WASTE MINIMIZATION/POLLUTION PREVENTION (WM/PP) STUDY

FOR

WITCO ORGANOSILICONES GROUP SISTERSVILLE PLANT

PROJECT XL

Project Final Report

December 9, 1998

ACKNOWLEDGEMENTS

STV Incorporated (STV) is grateful for the opportunity to participate in, and to serve on the WM/PP Study Team for, this most unique, innovative and valuable project.

STV acknowledges with thanks and appreciation the significant efforts and contributions of the many facility employees listed in Appendix D who participated in one or more of the four brainstorming sessions conducted during this study. Their involvement was indeed a key component for the success of this effort.

STV would also like to acknowledge the guidance, direction and input provided by the following members of the WM/PP Advisory Council:

Fred Dailey, Plant Manager
Dennis Heintzman, Director, SHEA
Pam Lyons, WVDEP
Tad Radzinski, USEPA
Ray Neupert, West Virginia University Parkersburg
Jim McKnight, Pleasants County Resident
Jesse Barnhart, Witco Employee

Special recognition and thanks for the extensive efforts and contributions of the following employee members of the WM/PP Study Team are extended to:

Tony Vandenberg, Senior Staff Environmental Engineer
Bob Kayser, Senior Development Scientist
Dale Koontz, Environmental Protection Operator
Okey Tucker, Environmental Protection/Energy Systems Technology Manager

Finally, acknowledgment is due to the following STV staff who served as members of the WM/PP Study Team, and who provided important contributions to the successful completion of this study.

James P. Guterl, PE, Project Manager
Roger L. Price, PE, Pollution Prevention Specialist
Robert P. Briggs II, PG, Environmental Scientist

This report was authored primarily by Roger Price and Tony Vandenberg, with significant comments and input by those listed above.

TABLE OF CONTENTS

Note:Wherever ***Business Confidential Information*** has been redacted from the Public Edition of this report, this is so-noted.

LIST OF TABLES

TABLE 8-6 POTENTIAL COSTS SAVINGS AND WASTE/EMISSION QUANTITY REDUCTIONS

LIST OF FIGURES

LIST OF APPENDICES

N: Wastes & Emissions Identified During Brainstorming Sessions
Compiled list of waste & emissions identified during brainstorming session #2 (2/A/priorw&e.doc)
Compiled list of waste & emissions identified during brainstorming session #3 (2/A/bs3newwe.doc)
O: Compiled List of Screening Criteria Generated During Session #1 (1/D/p2_crt~2.xls)
P: The USEPA's PBT list (wmppdat8.xls)
Q: Level 1 Waste & Emission Screening Methodology (3/A/sess#2.xls)
R: Level 2 Waste & Emission Screening Methodology
Level 2 Waste & Emission Screening: Workbook Template (3/A/scw~tmp.xls)
Level 2 Waste & Emission Screening: Workbook Sample (3/A/scw~sam.xls)
S: Summary of Waste & Emission Screening Results (3/A/sc_wesum.xls)
T: P2 Options Identified: Facility Sources of Information
Sistersville Pollution Prevention Activities Index (4/D/pp_act.mdb) Updated to October, 1998
Environmental Processes: 1997 Techno-Marketing Review, Process Research & Development, by Robert Kayser
Witco OrganoSilicones Waste Minimization: What have we done? What are we doing?; Process Research & Development; 2/18/98; by Jim Ritscher
Excerpts from Energy Systems Cost Savings Projects Studies; April 1997; by Nils Nilsen
U: P2 Council: Consolidated Summary of Brainstorming Session Results
P2 Council Membership
P2 Council Charter
P2 Council Charter -- to programmatically encourage progress on P2 activities with product/process specific wastes and emissions
V: P2 Options Identified -- Programmatic -- A Consolidated List (4/C/progop1.xls)
W: P2 Options Identified -- Product/Process Specific -- A Consolidated List (w&e_opt.xls)
X: P2 Options Identified -- Generic "Top-Tier" & "Mid-Tier" -- A Consolidated List (w&e_opt.xls)
Y: P2 Options Identified -- Generic "Bottom-Tier" -- A Consolidated List (w&e_opt.xls)
Z: P2 Options Ranked -- Programmatic-- A Consolidated List (4/C/progop1.xls)
AA: P2 Options Ranked -- Product/Process Specific -- Preliminary Priorities (w&e_opt.xls)
AB: P2 Options Screening -- Generic -- sample workbooks
Generic P2 Options Screening: Workbook Template (5/A/scp2~tmp.xls)
Generic P2 Options Screening: Workbook Sample (5/A/sc_opt1.xls)
AC: P2 Options Ranked -- Generic -- Sample workbook calculating average of scores generated by breakout groups (5/C/atempavg.xls)
AD: P2 Options Ranked -- Generic -- Workbook providing combined summary of average scores for all p2 options linked to all average workbooks (5/D/allopts.xls)
AE: P2 Options Ranked -- Generic "Top-Tier" & "Mid-Tier"-- Condensed Summary (w&e_opt.xls)
AF: P2 Options Ranked -- Generic "Top-Tier" -- 1st Priority P2 Options (w&e_opt.xls)
AG: P2 Options Ranked -- Generic "Top-Tier" -- 2nd Priority P2 Options (w&e_opt.xls)
AH: P2 Options Ranked -- Generic "Middle-Tier -- P2 Options (w&e_opt.xls)
AI: Technical Feasibility -- P2 Options Not Technically Feasible (w&e_opt.xls)
AJ: Economic Feasibility -- Site Specific List of Economic Criteria (1/D/econfac2.xls)
AK: Economic Feasibility -- Witco Capital Project Analysis Guidelines (6/A/capstand.doc; irrstand.xls)
AL: Economic Feasibility -- P2 Options Not Economically Feasible (w&e_opt.xls)
AM: Technically & Economically Feasible P2 Options (w&e_opt.xls)
AN: Technical & Economic Feasibility Undetermined -- P2 Options (w&e_opt.xls)
AO: "P2 Option Implementation Strategy Form" -- Sample (4/A/stratg01.doc)
AP: Implementation Strategy -- P2 Options, Programmatic (4/A/progop1.xls)
AQ: Implementation Strategy -- P2 Options, Product/Process Specific (w&e_opt.xls)
AR: Implementation Strategy -- P2 Options, Generic "Top Tier" (w&e_opt.xls)

EXECUTIVE SUMMARY

This report provides a comprehensive summary of the process and results of a Waste Minimization Pollution Prevention (WM/PP) Study recently completed at the Witco Corporation OrganoSilicones Group's (OSil) specialty chemicals manufacturing plant located near Sistersville, West Virginia.

On October 17, 1997, officials from the West Virginia Division of Environmental Protection, the US Environmental Protection Agency and OSil signed a Final Project Agreement to initiate a facility-based Project XL pilot program at the Sistersville plant. In return for a limited deferral to certain air emission controls, the agreement requires OSil to: (1) reduce air emissions by installing a control device which is currently not required by regulation; (2) recycle recovered methanol; and (3) implement a comprehensive WM/PP Study.

Commonly, WM/PP assessments are designed and conducted as a single event and are performed by an outside consultant or a select team of company personnel. However, recent experience suggests additional waste reductions can be achieved by integrating the WM/PP process into the company's standard business practices, facilitating employee development, and implementing a site-specific process tailored to the particular needs at their facility. This report discusses the development process for and results of such an employee driven WM/PP study.

A WM/PP Study Team was established to guide and conduct the daily activities of this WM/PP study. The multifunctional team consisted of OSil management and employees from appropriate departments and an independent contractor, STV Incorporated. An Advisory Committee of representatives of the community, regulatory agencies, and the plant has helped by offering comments and suggestions throughout the process.

