.



DEACTIVATION RINSE-2B PROTECTS BATH-2 FROM RINSE-l DRAG-OUT

What Influent Controls Could Lower Effluent Variability?

- Controls that equalize and reduce influent flow rates.

  Examples: **influent holding tanks,** variable speed influent pumping, first-stage drag-out rinses, conductivity-controlled rinses, water supply preconditioning.

- Segregation of incompatible wastestreams prior to treatment.

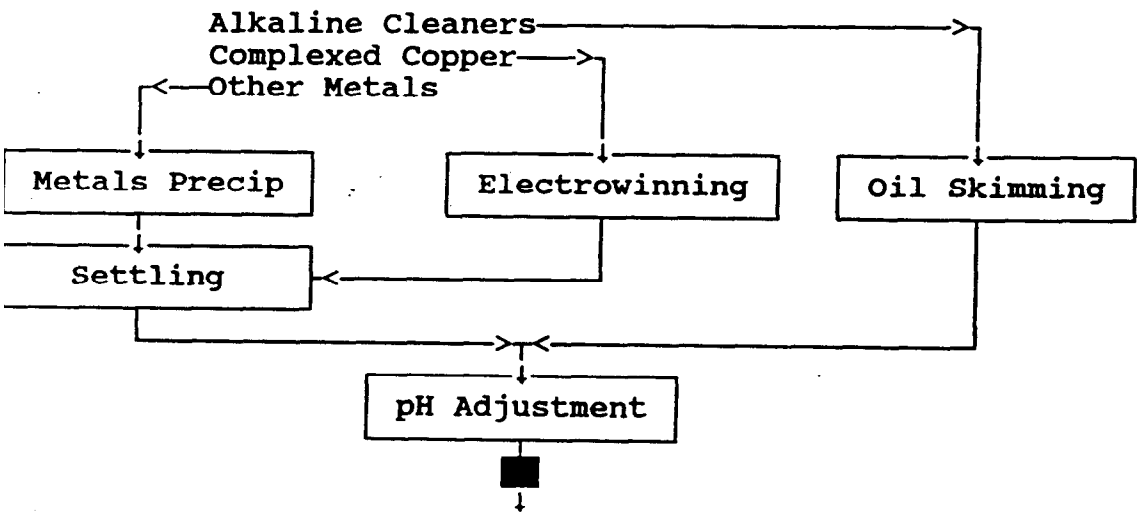
  Examples: alkaline chlorination of cyanide prior to any inadvertant iron complexing, reduction of hex-chromium, settling-flotation-ultrafiltration of oily wastewaters, acidic emulsion breaking, dechelation of complexed metals.

What Influent Controls Could Lower Effluent Variability?

- Separate handling of certain incompatible wastestreams and discharge around treatment.

  Example: electrowinning-electrodialysis of complexed metals around precipitation, pH adjustment of alkaline surfactants around settling.

SEPARATE HANDLING of WASTESTREAMS INCOMPATIBLE WITH BAT



What Treatment Unit Operational Controls Could Lower Effluent Variability?

- Controls that optimize treatment unit efficiencies.

  Examples: Batch treatment, flocculant - and/or coagulant-aided settling, baffling to prevent clarifier short-circuiting, even feeds rates.

- Controls that reduce operator error.

  Examples: Real-time monitoring of reaction end-points (pH, ORP, µmhos) tied to automated dosing, automated sludge wasting, feed alarms.

- Controls that reduce loadings and flows.

  Examples: first-stage drag-out, second-stage countercurrents, final DI-rinses reused through DI-columns, DI-water make-up, deactivation rinses, bath maintanence (electrowinning, electrodialysis, ion exchange, distillation).

What Discharge Controls Could Lower Effluent Variability?

- Controls that allow testing prior to discharge.

  Example: effluent holding with additional treatment capacity to re-treat off-spec flows.

NUMMI in Fremont batch discharges ~900,000 gpd of metal finishing wastewaters alternately from two 1.5 million gallon final effluent equalization tanks.

