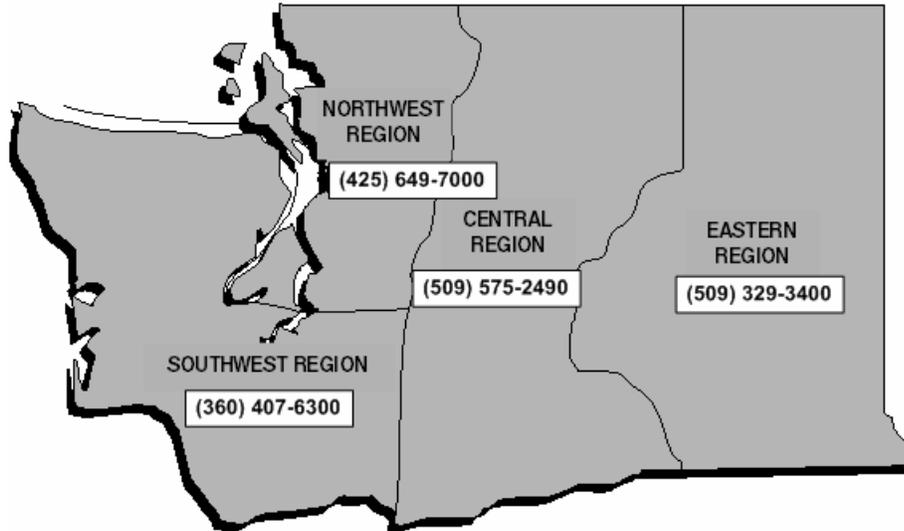




Cleaner Production Challenge
A Voluntary Resource Conservation Effort
Final Report

Washington State Department of Ecology
Hazardous Waste and Toxics Reduction Program
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Cleaner Production Challenge

A Voluntary Resource Conservation Effort

Final Report

Acknowledgments

The Department of Ecology and the Cleaner Production Challenge Team would like to thank the project endorsers and all the participating facilities in helping us complete this project. We especially appreciate the facilities providing information and speakers for the workshops and case studies.

Ecology's Cleaner Production Challenge Team consisted of Michelle Underwood (team leader), Mark Benedict, Michelle Costenaro, Judy Kennedy, Scott Lamb, Rolfe Parsloe, Rob Reuter, and Jenny Yoo. Our Management Representative was Dennis Johnson.

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Chapter 1: Executive Summary

The Wet Process Sector Project began in 2000 when the economy was rosy and The Boeing Company was at its highest level of production since World War II. The combination of the water and energy shortage in the state and proposed provisions on discharge limits under the Clean Water Act motivated electroplaters/metal finishers to work with the Washington State Department of Ecology. As an additional incentive, many of these facilities also had their second Five-Year Pollution Prevention Plan Update due in 2002.

The Wet Process Sector consisted of facilities that manufacture aerospace parts, printed circuit boards, and electroplated parts. The aerospace manufacturing facilities generated about two-thirds of the wastewater and hazardous waste sludge generated in the State of Washington. The plating and printed circuit board manufacturers account for over one-fourth of the wastewater and sludge generated in the same period.

Ecology provided technical assistance to the wet process sector through the Cleaner Production Challenge. This non-enforcement project focused on water use reductions and wastewater and sludge reductions through the implementation of simple, low-cost Pollution Prevention Opportunities.

The Cleaner Production Challenge team established the following goal: By December 2004, participating facilities would reduce wastes, normalized for production, by 10% to 25%, using calendar year 2000 as a baseline.

The team secured endorsements from:

- The Boeing Company
- American Electroplaters and Surface Finishers Society (AESF) – The Seattle/Puget Sound Branch
- Washington State Association of Metal Finishers (WSAMF)
- United States Environmental Protection Agency Region 10 (US EPA)
- Pacific Northwest Pollution Control Association (PNPCA)
- Pollution Prevention Resource Center (PPRC)

In May 2002, the height of participation, forty-six companies signed up for the Challenge: five in SWRO, two in CRO, one in ERO and the rest in NWRO. Seventeen more tentatively accepted the Challenge indicating that they were interested but could not commit to gathering data.

The team conducted two workshops in 2002 based on the needs identified during site visits. Throughout the project the Cleaner Production Challenge team kept in contact with facilities by conducting site visits, bringing up Cleaner Production Challenge issues through Pollution Prevention Planning and reporting, and gathering data on water, electricity and natural gas use, and dangerous waste (manifested waste, sludge) and wastewater generation. The team didn't identify any new training needs substantial enough to justify additional workshops. *Cleaner Production Challenge Update* newsletters were sent to participants, tentative participants, and other interested parties. The Cleaner Production Challenge website received over 3,500 hits in one six-month period.

Over the next couple of years of the project, the targeted industries experienced a significant decline due to domestic terrorism, increased foreign competition, and consolidation of processes and offshore production. These factors created unanticipated impacts on the Cleaner Production Challenge project.

In 2001, the team evaluated the practices for seventy-five facilities. By 2004, ten of these facilities closed, and the team chose not to contact three others due to pending compliance concerns. Participation in 2004 included twenty-seven facilities accepting the reduction goals and seven facilities already implementing the best management practices. Thirteen facilities also tentatively participated due to workload concerns, and seven of these provided resource use and waste generation data.

Wastewater and sludge generation from all facilities submitting data to this study reduced 67% and 40% respectively, comparing non-normalized data for 2000 and 2003.

Facilities implemented low cost opportunities such as training employees, installing rinse water controls and tracking resource use to achieve wastewater and sludge generation reductions. Operational control and awareness improved at many of these facilities.