PLAN AND ORGANIZE (Chapter 3)

This WM/PP Study involved facility personnel "up-front" in the planning, preparation, and implementation of a pollution prevention ("p2") opportunity assessment process which ultimately makes sense for the site and becomes integrated in the facility's business practices.

Four employee brainstorming sessions were a key component of the process. These sessions included representatives of a broad spectrum of site functions. In addition, a one-week survey was conducted by the Waste Reduction And Technology Transfer Foundation (WRATT) of Muscle Shoals, Alabama. They helped the plant identify waste and emission sources, and offered suggestions for options to reduce the quantity or toxicity of wastes and emissions.

IDENTIFY & CHARACTERIZE WASTES & EMISSIONS (Chapter 4)

The identity and character of the facility's wastes and emissions were substantially determined from: existing facility database; the WRATT Survey; and brainstorming sessions.

In order to facilitate subsequent analysis, the resulting combined list of identified wastes and emissions were grouped into two categories:

Product/Process Specific Wastes & Emissions
Generic Wastes & Emissions (widely applicable across the Plant)

SCREEN & PRIORITIZE WASTES AND EMISSIONS (Chapter 5)

Site specific waste and emission screening criteria, and a methodology for using those criteria were developed by site employees who participated in brainstorming session #1. The criteria are:

Quantity of waste or emission
Potential for impact on employee health & safety
Potential for impact on community health & safety
Potential for environmental impact
Potential to limit future production expansion
- Quantity of priority regulated chemicals

Potential to exceed regulatory or permit limits
Potential of current negative impact on public image
Current cost of waste management
Potential for existing technology to successfully reduce waste

Applying these criteria to product/process specific wastes and emissions helped identify priority product/process units to concentrate on. Similarly identified were the top generic wastes and emissions.

IDENTIFY P2 OPTIONS (Chapter 6)

Opportunities for pollution prevention were substantially determined from: facility ideas previously identified; WRATT Survey; and the brainstorming sessions. Table ES-1 summarizes the distribution of p2 options among categories.

TABLE ES-1 (Table 6-1)
SUMMARY OF DISTRIBUTION FOR IDENTIFIED P2 OPTIONS

P2 Option Category * Waste & Emission	**# of P2 Options**
P2 Council	Numerous
Programmatic P2 Options	42
P2 Options For Product/Process Specific W&E *	83
P2 Options For Top 11 Generic W&E	167
P2 Options For Remaining Generic W&E	40
TOTALS	332

The need to establish an on-going site P2 Council was a significant and important p2 option

identified by numerous participants throughout this study. P2 Council membership is recommended to be well rounded, representing many plant functions and all businesses. A draft council membership and charter have been written.

SCREEN & PRIORITIZE P2 OPTIONS (Chapter 7)

Screening of the generic wastes p2 options was conducted by site employees during brainstorming session #3. The results of this screening, combined with the waste & emission screening results, suggest initial priority should be given to the following "top tier" generic wastes and emissions:

Process Water Use
Waste Solvents
Drums
Drums #1 (Drumming Flushes)
Buckets & Lab Samples
Filtercakes

TECHNICAL & ECONOMIC FEASIBILITY (Chapter 8)

Site-specific technical and economic screening criteria were identified and weighting factors assigned during session #1. As a result of various levels of technical and economic feasibility determinations made throughout this study, some p2 options were eliminated from further consideration. More detailed evaluations of feasibility are required for many of the remaining p2 options.

For some p2 options, such as many of the programmatic p2 options, the technical feasibility is evident, and no further evaluation is required. For these options, and others that have been determined to be technically feasible, it is necessary to address the issue of economic feasibility.

Table ES-2 provides a summary of the results of technical & economic feasibility evaluations based on the current understanding of the p2 options, current business conditions, and the analysis done to-date.

TABLE ES-2 (Table 8-3)
FEASIBILITY ANALYSIS SUMMARY

Description			# Of P2 Options
Not Feasible	Technically	9	
	Economically	10	19
Feasibility Undetermined			184
Are Feasible	Determined Feasible During This Project	56	
	Previously Determined Feasible & In-Progress	31	87

DEVELOP IMPLEMENTATION PLAN (Chapter 9)

Building upon all of the information collected and work performed throughout this WM/PP study is a recommended plan to implement the results of this study. This implementation plan is a flexible, "work-in-progress" to be continuously refined subject to the activities and decisions of the site P2 Council. The following recommendations are just that, and are not necessarily commitments by the businesses to implement p2 options.

During brainstorming session #4 facility employees were asked to further evaluate and prioritize p2 options for implementation, and to participate in developing the implementation plan itself. Recommended priorities for this site-specific implementation strategy are:

#1. Establish An On-Going Site P2 Council Clearly, the first priority is establishing an on-going site P2 Council. Indeed, as of the date of this report, the P2 Council is being formed and expected to meet in January. Ultimately, the P2 Council will have the responsibility to pursue implementation of the results of this WM/PP Study, and to further define specific implementation actions as the program proceeds.

#2. Pursue Full Implementation Of Recent P2 Initiatives Feasibility analysis has already been completed for several p2 options, and implementation of those options is already in progress. Further, several p2 options identified prior to the formal start of this Study have been determined to be feasible and are also in progress. Table ES-4 gives details on these. High priority will certainly be given to proceeding with full implementation and completion of these recent p2 initiatives. OSil is working towards completing these options. However, that completion is contingent upon continued feasibility and continued availability of the resources to carry them out. These p2 options are anticipated to produce:

		Potential Cost $$ Savings *	Potential Waste/Emission Reductions
One-Time ("Complete") in 1998		$42,000	26,000 lbs
Expected Recurring ("On-Going")	XL Project Air Emissions Reduction and Methanol Recycle (Excludes capital savings from XL project)	$19,000/yr	770,000 lbs/yr
	Other P2 Options	$500,000/yr	990,000 lbs/yr
	TOTAL "ON-GOING"	$520,000/yr	1,800,000 lbs/yr

* Note that these savings do not consider the expense of implementing them. Hence net savings will be less. It is often difficult to assign that expense. For example, a totally new process unit may cost millions of dollars to construct. If that new process produces less waste, how much of the design and construction expense ought to be assigned to the p2 benefits? In the case of a process change being done explicitly for p2 reasons, the expense is more easily determined.

#3. Create P2 "Evergreen" List On Computer Network A prioritized list of waste problems along with a list of p2 projects which have been proposed in order to resolve those problems, is recommended to be created and installed on the computer network. It is believed that this will help establish and perpetuate awareness of needs for resources to implement p2 options.

#4. Establish System To Better Drive Costs To The Department, Process Or Product – Environmental Cost Accounting Developing a system to better drive costs to the department, process or product is recommended. OSil's Current systems do this only at a very high level. Unfortunately, Witco's recent implementation of all new information and accounting systems may delay allocating resources to this work for the near future.

#5. Enhance Employee Communication And Education Opportunities will be examined in an effort to continue and expand the site's efforts to communicate, educate and involve its employees in order to further broaden the base of p2 emphasis from environmental specialists to all site personnel. In this way p2 thinking and action will become further integrated and institutionalized into the current best approaches and continuous improvement process for managing all site business.

#6. Establish P2 Teams For Evaluating & Implementing Remaining Priority P2 Options Additional implementation activities and actions are suggested to continue this WM/PP Study within the context of an on-going, facility-wide p2 program. Although numerous p2 options have been determined to be feasible as a result of this study, there are many other unique p2 options for which the technical and economic evaluation is not yet complete. It is therefore suggested p2 teams be established in order to complete the analysis of:

Remaining priority programmatic p2 options
Remaining priority product/process specific p2 options
Remaining priority top-tier generic p2 options

#7 & #8. Establish P2 Teams For Evaluating & Implementing Middle Tier Generic P2

Options, and Bottom Tier Options In addition to the six "top-tier" generic wastes, numerous p2 options were also identified for the "middle-tier" and "bottom-tier" generic wastes. The P2 Council will be responsible to convene p2 teams to develop implementation strategies for these options, and/or to revisit them during a future repeat of this WM/PP study effort.