Linking P2 and Wastewater Discharge Compliance

Patrick Wooliever

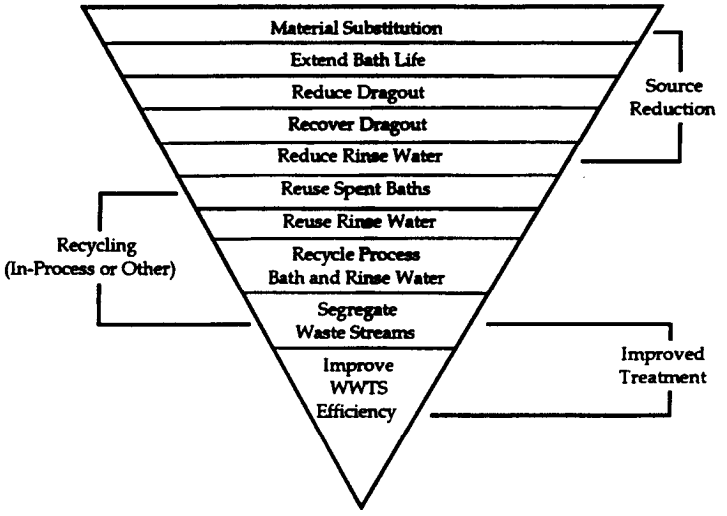
Environmental Engineer

Tetra Tech EM Inc.

Contaminant Loading in Wastewater

- Contaminant Loading is a combination of:
  - Wastewater Flow Rate (gallons per hour)
  - Contaminant Concentration (parts per million)
- ➨ Reduce either component and their is less waste to treat
  - ⬇ flow rate: more concentrated contaminant
  - ⬇ dragout: able to reduce flow rates

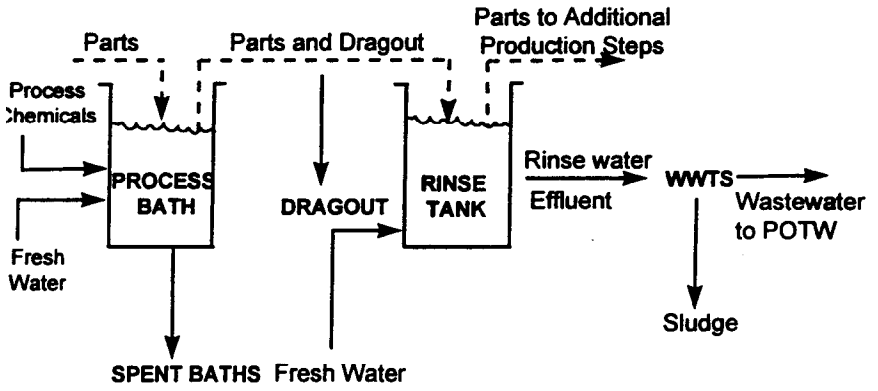
Hierarchy for Wastewater Reduction Strategies



Costs for Process Inputs/Outputs

- **Water use at 10 gpm**
  - **Fresh water:** **$130-$500**
  - **Sewer fee:** **$50-$100**
  - **WWTS chemicals:** $400
  - **WWTS sludge:** **$100**
- **Dragout at 0.1 gallon per hour**
  - **Chrome** **$100**
  - **Nickel** $200
  - **Cadmium** $65

Material Flows for Metal Finishing



Case Study 1
Reducing Contaminants/Dragout

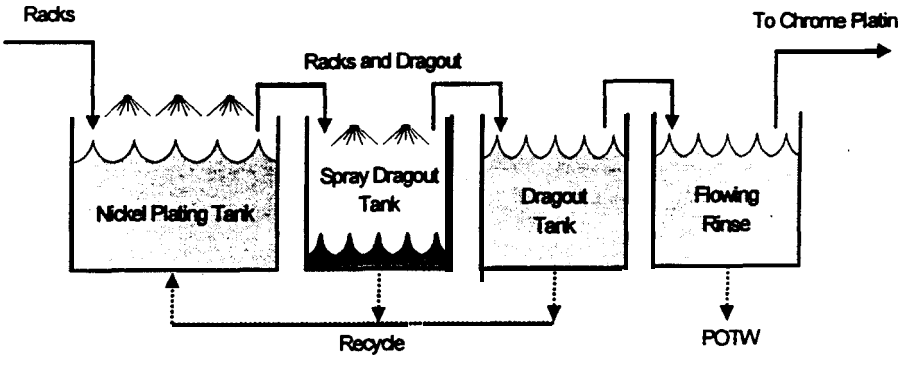
Facility Description

- Customer base: plumbing hardware and miscellaneous small jobs
- Metal stamping
- Decorative chrome and nickel plating
- 23 employees
- 40-year-old facility