The pollution prevention planning process and dangerous waste annual reporting help the Department of Ecology track current and future implementation projects. The team continues to work with Water Quality Permit Writers and Local Delegated Permit Writers to identify potential opportunities at wet process facilities. This interaction also allows Ecology to provide targeted technical assistance to each facility that prepares a pollution prevention plan.

Chapter 2: Introduction and Background

The Department of Ecology (Ecology) utilizes many different strategies to assess pollution prevention (P2) opportunities and provide technical assistance to facilities. Sector projects allow Ecology to focus on a specific industry sector to provide short-term and focused assistance.

In order to accomplish this, Ecology consults with businesses, performs site visits, and collects and analyzes data. Whenever possible, Ecology collaborates with industry trade groups or organizations on the project. Ecology conducted past sector projects with the following industry groups: electroplating, fiberglass, printed circuit boards, painting and coating, and national security/defense. Focusing limited resources on these sectors increases consistency and efficiency and addresses high environmental threats.

2.1 The Wet Processes Sector Project

Hazardous Waste and Toxics Reduction Program's (HWTR) first sector project was with electroplaters in 1994. The wet process sector¹ became a priority industry group with HWTR in 2000 due to the large amounts of hazardous waste it generated and the natural resources it

¹ The wet process sector includes facilities within the following Standard Industry Classifications (SIC): Electroplating/Metal Finishing SIC 3471-3479, Aerospace/Parts Manufacturing SIC 3721-3729, and Printed Circuit Boards SIC 3671-3699.

consumed. The wet process sector also had a history of non-compliance with the *Dangerous Waste Regulations* (Chapter 173-303 WAC) with over 900 citations between 1988 and 2000. Ecology estimated that the Wet Process Sector (WPS) included about 100 companies in 2000.

The team proposed a strategy to provide facilities in this sector with compliance inspections and technical assistance (TA) on low cost techniques for minimizing waste from their process baths. TA staff provided facilities with assistance on regulatory topics, answers to implementation questions and provided a level playing field at the facility level – a major concern of industry.

Ecology evaluated the practices of seventy-five facilities statewide in 2001 (the majority by site visit) to determine training and assistance needs. The team did not visit facilities with significant compliance violations.

TA staff observed that wet process manufacturing operations could significantly reduce waste volumes through dragout reduction and other low cost opportunities. These industries also had high potential to increase their water and energy efficiency. Ecology believed the industries would respond to a corporate challenge from Ecology and the Cleaner Production Challenge sponsors if technical assistance and training for line staff and water treatment operators were provided. Additionally, approximately half of these facilities had their second Five-year Update to their Pollution Prevention (P2) Plans due in September of 2002.

2.2 The Cleaner Production Challenge

The Cleaner Production Challenge (CPC or the Challenge) was a non-enforcement project designed to help companies in the aerospace parts manufacturing, plating and circuit board manufacturing industries. The CPC project aimed to reduce the amount of water used, wastewater produced and hazardous sludge generated. It also offered ways to conserve water and process chemicals.

The original 2000 scope of the CPC project proposed the following goals for wet process facilities:

- Assure compliance in priority industrial sectors.
- Reduce waste from these facilities by 10 to 25%.
- Move each industry sector out of the top 5 prioritized by the HWTR Program.
- Establish a self-directed support group for industry sectors to continue improvement.
- Meet the annual program hazardous waste reduction goal of 2% generated by all regulated facilities, and 7% adjusted for economic conditions of the CPC.

The CPC Team later selected the following goal for the focus of the project:

- All Tier 2 and Tier 3 WPS facilities will reduce annual waste generation by 10% and 25% respectively between 2000 and 2004 normalized for production.

Measured outcomes include percentage of waste reduced (hazardous waste and wastewaters), and percentage of resources conserved (gallons of water, kilowatt hours of electricity and cubic feet of natural gas). No goals were set for Tier 1 facilities. We enlisted their help to provide case studies and examples to other facilities.

Throughout the CPC project, Ecology challenged facilities to reduce their water, chemical and energy consumption, and hazardous waste generation by learning from facilities that have already implemented P2 opportunities. These opportunities also helped facilities maintain compliance with the *Dangerous Waste Regulations*.

By early 2004 it was clear that continuing the project through the end of 2004 would add little value to the businesses involved. New and different initiatives were on the horizon as our Beyond Waste strategy emerged. The team decided to end data collection with 2003 information.

Chapter 3: Technical Assistance Approach/Methodology

3.1 Tier Determination

The team developed a tier determination survey (Appendix A: Wet Process Sector On-site Checklist) which included questions on current implementation of P2 opportunities, waste generation, water use, and adherence to Best Management Practices (BMPs) for floors and sumps. The survey also gathered data on the TA approaches that appeal to the facility. Team members made tier determinations on seventy-five wet sector facilities in the state; facilities known to have significant compliance violations were not visited.

The team entered the data for tier determinations, BMPs, and technical assistance options into an Access database for analysis. The survey results assigned a facility to one of three categories – Tier 1, Tier 2 and Tier 3 facilities, based on the characteristics below:

Tier 1 facilities:

- Used most of the P2 measures applicable to its operations.
- Experienced historic declines in waste generation and water use.
- Used most of the BMPs for floors and sumps and were in full compliance.

Tier 2 facilities:

- Used some P2 measures applicable to its operations.
- Capable of implementing further P2 measures with technical assistance.
- Used some of the BMPs for floors and sumps.
- Showed potential to reduce wastewater and sludge generation.