Obtaining commitment and support generally is a product of good communication. When people are made aware of the importance of environmental compliance and waste reduction, realize how effectively they can contribute to the cause, and how easy it is to contribute, most will cooperate. Four of the first five priority implementation actions relate substantially to the issue of communicating results.

Finally, the assessment process should be repeated periodically. Repeated p2 assessments will identify new waste reduction options previously missed or considered too costly. P2 should become an ongoing part of doing business. It will be the responsibility of the P2 Council to determine when the process should be repeated. A tremendous quantity of information has been generated during the performance of this WM/PP Study. It is believed that at least one year will be required to make sufficient progress implementing the results of this study before considering repeating the process. It will be necessary at that time to revisit the "Plan and Organize" section of this report.

SIGNIFICANT OBSERVATIONS (Chapter 10)

The following provides a summary of significant observations made regarding the performance of this study which will provide useful "food for thought" for possible revisions and refinements to be considered when the repeat process is designed.

Involving facility-level personnel "up-front", even in the development of the ***process*** itself, is valuable. This involvement will, we believe, in the long run help to instill a facility-level culture in which individual employees are trained and empowered to continuously identify and implement new p2 opportunities and strategies... thereby helping to continuously improve upon the facility's already excellent environmental performance record.

Employee brainstorming sessions in which a broad spectrum of site functional areas, departments and activities are consistently represented are a key component of the process.

The employee brainstorming sessions themselves served as a valuable tool for employee training on p2. They also provided increased awareness to many participants regarding other plant operations.

To be effective, this approach requires a significant investment of site employee time resources...especially that of employees with a high level of knowledge regarding production processes and site operations. Up-front management support to commit these resources is essential.

TABLE ES-4 (Table 9-5)

IMPLEMENTATION IN PROGRESS -- RECENT P2 INITIATIVES

REDACTED BUSINESS CONFIDENTIAL INFORMATION ARE IN ITALICS

	W&E Rank	Wastes & Emissions	P2 Options	ID	Implementation Stage	Status Details [Internal P2 Activity Code is in brackets]	Potential Cost $$ Savings Neglecting Expense of Implementing Option	Potential Waste/E Quantity Redu
1		***Product B***	*Raw material recycle after last batch of campaign (need storage)*	6	3-Implementing	*Raw material recycle after last batch of campaign (need storage)*	$22,000 / yr (4 x 5600 lb/yr at $0.99/lb)	22,000 lb/yr
2		***Product C***	*Alternate processes; reduce lights*	11	1-Scoping	*Alternate processes; reduce lights*	N/Av	N/Av
3		***Product C***	*Mixtee Process*	278	6-In-place & On-going	*Mixtee Process*	$13,400 / year (34,000 lb at $0.10 / lb kiln cost plus 34,000 lb ethanol raw material at $0.30/lb)	33,772 lbs/year Aci 1,488 lbs/year Ethy
4		***Product C***	*Installing pump for chlorosilanes, instead of nitrogen transfers to avoid need for degassing -- reduce chlorosilane losses in nitrogen vents*	12	3-Implementing	*Installing pump for chlorosilanes, instead of nitrogen transfers to avoid need for degassing -- reduce chlorosilane losses in nitrogen vents*	N/Av	N/Av
5		***Product E***	*Product E Recovery*	279	5-Complete	*Product E Recovery*	$7,000 (5,800 lb * $1.23/lb)	5,800 lbs
6		***Product F***	*Product F Production in different unit*	280	6-In-place & On-going	*Product F Production in different unit*	$115,000 / yr (150,000 lb at $0.10 / lb kiln cost plus 150,000 lb alcohol raw material at $0.66/lb)	150,000 lbs/yr alco
7		***Product F***	*Product F Recovery*	281	5-Complete	*Product F Recovery*	$35,000 (30,000 lbs recovered @ $1.18)	20,000 lbs (30,000 recovered)
8		***Product G***	*Product G crude process change*	282	6-In-place & On-going	*Product G crude process change*	N/Av	N/Av
9		**Acid Alcohols, Alkyl Halides**	***Acid Alcohols, Alkyl Halides***	283	6-In-place & On-going	*Different unit*	N/Av	N/Av
10		**Boilers**	Supply - align better with demand, less steam and energy wasted	29	1-Scoping	Boiler modifications or new boiler being considered.	N/Av	N/Av
11		**Capper Air Emission**	Install Thermal Oxidizer	284	6-In-place & On-going	Part of Project XL; started up 4/1/98	None	270,000 lbs/year
12		**Capper Methanol**	Recover and sell methanol for reuse	285	6-In-place & On-going	Part of Project XL; in place as of 10/17/97 [307-97-1]	$19,000 just from methanol sale. (500,000 / 6.6 lb/gal * $0.25/gal)	500,000 lbs/yr (esti
13		**CFC Emissions**	CNT / Esters Refrigeration Replacement	286	6-In-place & On-going	Replaced R-22 using unit with ammonia / IPA unit 9/9/97. [116-97-1]	HCFC and maintenance costs	8,000 lb/yr R-22 H
14		**CFC Emissions**	Replace CFC in Intermediates E-601 with HCFC	287	6-In-place & On-going	R-11 was removed, and Suva-123 charged into E-601 coolant loop on April 14, 1997. [149-97-1]	None	None; any losses ar less environmentall material