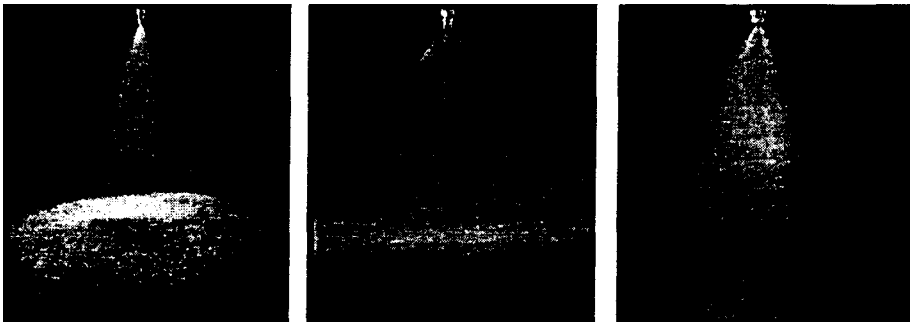
Motivation for Pursuing P2

- Competitive market: high volume, low profit margin
- Process control and efficiency
- Cost of raw materials and waste
- Compliance with wastewater limits
- Company TQM program
- Maintain good relationship with POTW

Nickel Plating Tank Layout

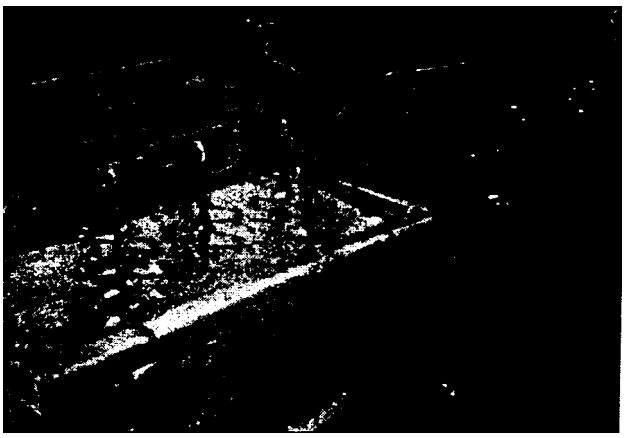


Hydraulic Spray Patterns

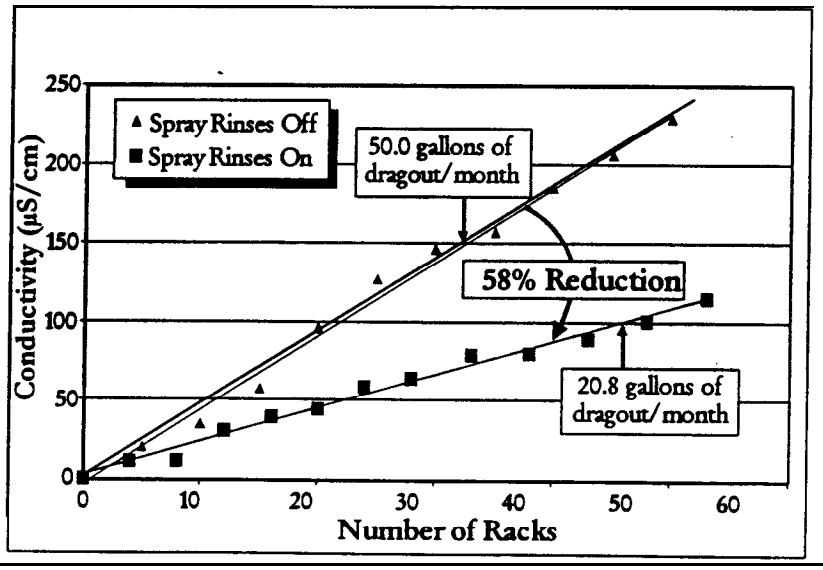


Full Cone **Flat Spray** **Fine Spray**

Spray Rinse In Dragout Tanks



Sprays Reduce Nickel Dragout by 58%



Spray Rinse Results

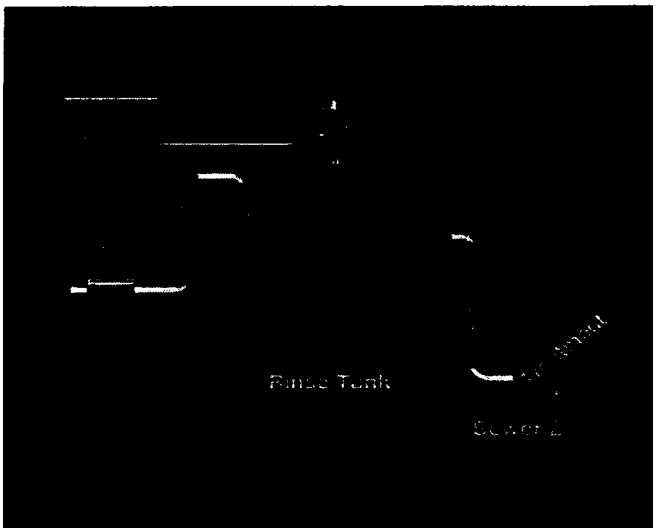
	Without Sprays	With Sprays	Monthly Savings
Nickel Solution Dragout	50.0 gal/mo	20.8 gal/mo	$313
Rinse Water	380,000 gal/mo	152,600 gal/mo	$185

Total Cost Savings = $5,976/year

17

Case Study 2
Reducing Wastewater