Tier 3 facilities:

- Used few P2 measures applicable to its operation.
- Capable of implementing P2 measures and BMPs with technical assistance.
- Showed high potential to reduce wastewater and sludge generation.

In January 2002, Ecology sent letters to 33 Tier 2 facilities and 26 Tier 3 facilities inviting them to sign up to the challenge to save money by reducing water, energy, and chemical use and generation of dangerous waste. Forty-seven of the seventy-five facilities surveyed during tier determination agreed or tentatively agreed to participate in the challenge.

The Challenge goals call for a 10% and 25% reduction of hazardous waste sludge and wastewater generation for Tier 2 and Tier 3 facilities respectively. The Challenge focused on

getting Tier 2 and 3 facilities to implement BMPs already employed by Tier 1 peers. The P2 opportunities highlighted include dragout reduction, spray rinsing, flow control, counter-current rinsing, and bath maintenance. The Challenge included special recognition from Ecology for participants of the Challenge that met the reduction goals by 2004.

3.2 CPC Technical Assistance / Deliverables

The CPC team provided on-site TA and employee training, and workshops throughout the Challenge. The team produced the CPC Toolkit CD which provided facilities information and assistance to increase their process control, reduce water use, produce less waste, and improve compliance. It also included strategy development ideas, P2 opportunity lists, case studies, worksheets, and vendor links.

Ecology used digital video equipment, purchased with grant funds, to provide individualized training for some facilities. The team filmed current dragout and rinsing practices and also demonstrated proper technique that showed resource savings and waste reductions. The facility received a copy of the video for future use. Ecology also utilized the video equipment to film case study examples for the workshops.

Each participating facility agreed to collect baseline data for calendar year 2000. Baseline data included water and energy usage, discharged and/or manifested wastewater, and dangerous waste sludge generated. Ecology planned to collect this information annually through the end of 2004 to evaluate the effectiveness of the CPC project. CPC team members worked directly with facilities that requested follow-up assistance.

3.3 CPC Workshops

Ecology secured a \$10,000 EPA grant in 2002 to host a Cleaner Production Challenge Workshop. This grant also funded the Pollution Prevention Resource Center's (PPRC) participation in developing vendor presentations, coordinating the vendor fair, and facilitating the workshop held in May 2002. The workshop focused on the basic practices and P2 opportunities for efficient and successful metal finishing: dragout reduction, rinsing techniques, and bath maintenance.

Ninety-eight people representing thirty-one facilities attended this workshop. Representatives from Federal facilities (five), Seattle City Light, Puget Sound Clean Air Agency and King County Industrial Waste also attended. Ten representatives from seven Publicly Owned Treatment Works (POTWs) attended the workshop and each received 0.6 Continuing Education Units (CEUs) established by Ecology.

All attendees were given a packet with the presentations and a CPC Toolkit CD. Sign-up sheets for site visits, additional information, and mentoring opportunities were also available. Fifty copies of the 30-minute EPA video *Pollution Prevention for Metal Finishers: Dragout Reduction* were handed out on request. EPA Region 10 provided 60 copies, including ten in Spanish. All the evaluations for the training came back positive (Appendix B: Workshop Evaluation Results). The highest marks went to the CPC Toolkit, workshop format, and the workbook.

Based on the support and positive feedback, the HWTR program offered a free advanced workshop in November, 2002. Ecology secured another EPA grant for \$20,000 which funded the Cleaner Production Challenge Advanced Workshop, established a CPC web presence at

PPRC (www.pprc.org/cpc), and purchased digital video equipment for presentations and training. This second workshop covered advanced techniques including electrowinning, filtration, reverse osmosis, and ion exchange. In addition to Ecology staff, representatives from The Boeing Company, National Association of Metal Finishers (NAMF), King County Industrial Waste and Hytek Finishing Co. presented topics, case studies, and an update on EPA’s Metal Products & Machinery (MP&M) rule.

Fifty-two people representing twenty-six facilities attended the second workshop. Two representatives from a local POTW also attended in addition to representatives from King County Industrial Waste and the Port of Seattle. Over half the attendees had attended the first workshop and already implemented some of the CPC opportunities.

Chapter 4: Results and Discussion

4.1 Data Analysis

Many facilities participating in the Challenge tracked their water and energy use, and wastewater and sludge generation for the years 2000 through 2003. Ecology determined how much wastewater and hazardous waste non-participating facilities generated from Discharge Monitoring Reports and Annual Dangerous Waste Reports. Of the original seventy-five companies, the team collected sludge data for about two thirds of the companies and wastewater data for one third of them. The team used this data to compare the resource use and waste generation for the industry before and after the Challenge.

However, due to the difficulty of obtaining information and the downturn in the economy, Ecology reduced the scope of data collection. Data was collected for the years between 2000 and 2003. Forty-three facilities gave data to Ecology for analysis, including 34 Tier 2 and Tier 3 facilities.

The team normalized the data based on production.² Generally, this industry decreased production in 2001 and 2002 compared to the base year of 2000. Figure 1 shows the average production factor of the different sectors. Aerospace manufacturing accounts for about two-thirds of the wastewater and sludge generated during this time period while Plating facilities have contributed less than one-fourth of the generated wastes. Printed Circuit Board Manufacturers and Other facilities contributed less than one-tenth of the wastewater and sludge generated during this time period.