	W&E Rank	Wastes & Emissions	P2 Options	ID	Implementation Stage	Status Details [Internal P2 Activity Code is in brackets]	Potential Cost $$ Savings Neglecting Expense of Implementing Option	Potential Waste/E Quantity Redu
15		**CFC Emissions**	Replace CFC in NPD E-734 with HCFC	288	6-In-place & On-going	R-11 was removed, and Suva-123 charged into E-734 "Vilters" coolant loop on July 24, 1997. [449-97-1]	None	None; any losses ar less environmentall material
16		**CNT/Esters**	CNT / Esters Refrigeration Replacement - Improved Refrigeration	289	6-In-place & On-going	Replaced old refrigeration unit, better condenser performance; 9/9/97. [116-97-2]	None	2600 lb/year VOC emissions
17		***Product S***	Different unit	290	3-Implementing	*Different unit*	N/Av	N/Av
18		**HCl**	*Recover HCl from Continuous Process*	295	1-Scoping	*Recover HCl from Continuous Process*	N/Av	N/Av
19		***Product K***	*Different process*	296	3-Implementing	*Different process*	N/Av	Raw material effici increase of at least
20		**MeCl, CFC emissions**	New Poly I / NPD Refrigeration Unit	297	1-Scoping	Replace existing Poly I and NPD refrigeration units with a new modern ammonia refrigerant unit; in capital plan	N/Av	N/Av
21		***System 1***	Cleaning - improve procedure and eliminate dead areas in lines	172	1-Scoping	*Cleaning - improve procedure and eliminate dead areas in lines*	N/Av	N/Av
22		**Oil Sheens**	PetroGuard booms to prevent oil sheens to River	298	6-In-place & On-going	We are now using Petro-Guard in a boom or blanket form to absorb oil from the waste water treatment systems. This prevents oil sheens from escaping the WWTU into the River. Implemented 3/1998 [601-98-1]	Cost of booms per year about equal. Less labor cost for changing booms.	Low lbs per yr of oi 7000 lb of booms (4 new booms / year v of old booms; 48 fe 150 lb/set)
23		***Product M***	*Alcohol lights--why not feed to Unox?*	216	1-Scoping	*Getting samples and analyses of lights. Should be fairly pure. Investigating purifying. 9/14/98*	$10,000 /year (100,000 lb at $0.10 / lb kiln cost)	None
24		***Product M***	*Different process*	299	6-In-place & On-going	*Eliminates byproduct formation and emissions [204-97-2]*	None	162 lb/batch Ethyl
25		***Product M***	*Recover the alcohol if possible and reuse or sell*	217	1-Scoping	*Getting samples and analyses of lights. Should be fairly pure. Investigating purifying. 9/14/98*	$30,000 / year (100,000 lb/yr at $0.30 / lb) less cleanup costs	100,000 lb /year
26		***Product N***	*Uses for By-Product*	300	1-Scoping	*Investigating product applications for by-product*	N/Av	N/Av
27		***Product O***	*Different process*	301	1-Scoping	*Construction of new unit in capital plan; new process much more efficient*	N/Av	N/Av
28		***Product O***	*Uses for By-Product*	302	1-Scoping	*Investigating product applications for by-product*	N/Av	N/Av
29		***Product P***	*Modify equipment*	274	1-Scoping	*Project being scoped. 7/27/98*	N/Av	N/Av
30		***Product P***	*Venting revisit*	275	1-Scoping	*Project being scoped. 7/27/98*	N/Av	N/Av
31		***Product P***	*Different process*	276	3-Implementing	*Process to be implemented. Project kicked off 7/98.*	N/Av	N/Av
32		***Product Q***	*Different process*	306	1-Scoping	*Looking at different synthesis route*	N/Av	N/Av
33	1	**Process Water Use**	Cooling towers -- expand use to reduce water use	46	1-Scoping	New cooling tower for Poly I / NPD in capital plan ajv 9/23/98	N/Av	N/Av
34	2	**Waste Solvents**	*Different process for Product S*	303	3-Implementing	Less waste solvents, due to smaller unit	N/Av	N/Av
35	2	**Waste Solvents**	*System 3 -- Cleanup solvent mix change*	304	6-In-place & On-going	*Eliminate toluene from System 3 solvent cleanup mix. Implemented 12/1996 [104-97-1]*	$28,000 / year (107,000 lb at $0.10 / lb kiln cost plus 107,000 lb toluene raw material at $0.16/lb)	107,000 lb/year tol

	W&E Rank	Wastes & Emissions	P2 Options	ID	Implementation Stage	Status Details [Internal P2 Activity Code is in brackets]	Potential Cost $$ Savings Neglecting Expense of Implementing Option	Potential Waste/F Quantity Redu
36	2	**Waste Solvents**	Reclaim / reuse	259	4-Evaluating	IPA Recovery program is in place, however more IPA ought to be recovered than is. 6/98	N/Av	N/Av
37	2	**Waste Solvents**	Reuse of solvents -- last pass clean-up used for first pass on next batch / campaign	260	4-Evaluating	Is being done in some Poly I systems. Could do more?? 8/98	N/Av	N/Av
38	2	**Waste Solvents**	Solventless Copolymers	305	6-In-place & On-going	More products switched to solventless	N/Av	N/Av
39	3	**Drums**	Drumfilling and line flushing better methods in Poly II Drumfilling	307	3-Implementing	Drumfilling procedures in Poly II are being revised to reduce the amounts flushed to waste before drumming. 9/23/98	$34,000 / year Cost of drums (26 drums/week, * 52 wk/yr * $25 /drum) $7,000 / year Drum Disposal (26 drums/week, * 52 wk/yr * $5 lb/drum)	54,000 lb/year of d drums/week, 1350 drums/year, * 40 lb
40	3	**Drums**	Install line from Poly 1 to Poly 2 for HVO, use T-489	63	3-Implementing	Project in Engineering. 7/29/98	N/Av	N/Av
41	3	**Drums**	Totes: recycle one-way totes via tote supplier	81	6-In-place & On-going	We have sent back 52 from the plant to our supplier/recycler using their program. 8/4/98	N/Av	N/Av
42	3	**Drums**	Warehouse Layout Improvement	291	6-In-place & On-going	New layout of Warehouse reduces likelihood of overage products becoming wastes; reduces chances of damaging drums with forklifts	$15,000 / year in damaged drums; overage savings not quantified	24,000 lb/year of d ($15,000/yr * 40 lb $25 / drum)
43	4	**Drums #1 Product**	Drumfilling and line flushing better methods in Poly II Drumfilling	308	3-Implementing	Drumfilling procedures in Poly II are being revised to reduce the amounts flushed to waste before drumming. 9/23/98	$190,000 / yr Product Savings (8 dr/wk x 300 lb/dr x $1.50/lb x 52 wk/yr) $12,000 / yr Kiln disposal cost savings (8 dr/wk x 300 lb/dr x $0.10/lb x 52 wk/yr)	120,000 lb/yr Produ savings (8 dr/wk x 52 wk/yr)
44	4	**Drums #1 Product**	New Intermediates Drum Pad	292	5-Complete	Area to collect drums for recovery; facilitates recovery, lessens chance of material becoming a waste; enhance groundwater protection.	N/Av	N/Av
45	5	**Pallets**	Reusable plastic pallets for drum flush -- eliminate disposing 2,000 wooden pallets per year	177	3-Implementing	300 plastic pallets have been ordered and received 10/98. Plastic pallets can be reused many times in the drum flusher, , reducing the use of wooden pallets which must be disposed of. 9/24/98	Expense: $24,000 (300 plastic pallets x $79) Savings: $24,000 / yr (2,000 pallets/yr x $12/pallet)	200,000 lb/yr (2,00 pallets/yr x 100 lb/p
46	6	**Buckets & Lab Samples**	In- process analyzer installations	37	1-Scoping	In - Unit Testing AdHoc Team studying tests that may be performed by operators, or displaced by in-stream instrumentation. In stream instrumentation could potentially eliminate some samples; in-unit testing by operators may reduce sample size. 8/5/98	N/Av	N/Av

	W&E Rank	Wastes & Emissions	P2 Options	ID	Implementation Stage	Status Details [Internal P2 Activity Code is in brackets]	Potential Cost $$ Savings Neglecting Expense of Implementing Option	Potential Waste/E Quantity Redu
47	6	**Buckets & Lab Samples**	Operators run analysis on some samples in area	41	1-Scoping	In - Unit Testing AdHoc Team studying tests that may be performed by operators, or displaced by in-stream instrumentation. In stream instrumentation could potentially eliminate some samples; in-unit testing by operators may reduce sample size. 8/5/98	N/Av	N/Av
48	6	**Buckets & Lab Samples**	Product by Process	43.1	1-Scoping	Witco initiative to try to define products moreso a head of time by the process that makes them, and less so by analysis after-the-fact. 9/23/98	N/Av	N/Av
49	7	**Filtercakes**	*Different process for Product R*	293	3-Implementing	Filter cartridge vs. filter press	N/Av	N/Av
50	7	**Filtercakes**	NPD Filtration Improvements	294	6-In-place & On-going	Eliminate use of filteraids during filtration and reduce solvents needed to clean filter, by changing to cartridge filters. [405-97-1]	N/Av	N/Av
51	7	**Filtercakes**	Plate / frame filters - eliminate, replace	118	1-Scoping	K-3/K-5 Filter Replacement project -- looks like large cartridge filter system will not work technically; eventual solution would improve safety, might reduce filtercake waste loads; results could apply to other process units -- 8/11/98	N/Av	N/Av

N/Av = Not Available

1.0 INTRODUCTION

This report provides a comprehensive summary of the process and results of a Waste Minimization Pollution Prevention (WM/PP) Study recently completed at the Witco Corporation OrganoSilicones Group's (OSil) specialty chemicals manufacturing plant located near Sistersville, West Virginia. In general, this report will provide the following:

- The results of the WM/PP Study;
- Identification of the WM/PP opportunities OSil has determined to be feasible;
- Discussion regarding the basis for excluding other opportunities as not feasible; and
- Recommendations as to whether the WM/PP Study should be continued.