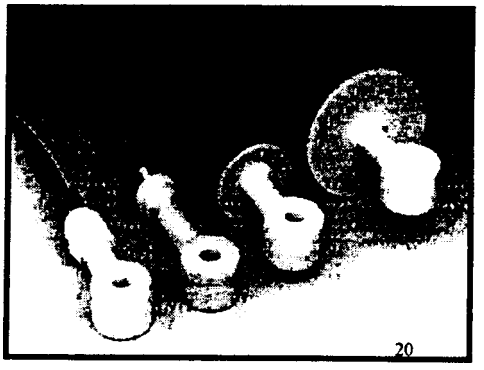
Conductivity Control System



19

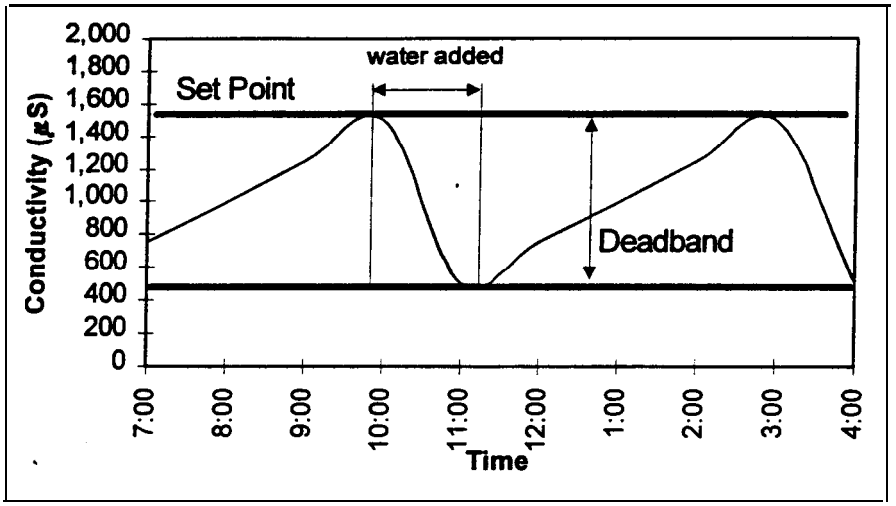
Electrodeless Sensor

- Uses two parallel torroids
- Non-conductive casing (polypropylene or PVDF)
- No electrodes; no fouling
- Can measure full range of conductivity



20

Conductivity Measurements in Rinse Tank



21

Facility Description

- Sports, plumbing, automotive hardware
- Specializes in electroplating zinc die-cast parts
  - Also electroplates steel and brass parts
- Hand Operated Rack Line
  - Brass, copper, nickel, chrome
- Manually-Operated Barrel Hoist Line
  - Copper
- 60 employees

22

Facility Operating Costs (Baseline)

	Monthly Rate	Monthly Cost
Rinse Water Use	520,000 gal	$640
Wastewater Discharge	520,000 gal	$260
WWTS Operation	520,000 gal	$5,800
Sludge Generation	2.6 tons	$1,400
Total =		**$8,100**