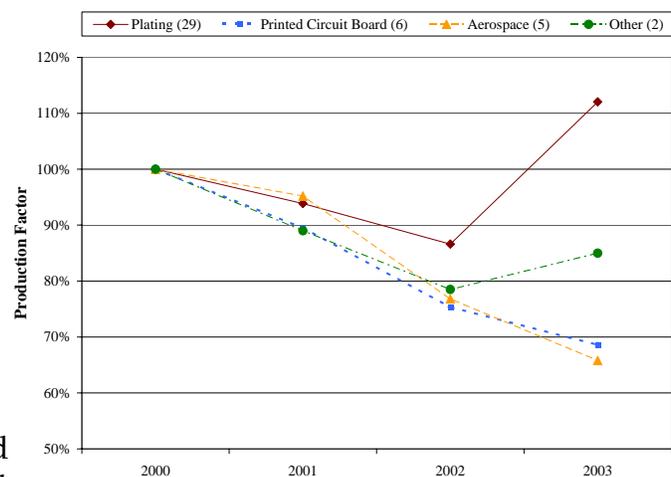


Figure 1: Industry Production Level

² For example, the employees at a facility could have produced 5,000 parts and generated 1,000 pounds of sludge in 2000, but in 2003 they produced 10,000 parts and still generated 1,000 pounds of sludge. Therefore the normalized sludge production for 2003 would be 500 pounds.

$$\frac{5,000 \text{ parts}}{10,000 \text{ parts}} \times 1,000 \text{ pounds} = 500 \text{ pounds (normalized)}$$

The facilities provided the data used for this analysis. The accuracy of the data depends on many factors including the facility’s counting and tracking practices and meter calibration. Some facilities did not start tracking this information until after 2000 making it difficult to correlate the data over the entire challenge. Other facilities do not dispose of all waste streams each year so an annual comparison may be misleading. The team tried to validate the accuracy of the data, but could not fix all problems. Ecology did not include data from facilities who: had obvious data inaccuracies, reported as a small quantity hazardous waste generator, failed to submit a dangerous waste report, closed their process line, or experienced an ownership change between 2000 and 2003.

As explained previously, TA staff evaluated the operation practices of facilities in the metal plating, printed circuit board, and aerospace sectors. Each facility was given a water and waste reduction goal, based on their current practices. The wastewater and sludge generation reduction goals varied from zero to 25%.

Table 1: Number of Facilities that Reached the Challenge Goals

		Only Wastewater ³	Only Sludge	Wastewater & Sludge	Total Facilities
Tier 1 No Goal	Decrease	2	0	3	7
	Increase	0	2	2	
Tier 2 10% Goal	Reached goal	1	6	5	18
	Did not reach goal	2	6	1	
Tier 3 25% Goal	Reached goal	0	5	2	12
	Did not reach goal	2	3	2	

Table 1 shows how many facilities reached their goal between 2000 and 2003. Some of these facilities only measured sludge generation.

Table 2: Wastewater and Sludge Goals Each Year

	2001	2002	2003	Ever
Wastewater	25%	33%	33%	47%
Sludge	39%	30%	28%	60%

Table 2 shows the percent of Tier 2 and Tier 3 facilities that met their 10% or 25% reduction goal, after normalizing the data based on production. Only 28% of the facilities that reached their wastewater goal met it every year, and 22% for sludge. Many of these facilities implemented reduction opportunities, but didn’t see the reductions each year because of delayed implementation, employee turnover or other company changes. However, 47% of the facilities we collected data from met their wastewater goal at least once during the three year period, and 60% for sludge.

³ Not all participating facilities provided wastewater generation information. Ecology did not count facilities with missing data under “Did not reach goal.”

Table 3: Industry Sectors Reaching their Goals

	Plating	Printed Circuit Board	Aerospace	Other
Reached Goal	87%	100%	75%	100%
Did not reach goal	13%	0%	25%	0%
Number of Companies	15	2	4	1

Table 3 shows the percentage of facilities who reached their wastewater and/or sludge reduction goal at least one year during the challenge.

Table 4: Participating Facilities Reaching their Goals

Accepted the Challenge	yes	yes	no	no
Attended a Workshop	yes	no	yes	no
Reached goal	7	3	5	4
Did not reach goal	1	1	1	0

Table 4 shows the relationship between participation and the facility’s ability to reach their wastewater or sludge generation reduction goal. The level of participation from facilities varied. Ecology offered TA to all facilities, regardless of their participation level. The team collected full data sets from only twenty-two of the thirty-four facilities remaining in the challenge.

Table 5: Total Industry Waste Generation

			2000	2001	2002	2003
Wastewater <i>gallons</i>	Normalized	Generation	362,670,777	217,120,459	253,612,421	196,834,366
		Reduction	-	40%	30%	46%
	Not-Normalized	Generation	362,685,733	216,378,794	185,464,065	120,163,206
		Reduction	-	40%	49%	67%
Sludge <i>pounds</i>	Normalized	Generation	2,604,674	2,537,119	2,871,617	2,326,314
		Reduction	-	3%	-10%	11%
	Not-Normalized	Generation	2,604,674	2,580,155	2,255,905	1,550,411
		Reduction	-	1%	13%	40%

Table 5 shows that wastewater and sludge generation from all facilities included in this study was reduced 67% and 40% respectively, comparing non-normalized data for 2000 to 2003.

4.2 Case Studies

4.2.1 Puget Sound Naval Shipyard

PSNS installed a new Ion Exchange system to treat their metal bearing wastewater. The metals from the acid regeneration solution from the cleaning of the ion exchange columns will be

recovered in an Electrowinning process. The hexavalent chromium reduction and the cyanide destruction pretreatments will continue prior to the ion exchange. This new system produces a cleaner discharge, reduces the hazardous waste sludge generated, and increases the potential for metals recycling.