Commonly, WM/PP assessments are designed and conducted as a single event and are performed by an outside consultant or a select team of company personnel. However, recent experience suggests additional waste reductions can be achieved by integrating the WM/PP process into the company's standard business practices, facilitating employee development, and implementing a site-specific process tailored to the particular needs at their facility. This report discusses the development process for and results of such an employee driven WM/PP study.

A WM/PP "Study Team" was established to guide and conduct the daily activities of this WM/PP study. The multifunctional Study Team consisted of OSil management and employees from appropriate departments and an independent contractor. OSil selected STV Incorporated (STV) as its independent contractor, based on STV's demonstration of appropriate experience and training in WM/PP projects.

STV Incorporated is a multi-discipline engineering, environmental, architectural, and construction management firm which offers complete project services through 22 offices nationwide. The STV project team provides expertise and experience in all elements of chemical processing facility design as well as industry-specific pollution prevention opportunity assessments and planning. STV's role is illustrated in the following description of the approach that was used in planning and organizing this WM/PP study:

◊ Rather than serve as an outside *consultant* hired to conduct an independent p2 opportunity assessment, the independent contractor (STV) served as a ***facilitator and catalyst*** for this process. This was intended to encourage development from within of a site-specific ***process*** for conducting an assessment of the Sistersville facility.

◊ STV provided external p2 program development expertise and administrative support to ***assist*** select teams of facility employees in developing an appropriate and site-specific "facility-level" p2 opportunity assessment process tailored to the needs of ***their*** facility.

2.0 BACKGROUND

In order to better understand the setting within which the WM/PP Study was conducted, it will be helpful to present some background material. The background information provided in the following sections includes:

- Facility Description
- Project XL
- Final Project Agreement
- Air Emissions
- WM/PP Project Overview
- WM/PP Study Overview

Subsequent sections of this report then provide more details regarding the activities and results of this WM/PP Study.

2.1 FACILITY DESCRIPTION

The OrganoSilicones Group (OSil) of Witco Corporation is a specialty chemical manufacturer, with production facilities located in Sistersville, West Virginia and in Belgium, Brazil, Italy, Mexico, Korea, Thailand, Indonesia, Malaysia and Hong Kong. The subject WM/PP Study took place at the Sistersville plant, which is located within a rural setting along the eastern bank of the Ohio River in northern West Virginia. The facility's operating units encompass approximately 50 acres and are centrally located within a total land area of 1300 acres. The current plant population is approximately 600, consisting of both salary and hourly union (ICWUC) employees.

OSil manufactures a broad range of silicone and silane products, plus organic chemical intermediates related to the silicones and silanes products. The Sistersville plant manufactures approximately 1000 silicone and silane chemical products and intermediates for industrial and food grade use. Customers use Sistersville products to manufacture familiar consumer products such as diapers, facial tissues, waxes, shaving and hair care products, deodorants, fabric softeners, fiberglass insulation, urethane foams for seating, insulation, tires, paints and coatings and plastics.

In the process of manufacturing its products, OSil creates approximately 49,000,000 pounds of waste (including sludges derived from waste treatment) per year, consisting of 1,600,000 pounds of air emissions and 47,000,000 pounds of liquid and solid waste. Treated hazardous waste streams consist of ignitable waste solvents, distillation residues (lights and heavies), acidic wastewater, water reactive chlorosilane wastes, sludges and laboratory wastes.

In the past, OSil has implemented a number of pollution reduction opportunities at its Sistersville plant and is committed to implementing source reduction where possible and cost effective. As a result of its WM/PP commitment, in the past five years waste volume has remained relatively constant, although production has increased almost 30 per cent.

2.2 PROJECT XL

In 1995, the United States Environmental Protection Agency (USEPA) announced a set of actions which introduced Project XL pilot programs for facility-based, industry-based and government agency programs. Project XL, which stands for "e**X**cellence and **L**eadership" is a national pilot program that tests innovative ways of achieving better and more cost effective public health and environmental protection. Project XL was designed to give regulated sources the flexibility to develop alternative strategies to replace or modify specific regulatory requirements. A condition of the modification or replacement was that it would produce greater environmental benefit. Additional information on the USEPA's Project XL is available on the Internet at:

http://www.epa.gov/ProjectXL

2.3 FINAL PROJECT AGREEMENT

On October 17, 1997, officials from the West Virginia Division of Environmental Protection (WVDEP), the USEPA and OSil signed a Final Project Agreement (FPA) to initiate a facility-based Project XL pilot program at the Sistersville plant. In return for a limited deferral to certain air emission controls, the FPA requires OSil to: reduce air emissions by installing a control device that is currently not required by regulation; recycle recovered methanol; and implement a comprehensive WM/PP Study.

2.4 AIR EMISSIONS

Under the FPA, OSil will reduce air emissions from a polyether methyl capper unit in two distinct ways. First, air emissions of organic compounds (methyl chloride, dimethyl ether and methanol) from process vents associated with the capper unit will be reduced by 98% by installing and operating a control device that is currently not required by regulation, i.e. a vent incinerator on the capper unit. Second, discharges of condensed methanol from the capper unit's recovery equipment to the wastewater treatment system will be minimized. OSil will direct 95% of the recovered methanol toward recycling or thermal recovery/treatment, and will restrict traditional bio-treatment of the methanol in the wastewater treatment units by recycling recovered methanol rather than disposing the methanol through the wastewater treatment unit (WWTU).

The project will result in the destruction of 98 percent (by weight) of the organic compounds in the vent stream, or about 309,000 pounds per year. OSil will recover and reuse or recycle an estimated 500,000 pounds of methanol per year, methanol that would be otherwise be treated in the WWTU. This will result in a reduction in sludge from the WWTU of about 815,000 pounds per year. **Table 2-1** summarizes the benefits to the environment due to Project XL.

TABLE 2-1
REDUCTION IN EMISSIONS AND DISCHARGES DUE TO PROJECT XL

	Baseline (1995)	Reduction Due to XL
Air Emissions from Capper Unit (lb/yr)	277,000	271,000
Air Emissions from WWTU (lb/yr)	140,300	38,000
Total Project Related Air Emissions (lb/yr)	417,300	309,000
Capper Organic Discharges to WWTU (lb/yr)	790,000	551,000
Sludge Generated from Capper Methanol (lb/yr)	1,117,300	815,000

2.5 WM/PP PROJECT OVERVIEW

In an effort to formalize its continuing source reduction efforts, OSil has, as part of the Project XL, implemented a comprehensive WM/PP Study. The goal of the WM/PP Study is to identify and implement source reduction and sound recycling opportunities, as defined in EPA's Hazardous Waste Minimization National Plan (EPA 530/R-94/045). The WM/PP Study has been guided by an Advisory Committee and Study Team.

The Advisory Committee consisted of a representative from the USEPA and the WVDEP, the Plant Manager, the OSil Director of Safety, Health and Environmental Affairs and stakeholder representatives. The stakeholder representatives included a WV University Industrial Extension Specialist, a plant union employee and a local citizen. The Advisory Committee role was to provide review and comment on the Study Team's performance and progress.

The multifunctional Study Team consisted of OSil management and employees from appropriate departments and an independent contractor. OSil selected STV Incorporated (STV) as its independent contractor, based on STV's demonstration of appropriate experience and training in WM/PP projects. In addition to reviewing plant operations and previous WM/PP efforts at the plant, the Study Team was responsible for conducting this WM/PP Study. This unique, employee driven WM/PP Study will be the focus of the remainder of this report.