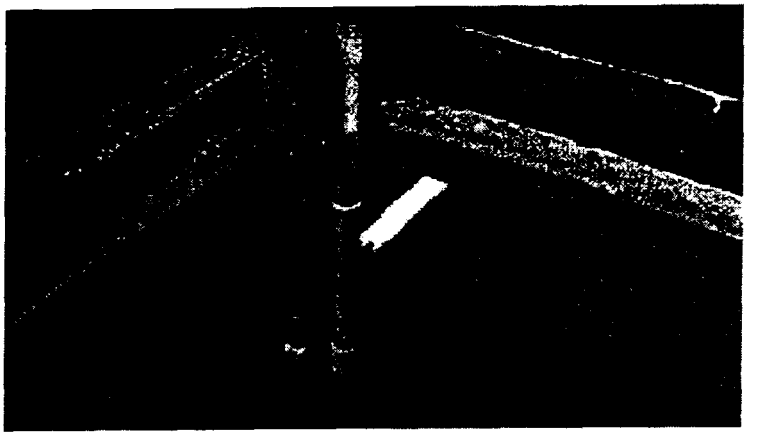
23

Rinse Tank Types with Conductivity Control Systems

- Acid activation (new parts)
- Acid activation (nickel-plated)
- Acid activation (barrel line)
- Chrome
- Copper cyanide and brass
- Copper (barrel line)
- Nickel (satin)
- Nickel (die-cast)
- Nickel (steel)

24

Electrodeless Sensor



25

Conductivity Control System costs

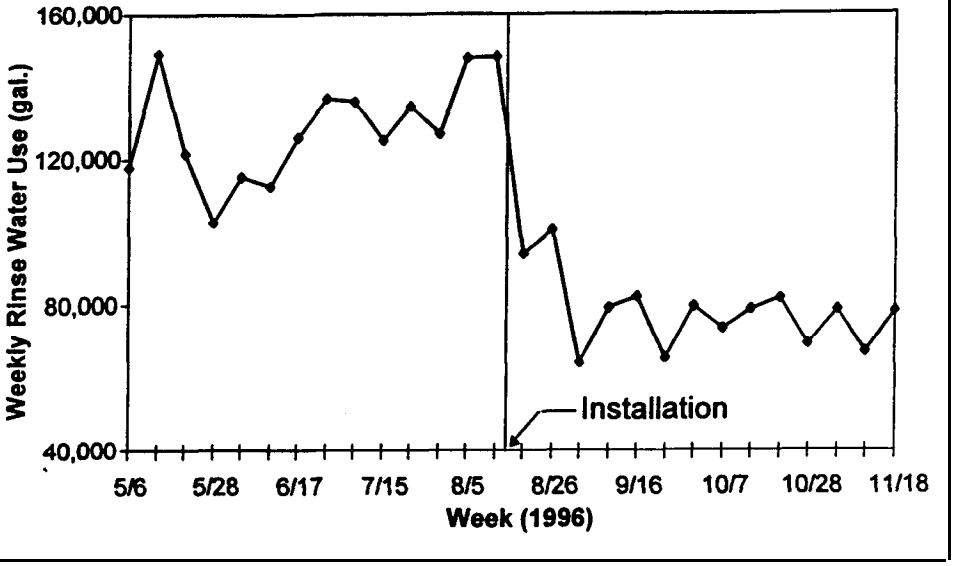
	Conventional[a]	Electrodeless[b]
Capital	$290	$1,140
Additional Hardware	$100	$250
Installation	$400	$600
Total (per system)	$790	$1,990

[a] Conventional sensor, analyzer with no display, and analog set point and deadband

[b] Electrodeless sensor, analyzer with digital display, and programmable set point and deadband

26

Rinse Water Use



Conductivity Control System Results

	Per Month		Monthly
	Before	After	Savings
Rinse Water Use	516,000 gal	296,000 gal	$280
Wastewater Discharge	516,000 gal	296,000 gal	$110
WWTS Chemical Use	$4,000	$3900	$800
WWTS Sludge		Not Quantified	

Total Cost for Nine Systems = $14,500
Total Cost Savings = $14,300/yr
Payback Period = < 1.0 year

28