4.2.2 The Boeing Company – Auburn Plant

Through the use of the Rinse Water Reduction Calculator, the Boeing Plant in Auburn reduced rinse water usage by more than 50 percent in selected tank lines. This calculator uses a Microsoft Access database to model single, double, and triple counter current rinse tanks. Water usage can then be controlled with the use of timers taking into account requirements driven by health and safety, governing specifications, and part quality. The Rinse Water Reduction Calculator will be made available on the Boeing Company website (<http://www.boeing.com/special/rrcalc/>).

4.2.3 Novation

Novation reduced their consumption of rinse water and generation of waste water by switching from continuous flow to static rinse tanks. This resulted in a sludge reduction of 74,000 pounds in 2001 to 65,000 pounds in 2003 despite a significant increase in production (PF 1.82).

4.2.4 Skills Corporation

Skills Corporation rebuilt their entire plating line after a project with Ecology's TREE team in 2001. They improved employee practices and installed flow controls. Between 2000 and 2001 they reduced their wastewater generation by 20% and their sludge generation 25%.

4.2.5 Prototron Circuits Inc.

Prototron Circuits installed flow restrictors and new bath monitoring equipment. They succeeded in reducing their normalized wastewater generation nearly 55% between 2000 and 2003.

4.2.6 Art Brass Plating

Art Brass experimented with new conductivity set points in their rinse tanks. They reduced wastewater generation over 40% between 2000 and 2003, normalized for production.

4.2.7 Metal Finishing Inc.

Metal Finishing extended the use of their rinse baths from one to five weeks and altered chemical usage. They reduced their normalized sludge generation over 70% between 2000 and 2003.

Chapter 5: Conclusions

The wet sector industry succeeded in reducing their water consumption, wastewater and sludge generation during the span of the project. This achievement coincided with a downturn in the economy and decreased demand for wet sector produced products after the September 11, 2001 terrorist attacks. Airplane and printed circuit board production decreased sharply throughout the project period; electroplated metal parts demand rebounded in 2003.

The level of participation in the CPC varied, with greater participation from companies in western Washington, especially those located near Boeing facilities. The proximity of these companies to each other, their customers, industry association and the workshops provided may have

encouraged facilities to participate. Ecology provided all companies with an initial site visit, invitations to the workshops, access to workshop proceedings, data tracking software, and a newsletter showcasing successful case studies from their peers. HWTR also provided the large and medium quantity generators with assistance on their five year Pollution Prevention Plan updates.

Many facilities implemented low cost methods (training, rinsewater controls and measurement) to achieve wastewater and sludge generation reduction. Operational control and awareness has improved at many of these facilities. Only one facility implemented higher cost, more advanced technology during the timeframe of the project. During this economic downturn many companies may not have had the resources to pursue these options.

The wet process sector facilities implemented simple, low cost P2 opportunities to reduce wastewater and sludge generation. The level of implementation depended upon the management support and complexity of the available opportunities at each individual facility. The P2 planning process and annual reporting help Ecology track current and future implementation projects. This interaction also allowed Ecology to provide targeted TA to each facility that prepares a plan.

5.1 Anomalies

Several companies using advanced technology closed unexpectedly during the project. Boeing Kent Space Center used a complex Reverse Osmosis Wastewater Treatment System and Hytek Finishing – North used an Ion Exchange Resin Wastewater Treatment System. TTM-Burlington, which was using Computer-Aided Manufacturing (CAM) for all their wet processes, also closed.

Companies with technologically advanced processes are more efficient and minimize their waste generation. These facilities have an economic advantage over other facilities that have not optimized their processes since their resource use and waste production are lower when normalized for production. These process upgrades should have an economic pay-off of two years or less. Ecology would not expect these technologically advanced companies to cease production; this could mean that the capital required to install and operate the equipment may require a higher return on investment.

5.2 Lessons Learned and Future Steps

The CPC data collection originally ran through the end of 2004, but due to several factors, the team decided to end the data collection after 2003. A data collection difficulty the CPC team encountered was establishing the base year as 2000. This required facilities to gather historical data from two years prior to the start of the challenge in 2002 and historical data is very difficult and time-consuming to gather and verify.

Another challenge to the data collection involved the ability to gather data from multiple sources: the DW data could be gathered from the Annual Reports, wastewater discharge data had to be obtained from the Discharge Monthly Reports (DMRs) sent to their POTW or to Ecology, and water consumption data came from bi-monthly bills which included non-process waters used at the facility. Many times the DMR data recorded the maximum flow discharged or the maximum allowable under the permit instead of the actual monthly flow.

Energy consumption data proved very difficult to collect. Energy data is not readily available to Ecology and asking for data not reported directly to Ecology may require a more formal commitment on the part of the participating company or increased partnering with utility providers. Partnering with utilities providers would provide better TA to the facilities on conservation opportunities and data acquisition.

The HWTR program should continue to work with Water Quality permit writers to further identify opportunities at wet process facilities. Cross-programmatic involvement would increase the visibility of the project and also alert the Local Delegated Authority permit writers of Ecology's efforts.

HWTR could provide the initial screening checklist to each facility to use as a "before and after" assessment to see if they changed Tiers as a result of implementing opportunities identified during the CPC.