2.6 WM/PP STUDY OVERVIEW

A review of the literature will find a significant variety of approaches to performing assessments. In most cases, the structure of the assessment is tailored to accommodate the individual style and character of the assessment team, the nature of the organization to be assessed, and the specific objectives of the assessment. In general, most p2 assessments will, however, include the following very typical elements:

- Plan and organize
- Identify & characterize wastes & emissions
- Screen & prioritize wastes and emissions for p2 options analysis
- Identify p2 options
- Screen & prioritize p2 options for further evaluation
- Perform technical & economic feasibility analysis
- Develop implementation plan
- Implement, monitor & communicate results
- Refine & repeat process

In the past, many companies have identified p2 opportunities through the performance of a "pollution prevention opportunity assessment" which incorporate these elements. A very common practice is to arrange for an outside consultant to perform the assessment; or to select a team of individuals from within the organization for this purpose. In any event, the project is usually designed and conducted as a single event, with repeat single event assessments contemplated for sometime in the future.

Many p2 opportunities have been identified, and significant waste and emission reductions achieved throughout industry by this approach. However, it is believed that additional ***cost-effective*** reductions can be achieved where pollution prevention becomes integrated and institutionalized within the organization's standard business practices. In fact, this core belief served as a driving force during the planning phase and throughout this WM/PP study.

3.0 PLAN AND ORGANIZE

It has been STV's experience the most effective and successful p2 programs originate at the facility/plant level and involve a substantial amount of employee participation and involvement. In this context, the following approach was used to plan and organize this WM/PP Study:

- ♢ Rather than serve as an outside *consultant* hired to conduct an independent p2 opportunity assessment, the STV served as a ***facilitator and catalyst*** for this process. This was intended to encourage development from within of a site-specific ***process*** for conducting an assessment of the Sistersville facility.

- ♢ STV provided external p2 program development expertise and administrative support to ***assist*** select teams of facility employees in developing an appropriate and site-specific "facility-level" p2 opportunity assessment process tailored to the needs of ***their*** facility.

This method of involving more facility-level personnel "up-front" even in the development of the ***process*** will, we believe:

- ♢ result in an increased sense of employee ownership at the facility level,

- ♢ increase the likelihood that p2 opportunity assessments and related activities will become integrated into on-going operating practices at the facility-level, and

- ♢ in the long run, create a much more effective facility-level p2 Program.

In summary, the ultimate objectives of the Study included:

- ♢ Involving key facility employees in the planning, preparation, and implementation of a unique, site-specific, facility-level p2 opportunity assessment process which ultimately...

  - •makes sense for the site
  - •is organized and documented
  - •can be repeated (after refinement, if necessary)
  - •becomes institutionalized and integrated in the facility's business practices

- ♢ Helping, in the long run, to instill a facility-level culture in which individual employees are trained and empowered to continuously identify and implement new p2 opportunities and strategies. Such a culture will help continuously improve upon the facility's already excellent environmental performance record.

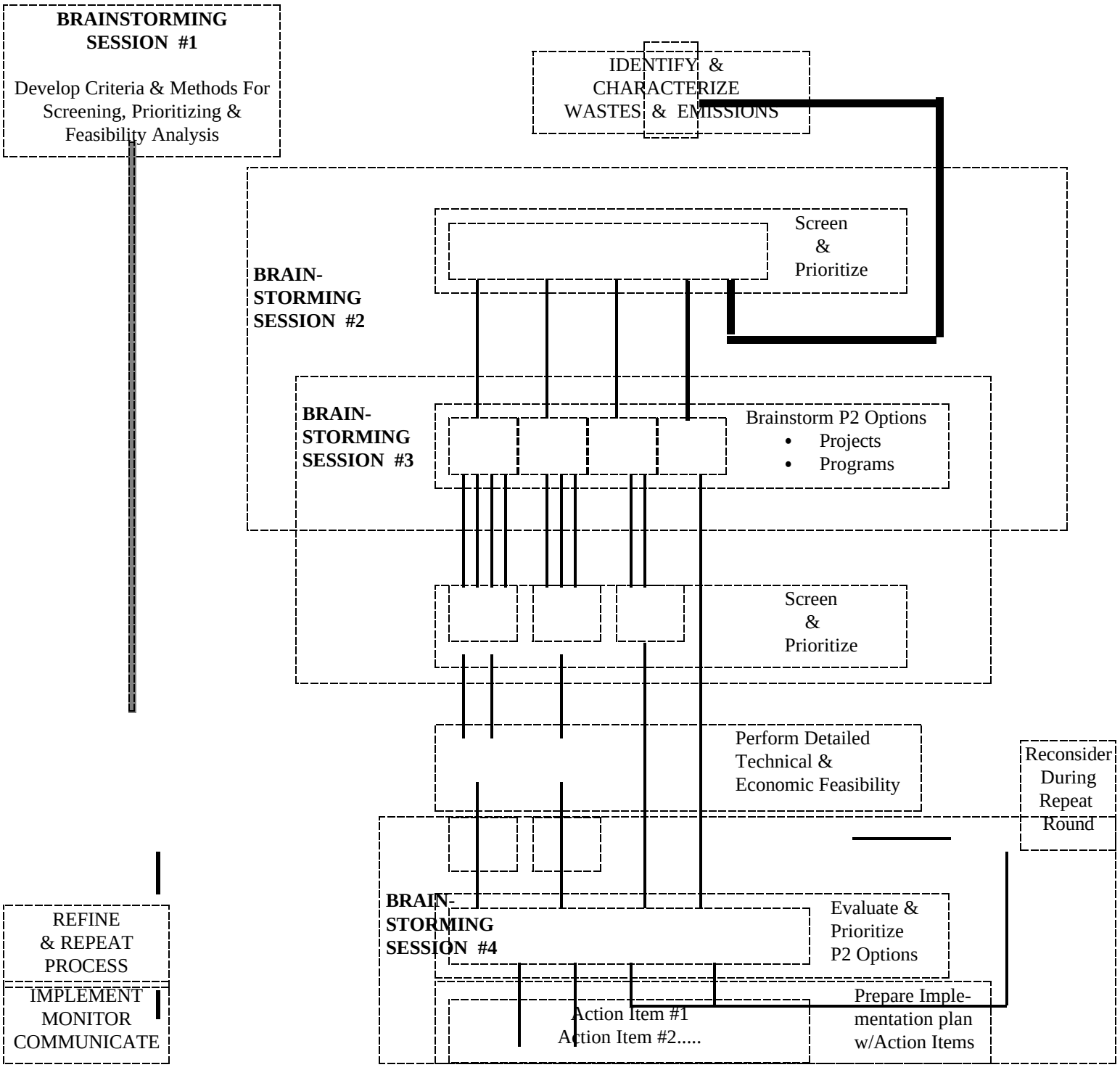
3.1 STUDY PLAN OVERVIEW

An initial project plan (**Appendix A; 1/A/witplan.doc**) and initial project schedule (**Appendix B; 1/A/witsch02.doc**) was developed in order to conduct the proposed facility-level p2 opportunity

assessment for the Sistersville facility. The proposed process is illustrated in **Figure 3-1 (also see Appendix C; 1/A/process1.doc)**.