Appendix A: Wet Process Sector On-Site Checklist

Wet Sector Process: **On-site** Checklist

Facility Name: _____ EPA ID #: _____ Visit Date: _____

Based on: [Site Visit] or [Prior Knowledge and Records Only] Visitor: _____

BMPs every facility should have (answer "No", if not anywhere in facility):

- 1 a. [Y/N] Clean and dry floors
 - b. [Y/N] Sumps with < 1/2" of liquid
 - c. [Y/N] Floors, sumps and trenches should have an appropriate chemical resistant coating
2. [Y/N] Spill reduction devices in place (e.g. splash guards b/w tanks, overspray curtains, etc.)
- 3 a. [Y/N] Secondary Containment in all sumps servicing process tanks
 - b. [Y/N] Sumps have a leak detection system between first and secondary containment for overflow
4. [Y/N] Do you have an inspection/maintenance plan or log?
 - Where is it kept?
 - How often is it updated?

Drag-out Reduction (answer "Yes" to questions 1-32, if anywhere in facility):

1. [Y/N] Are parts racked to minimize drag-out? (Tier 2)
2. [Y/N] Is the withdrawal speed minimized? (Tier 2)

What is the withdrawal speed? _____ ft/sec (If manual, calculate average time)
3. [Y/N] Is the hoist motorized? (Tier 2)
4. [Y/N] Is hang time optimized? (Tier 2)

What is the hang-time? _____ sec (If manual, calculate average)
5. [Y/N] Make use of stationary or sliding drain boards? (Tier 2)
6. [Y/N] Use air knives/squeegees/rollers so excess solutions goes back into process bath? (Tier 2)

Rinsing practices:

7. [Y/N] Are parts misted? (Tier 2/1?)

How is misting applied? _____
8. [Y/N] Use a drag-out recovery tank? (Tier 2)
9. [Y/N] Is a dead rinse used?

If yes, how often is the water changed? _____

What % of water is changed at one time? _____
10. [Y/N] Use rinse water from first rinse to make up the process bath? (Tier 2)
11. How is new rinse water added to the rinse process: (Tier ???)

Added directly to the parts? Added directly to the last rinse tank?

How is the water added to each tank (including process tank)?

Continuously manually poured pumped
12. How many rinse tanks are present? _____
13. [Y/N] Is double counter-current rinsing used? (Tier 2)
14. [Y/N] Is triple counter-current used? (Tier 1)

Wet Sector Process: On-site Checklist

Facility Name: _____ EPA ID #: _____ Visit Date: _____

Based on: [Site Visit] or [Prior Knowledge and Records Only] Visitor: _____

15. What causes your rinse tanks to become less effective? _____
How do you measure this? pH TDS/conductivity other _____
How often are measurements taken? _____

16. [Y/N] Identify maximum allowable final rinse concentration? (Tier 2) Concentration: _____

17. [Y/N] Place flow restrictors on tanks where water flow is not automatically controlled by pH or conductivity? (Tier 2)

18. [Y/N] Are parts rinsed in a dedicated rinse tank? (Tier 2)

Advanced Technology/Automation:

19. [Y/N] Are they re-using their water after treatment? (Tier 1)

20. [Y/N] Are water additions automated? (Tier 1)

21. [Y/N] Do conductivity probes/pH meters trigger the water additions? (Tier 1)

22. [Y/N] Are flow meters in place on process lines? (Tier 1)

23. [Y/N] use deionization to treat incoming process water? (Tier 1)

24. [Y/N] Is ion exchange in use for wastewater treatment? (Tier 1)

25. [Y/N] Is ultra-filtration or reverse osmosis used to treat wastewater for reuse? (Tier 1)

26. [Y/N] Use electrolytic cyanide destruction? (Tier 1)

27. Check which of the following are currently in use:

- | | |
|------------------------------------------------|----------------------------------------------------------------------|
| <input type="checkbox"/> Reuse spent acid/base | <input type="checkbox"/> Freeze Crystallization |
| <input type="checkbox"/> Vapor Degreaser | <input type="checkbox"/> Evaporator (w/ permit?) |
| <input type="checkbox"/> TBG _____ | <input type="checkbox"/> Plastic balls in tank (evaporation control) |
| <input type="checkbox"/> Other _____ | |

Process Chemistry/Bath Maintenance:

28. [Y/N] Does the facility know when they need to regenerate their process bath? (Tier 3)
When is it spent?

29. [Y/N] Do they (platers) plate unwanted metals onto dummy electrodes? (electrowinning) (Tier 2)

30. [Y/N] Substitute boric sulfuric acid anodize for chromic acid anodize? (Tier 1)

31. [Y/N] Substitute non-cyanide or alkaline Zn/Ni/Cu for cyanide Zn/Ni/Cu? (Tier 1)

32. [Y/N] Do they minimize effective concentration in bath? (Tier 2)

Resource Use:

33. Process chemical used: Chemical costs: _____ Quantities: _____

34. Water use: Quantity used _____ Cost _____

35. Energy use: [Electricity] or [Gas]: Consumption _____ Cost _____

36. Waste management cost (annual) _____

Wet Sector Process: On-site Checklist

Facility Name: _____ EPA ID #: _____ Visit Date: _____

Based on: [Site Visit] or [Prior Knowledge and Records Only] Visitor: _____

Technical Assistance Services:

37. What are the key environmental issues or problems that your facility has to address?

38. How does your facility measure "environmental success" (specifically, what do you measure or track?)

39. What trade associations are you a member of?

40. What form of technical assistance would your facility use/prefer? Rank the top 3 (number them); check others of high interest?

Checklists

Internet-based tools

Workshops:

• Rinsing Techniques

Publications

Mentoring (one-on-one peer assistance)

• Drag-out Reduction Techniques

Training Classes (presentations)

Case Studies

Site Visits:

Email list service

• WDOE Staff

• Vendor Product Discussions

Engineering Assistance
- *Examples:*
benchmarking water use,
designing process
monitoring or tracking
systems.

• PEER Facility Staff

• MP&M
(Metal Product & Machining)
Draft Rule Standards

(Includes TREE Team visits)

Other: _____

• Regulatory Compliance
(includes TBG, PBR)

• Peer Exchange

Wet Sector Process: **On-site** Checklist

Facility Name: _____ EPA ID #: _____ Visit Date: _____

Based on: [Site Visit] or [Prior Knowledge and Records Only] Visitor: _____

Measurements Sheet:

Due to customer specifications and/or the product, they may not be able to hang the parts for any "optimal" time since the parts will start to dry. This is especially true for printed circuit boards. Hang time is really limited in circuit board manufacturers since the entire board must remain wet. As a result, by the time the part is completely pulled out, it must be immersed in the next tank immediately since the top has started to dry.

Process: _____

Hang Time
Measurement

Event	Time (sec)	Average (sec)
1		
2		
3		

Slow withdrawal. Hold a 12 " ruler up to the tank at the level of the rim of the tank at zero inches (12" of the ruler below the tank). Move the ruler up at the same speed the part is being removed. Count the seconds it takes for the ruler to be raised 1' Estimate for in between values.

Event	Time
1	
2	
3	
4	
Average Time	
Average Speed	

Time (seconds)	Speed (ft/min)
≤ 1	> 60 ft/min
2	30
3	20
4	15
5	12
6	10
7	8.6
8	7.5

Process: _____

Hang Time
Measurement

Event	Time	Average (sec)
1		
2		
3		

Withdrawal Measurement:

Event	Time
1	
2	
3	
4	
Average Time	
Average Speed	

Time (seconds)	Speed (ft/min)
≤ 1	> 60 ft/min
2	30
3	20
4	15
5	12
6	10
7	8.6
8	7.5

Appendix B: Workshop Evaluation Results

B.1 Cleaner Production Challenge Workshop – May 15, 2002

Ecology Session		<u>Average</u>	<u>Number of Responses</u>
General Review		5 - Highest	
Dragout Reduction		3.8	-
How effective was the presentation?		4.1	18
Was it presented at the appropriate level?		3.8	17
How much do you currently use these techniques?		3.2	16
Will you make changes in this area?		3.6	16
Rinsing Techniques		3.9	-
How effective was the presentation?		4.1	18
Was it presented at the appropriate level?		3.9	17
Do you currently use these techniques?		3.5	16
Will you make changes in this area?		3.8	16
Bath Maintenance		3.8	-
How effective was the presentation?		4.1	18
Was it presented at the appropriate level?		3.9	17
Do you currently use these techniques?		3.5	16
Will you make changes in this area?		3.5	16
Strategy Development		3.9	-
How effective was the exercise?		4.0	17
Was it presented at the appropriate level?		3.9	16
Will you use the form to implement change?		3.9	15
Was the workshop format effective?		5.0	18
Was the workbook useful?		4.9	18
Were all your questions answered?		4.4	17
Would you be interested in a follow up workshop?		4.2	17
Have you signed up for an Ecology visit?		2.4	14
Will you use the CD toolkit?		5.0	18
Vendor Presentations		<u>Average</u>	<u>Number of Responses</u>
General Review		5 Highest	
Chemical Supply		3.9	13
Flow Control Technology		3.8	10
Spray Nozzles		3.9	9
Evaporators		4.1	9
Water Reuse Technologies		4.2	10
Industrial Floor Coatings and Sealants		4.2	9
Overall		3.8	11
Tabletop Displays		3.8	10

Next Steps		Rank	Number Interested
Topics to Provide More Information		1 - Highest	
Dragout Reduction		1	6
Rinsing Techniques		1	6
Bath Maintenance		11	3
Strategy Development		7	3
Cost Analysis		5	4
Acid Sorption		16	1
Agitate Rinse Tanks		5	4
Bath Concentration			0
Bath Dumping		11	3
Carbon Treatment		11	2
Carbonate Freezing		11	2
Diffusion Dialysis		11	2
Electrocoagulation		7	4
Electrowinning		7	3
Filtration		1	5
Freeze Crystallization		16	1
Heat Baths			0
Ion Exchange		1	5
Membrane Electrolysis		16	1
Polymers		16	1
Reverse Osmosis		7	3
Wetting Agent		16	1
Vendors: topics / companies		16	1
Filter Press		16	1
			0
Additional Topics:			1
Comments:			
Additional Topics (for more information)			
The use of surfactants instead of volatile solvents for cleaning may have negative impacts on wastewater treatment plating processes			
What did you like / dislike more about this workshop?			
Morning sessions were excellent. Vendor talks a little too long.			
Very informative people on wastewater treatment			
Good information - well presented.			
All the info			
I learned a lot that I did not know			
Some presenters only spoke to one half of the audience instead of the overall audience... lost my attention.			
I think it should have been ½ day offered in all regions. Thank you for the handout and CD toolkit.			

Overall Comments	
	Thank you for this workshop
	Overall it was excellent. It was great to have everyone in one place - compliance, utilities, Ecology, vendors. The morning session was great.
	Good job ☺
	Great
	This was a good start of basic information to expand on for future workshops
	Some speakers started each statement with "Uhm..."
	I would have liked vendor / industrial case studies in Dragout Reduction, Rinsing Techniques, and Bath Maintenance. Thanks for the information, lunch, and great weather in Seattle!
Other Comments	
	Not a manufacturer or industry - city utility operator
	Signed up for City Light visit.
	Left early
	This evaluation was sent from The City of Spokane, Wastewater Management.