FIGURE 3-1

POLLUTION PREVENTION ASSESSMENT PROCESS



3.2 BRAINSTORMING SESSIONS

As can be seen from Figure 3-1, employee brainstorming sessions were a key component of the process. Four brainstorming sessions were conducted. The following provides a brief summary of a few of the common, key characteristics of these sessions:

- ◊ Each session was one day in duration, and typically consisted of:
  - ◊ safety topic
  - ◊ participant introductions
  - ◊ brief overview and update on the XL Project, and of the WM/PP process
  - ◊ brief instruction regarding the basic definition and concepts of p2
  - ◊ update regarding the WM/PP process and results obtained thus far
  - ◊ a section to revise/revisit/refine the results of previous sessions
  - ◊ two or three working sections to address the day's principal objectives, which typically consisted of:
    - ◊ combined group introduction
    - ◊ small group break-out sections for brainstorming
    - ◊ combined group report-out

- ◊ Each session was preceded by a half-day meeting of the study team to complete final session preparations, and followed by a half-day meeting of the study team in order to assemble session results and prepare an updated study plan-of-action.

- ◊ 18 - 27 site personnel participated in each session

- ◊ A total of 48 site personnel participated in at least one of the sessions

- ◊ A broad spectrum of site functional areas, departments and activities were consistently represented throughout all four brainstorming sessions. These included:

  - Production
  - Distribution
  - Purchasing
  - Engineering
  - Maintenance
  - Energy Systems
  - Safety
  - R&D
  - Environmental Protection

- ◊ Active participation and support were provided by both salaried and union hourly employees.

- ◊ Most participants attended a "P2 101" training class conducted by the independent

contractor.

◊ Consistency between all four sessions was provided by a core group of fifteen individuals who elected to participate in at least three of the four sessions (seven individuals participated in all four sessions).

◊ Broader involvement by more site employees was achieved where substitutions and additions were made when individuals could participate in only one or two of the four sessions. In some cases this also allowed for several enthusiastic representatives to "take turns."

A comprehensive summary, which identifies those who participated in each of the four brainstorming sessions, is provided in **Appendix D (1/A/brain_s4.xls)**. A few highlights are provided in the following summary tables.

TABLE 3-1
PROFILE OF SESSION PARTICIPANTS
TOTAL FACILITY

Department	# Of Participants				# Of Different Individuals Who Participated In.....		
	Session #1	Session #2	Session #3	Session #4	1 or 2 Sessions	3 or 4 Sessions	Total
Managers	2	0	2	3	4	0	4
Production & Distribution	6	4	8	6	17	2	19
R&D	4	4	3	5	1	4	5
Environmental Protection	4	5	5	5	7	3	10
Energy Systems	2	2	2	2	2	2	4
Maintenance	0	1	2	3	2	1	3
Engineering	1	0	1	1	0	1	1
Safety	1	1	1	1	0	1	1
Purchasing	1	1	1	1	0	1	1
TOTAL	21	18	25	27	33	15	48

TABLE 3-2
PROFILE OF SESSION PARTICIPANTS
PRODUCTION & DISTRIBUTION

Department	# Of Participants				# Of Different Individuals Who Participated In.....		
	Session #1	Session #2	Session #3	Session #4	1 or 2 Sessions	3 or 4 Sessions	Total
NPD	2	1	1	0	4	0	4
Poly I	0	1	2	2	2	1	3
Poly II	1	0	1	1	0	1	1
Silanes	2	2	2	2	8	0	8

Distribution	**1**	**0**	**2**	**1**	**3**	**0**	**3**
TOTAL	**6**	**4**	**8**	**6**	**17**	**2**	**19**

TABLE 3-3
PROFILE OF SESSION PARTICIPANTS BY JOB FUNCTION

Department	# Of Participants				# Of Different Individuals Who Participated In.....		
	Session #1	Session #2	Session #3	Session #4	1 or 2 Sessions	3 or 4 Sessions	Total
Managers	2	0	3	5	6	0	6
Technical Support	14	13	13	14	17	10	27
Hourly	5	5	9	8	10	5	15
TOTAL	21	18	25	27	33	15	48

In addition to a list of session attendees, **Appendix D** also provides the following:

- Summary list of session handouts (handmtg1.doc)
- Summary list of benefits and concerns reported for each session (b&c.doc)

Brief discussions and descriptions of the principal objectives and activities of the four brainstorming sessions follow.

3.2.1 Brainstorming Session #1

Brainstorming session #1 was held on Tuesday, March 24, 1998, and included:

- Two-hour instruction regarding basic definition and concepts of p2, environmental cost accounting, & best-in-class facility-level p2 programs
- Develop preliminary list of economic factors to be addressed within the context of performing total cost assessments of proposed WM/PP opportunities.
- Develop site-specific criteria and methodology for screening, prioritizing, and selecting both (1) waste streams to be evaluated, and (2) WM/PP opportunities.

Appendix E provides considerably more detailed information regarding each of the following planning elements related to session #1.

- Initial Proposed Agenda & Deliverables (1/C/witmtg01.doc)
- Detailed Proposed Agenda (1/C/witmtg11.doc)
- Session follow-up/updated plan-of-action (1/C/actplan1.doc)

3.2.2 Brainstorming Session #2

Brainstorming session #2 was held on Wednesday, April 29, 1998, and included:

- Brief instruction for new participants
- Revisit/revise/refine site-specific list of economic factors developed during session #1.
- Revisit/revise/refine site-specific screening criteria and methodology developed previously.
- Develop preliminary site-specific list of priority waste streams (especially generic)
- Identify potential p2 opportunities for specific wastes and emissions
- Identify potential programmatic p2 opportunities

Appendix F provides considerably more detailed information regarding each of the following planning elements related to session #2.

- Initial Proposed Agenda & Deliverables (1/C/witmtg02.doc)
- Detailed Proposed Agenda (1/C/witmtg21.doc)
- Final agenda provided to participants (witmtg22.doc)
- Session follow-up/updated plan-of-action (1/C/actplan2.doc)

3.2.3 Brainstorming Session #3

Brainstorming session #3 was held on Wednesday, June 3, 1998, and included:

- Revisit/revise/refine site-specific list of economic factors, screening criteria & methodology, and potential WM/PP opportunities developed previously.

- Identify additional potential WM/PP opportunities.

- Screen, prioritize, and select WM/PP opportunities for further evaluation and action.

Appendix G provides considerably more detailed information regarding each of the following planning elements related to session #3.

- Initial Proposed Agenda & Deliverables (1/C/witmtg03.doc)
- Detailed Proposed Agenda (1/C/witmtg31.doc)
- Small Group Instructions (1/C/insmtg31.doc)
- Session follow-up/updated plan-of-action (1/C/actplan3.doc)

3.2.4 Brainstorming Session #4

Brainstorming session #4 was held on Wednesday, August 26, 1998, and included:

- Update regarding the WM/PP process and results obtained thus far.

- Obtain additional input and support for creation of a P2 Council.

- Brainstorm implementation elements (e.g., recommended program activities for selected WM/PP opportunities)

- Develop an outline of a strategy for implementing the results of the WM/PP Study

Appendix H provides considerably more detailed information regarding each of the following planning elements related to session #4.

- Initial Proposed Agenda & Deliverables (1/C/witmtg04.doc)
- Detailed Proposed Agenda (1/C/witmtg42.doc)
- Final agenda provided to participants (witmtg43.doc)
- Small Group Instructions (1/C/insmtg41.doc; 1/C/insmtg42.doc; insmtg43.doc)

3.3 EDUCATION & TRAINING

Most participants attended a "P2 101" training class conducted by the independent contractor. The training class was two-hours in duration and designed to ensure a consistent understanding among all participants regarding the basic definition and concepts of p2, and to introduce the participants to the issues of environmental cost accounting and "best-in-class" facility-level p2 programs.

Appendix I provides a copy of each of the training class handouts provided to each participant, which included the following.