B.2 Cleaner Production Challenge Advanced Workshop – November 19, 2002

	Avg	Total #	1	2	3	4	5
			No		Maybe		Yes
Background							
Which best describes your facility / organization:							
Metal Plating		10					
Printed Circuit Boards		0					
POTW		2					
Government		3					
Consultant		3					
Other		6					
Are you currently signed up for the Challenge?							
Have you Turned in the Baseline Data?		20	12				8
Did you attend the CPC Workshop here in May 2002?							
Did you use the CD toolkit?		17	14				3
Did you implement any related changes?		26	10				16
Details		18	8				10
		17	8				9
		7					
Part I							
Cleaner Production Challenge Workshop I Summary							
How effective was the presentation?	4.3	24	0	0	4	9	11
Do you currently use these techniques?		23	2		9		11
Do you foresee making changes in this area?		21	2		9		9
Comments / why or why not		4					
Filtration							
How effective was the Ecology presentation?	3.9	25	0	1	6	13	5
How effective was the Case Study?	3.2	25	3	3	6	11	2
Do you currently use these techniques?		23	6		7		9
Do you foresee making changes in this area?		23	6		13		3
Comments / why or why not		6					

Reverse Osmosis							
How effective was the Ecology presentation?	4.3	25	0	0	3	10	11
How effective was the Case Study?	4.1	23	0	0	4	11	7
Do you currently use these techniques?		22	18		2		2
Do you foresee making changes in this area?		22	10		11		1
Comments / why or why not		4					
Overall Comments		4					
Part II							
Metal Products and Machinery (MP&M) Rule							
How effective were the presentations?	4.5	25	0	0	3	7	14
Comments		9					
Electrowinning							
How effective was the presentation?	4.1	26	0	0	7	10	9
Do you currently use these techniques?		23	19		3		0
Do you foresee making changes in this area?		22	16		5		0
Comments / why or why not		5					
Ion Exchange							
How effective was the presentation?	4.3	22	0	0	1	13	8
Do you currently use these techniques?		20	12		2		6
Do you foresee making changes in this area?		19	8		7		4
Comments / why or why not		7					
Hytek Case Study							
How effective was the presentation?	4.4	20	0	0	3	6	10
Would you like to use video training at your facility?		17	6		7		4
Comments		2					
Summary							
Did you like the facility participation and case studies?		22	0		3		19
Were all your questions answered from this workshop?		20	1		6		13
If not:		1					
For what topics would you like more information?							
Pollution Prevention							8
Best Management Practices							7
Regulation Changes							5
Inspection / Compliance Issues							11
Dragout Reduction							3
Rinsing Opportunities							2
Bath Maintenance							4
Other?							1
Overall Comments		10					
What best describes your facility / organization?							
Metal Finishing							
Anodizing							
Industrial pretreat / paint							
Air craft electronics							
Aerospace - light aluminum finishing							
Paint / pretreatment							

What did you implement relating to Workshop I?
Rinsing
Reviewed for information
Awareness training for shop personal; most techniques described have been implemented or are under study / review
Spray rinse
Rinse water savings
Cut water usage in half
Rinsing techniques; dragout reduction
CPC Workshop I Summary - Comments
Not my area of interest as a consultant
Informative
Maybe in parts hanging
Looking to implement counter-current / multiple rinse tanks; exploring conductivity meters
Filtration - Comments
Looking for projects
Production costs
Informative
Currently using UF in our area
No cost analysis; difficult to gauge whether a viable solution to current woes.
Very difficult to listen to speech habits, painful. (Case Study)
Reverse Osmosis - Comments
Ecology speaker was by far the best speaker
My company has designed a few systems
Informative
No looking into water reusing yet
Overall Part I Comments
Need to have someone summarize what industries are realistic candidates for application of these technologies
Baseline data is confidential
Good class very informative
Good program with DOE providing an introduction to the technology and then a user remarking on actual implementation
MP&M - Comments
Concerned with anti-environmental attitude
Very useful for a workshop of this type
Informative
Informative
Very helpful information
Good summation of MP&M rule. Nice having an industry leader present and commenting on rule.
Good presentation by Mike Kelly
I learned a lot that I did not know
I have to agree with Cathy Buller; "The most comprehensive presentation on MP&M ever give" It actually made sense!

Electrowinning - Comments
Not Ready
Possible use in Au (gold) plating lines
Not big enough
NA - won't work in our facility
Not economical
Ion Exchange - Comments
NA
Yes - always a way to improve
Not Ready
Need more data about ion exchange & RO systems
Operation to small
Very sharp person
Hytek - Comments
Don't have now
Talked too long
Were all your questions answered?
Would have liked to have some vendors for different systems
Additional Topics?
Open Q&A session with audience concerns / problems
Overall Comments
Place MP&M info at the end next time
Very informative, helpful to see available technologies
Good lunch
Good program - look forward to Workshop III. Nice facility; Good location; enjoyed lunch (thanks!); Good use of AV Equipment and written handouts
Industry speakers did an excellent job; Interaction at "breaks" was outstanding
Good session. Lots of ideas to think about.
Program was very informative and effective
Great day!
Very good food - good choice
A lot of good information, the speakers were knowledgeable and they moved along at a good rate