- Pollution Prevention Basics (1/F/dp2basic.ppt)
- Environmental Cost Accounting For P2 Projects (1/F/deca.ppt)
- Establishing A Best-In-Class Facility-Level P2 Program (1/F/dbest.ppt)

3.4 POLLUTION PREVENTION ASSESSMENT GUIDE

During the first brainstorming session, participants were provided with a copy of a draft "Pollution Prevention Assessment Guide". This document was designed to serve as an example guide to begin the process and assist site personnel in developing a site-specific, on-going pollution prevention assessment program for the Sistersville facility. In addition to the basic steps for performing p2 opportunity assessments, this draft guide and its attachments provided some important initial insights in such areas as:

- Characteristics to be determined for each waste & emission
- Economic considerations for environmental cost accounting
- Criteria for screening, ranking and setting priorities
- Methods for screening, ranking and setting priorities

Appendix J provides a copy of each of the following pollution prevention assessment guide documents.

- Draft P2 Assessment Guide (1/A/p2guide1.doc)
- Draft P2 Assessment Guide -- Attachments (1/A/p2guide2.doc)

- Draft P2 Assessment Guide -- Worksheets (1/A/p2guide3.doc)

3.5 WRATT SITE SURVEY

In addition to the extensive employee involvement activities associated with the brainstorming sessions, a one-week survey was conducted in February, 1998 by the Waste Reduction And Technology Transfer Foundation (WRATT) of Muscle Shoals, Alabama, to identify waste and emission sources, and where possible, offer suggestions for options to reduce the waste or emission quantity or toxicity.

A very significant and fruitful planning effort was put forth by the EP department's Study Team member in order to ensure the WRATT assessment team was able to meet with representatives from every facility department, and to help the team focus on a few typical priority process specific wastes and emissions. The detailed schedule for the one-week survey is provided in **Appendix K (1/E/ppast.xls)**

4.0 IDENTIFY & CHARACTERIZE WASTES & EMISSIONS

Identifying and characterizing wastes and emissions is a very significant, indeed on-going effort. For WM/PP study purposes it is useful to attempt to define waste and emissions in terms of the following characteristics:

- Name and general description
- Waste stream composition, physical/chemical characteristics
- Quantities (for the past 5 years, if available)
- Processes which generate the waste (percent of total)
- Current management practice
- Costs for waste management
- How are quantities and costs tracked
- History of pollution prevention for this waste stream
- Applicable compliance requirements
- Complaints from local residents or workers

The remainder of this chapter summarizes the information sources and results of efforts within this WM/PP Study to identify and characterize wastes and emissions.

4.1 INFORMATION SOURCES

The identity and character of the facility's wastes and emissions were substantially determined from one of the following three sources:

- Existing Facility Database
- WRATT Survey
- Brainstorming Sessions

The following sections provide a brief summary description of these information sources, whereas **Section 4.2** briefly summarizes the process and results of activities performed during this WM/PP study in order to identify and characterize the facility's wastes and emissions.

4.1.1 Existing Facility Database

The existing facility database served as the most significant source of information regarding the facility's waste and emissions identity and character. A significant resource of data was initially provided by the EP Department in a three-ring binder notebook entitled Sistersville Plant Waste Minimization/Pollution Prevention Study Data. **Appendix L (2/C/wmppdat8.xls; 2/C/datarec1.doc)** provides a comprehensive list of documents contained within the three-ring binder notebook. The following documents contained within the notebook (and reproduced in **Appendix L**) were especially useful for purposes of identifying and characterizing wastes and emissions:

- Sistersville Plant 1995 Material Balance (2/C/sah0016.ppt)
- 1996 Air Emissions Inventory (2/C/aei96a.xls)
- Lbs by Disposal Unit for 1997 (wmppdat8.xls)
- Operating Record Summary: Lbs by Disposal Unit (wmppdat8.xls)
- 1996 Office of Air Quality, Certified Emissions Statement Invoice (Due 7/1/97)
- Liquid/Solid Wastes Not Assigned to Product/Process Specific Units (wmppdat8.xls)

4.1.2 WRATT Survey

As previously mentioned, a one-week survey was conducted by WRATT to identify waste and emission sources, and where possible, offer suggestions for options to reduce the waste or emission quantity or toxicity. The results of this survey are provided in a separate bound report entitled Waste Reduction Assessment Report: WITCO Corporation OrganoSilicones Group. In addition, individual reports were prepared to summarize observations made during the WRATT Survey by STV and Witco EP members of the WM/PP study team.

Appendix M provides a copy of each of the following WRATT Survey documents.

- WRATT Waste Reduction Assessment Report: Executive Summary
- WRATT survey; AJV summary of p2 ideas generated (4/A/p2idea0.xls)
- WRATT survey; JPG report on observations made (4/A/t1stvrpt.doc)
- WRATT survey; RLP report on observations made (4/A/t1report.doc)

4.1.3 Brainstorming Sessions

During each of the first three brainstorming sessions, a segment of time was set aside during which waste and emissions were identified by facility employees who participated in those sessions.

These brainstorming sessions provided substantial definition to the identity of the most significant liquid/solid wastes not assigned to products/process units (those liquid/solid waste streams for which it is not easy to use the existing data collection system in order to assign the source of the waste back to a particular product or process unit).

Appendix N provides a copy of each of the following brainstorming session summary documents.

- Compiled list of waste & emissions identified during brainstorming session #2 (2/A/priorw&e.doc)
- Compiled list of waste & emissions identified during brainstorming session #3 (2/A/bs3newwe.doc)

These "Generic" wastes and emissions are summarized in subsequent **Section 4.2.2**.

4.2 STUDY RESULTS

In order to facilitate subsequent analysis, the resulting combined list of identified wastes and emissions were generally grouped into one of the following two categories

- Product/Process Specific Wastes & Emissions
- Generic Wastes & Emissions

The following sections briefly summarize the process and results of activities to identify and characterize the facility's wastes and emissions.

4.2.1 Product/Process Specific Wastes & Emissions

For the purposes of this study, using the existing facility database, it was possible to categorize the source or type of product/process specific waste into one of the following three groups:

♢ Air Emissions Directly Assigned to Individual Products/Process Units
- ~ 3% of total facility wastes and emissions
- Principally VOC fugitive and point sources, and also includes hazardous air pollutants, particulates, SO_2, NO_x, CO, and ozone depleting substances.
- Generated by 50+ process units

♢ Liquids/Solids Directly Assigned to Individual Products/Process Units
- ~ 26% of total facility wastes and emissions
- Generally includes significant individual sources and/or those wastes subject to unique management practices

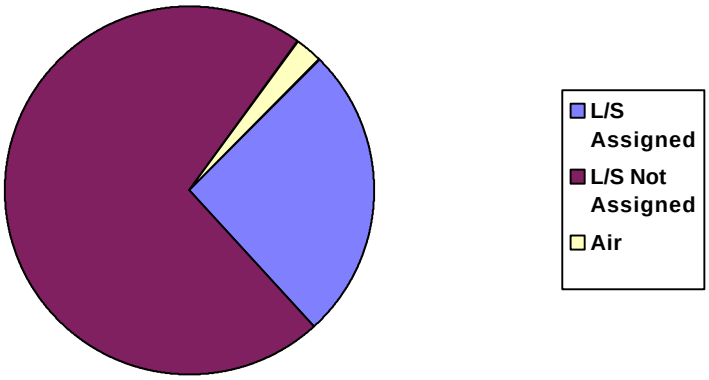
♢ Liquid/Solids Not Directly Assignable to Individual Products/Process Units
- ~ 71% of total facility wastes and emissions
- With the existing data collection system, for many liquid/solid waste streams it is not easy to assign the source of the waste back to a particular product or process unit
- Such waste tracking has not been necessary nor required for waste management purposes, for example...
  - waste solvents – which accounts for 48% of the non-assigned wastes;
  - individual discharges to the WWTU (consequently WWTU sludges -- which accounts for 33% of the non-assigned wastes).

In summary, as can be seen from Table 4-1, there remains a significant quantity of waste and emissions for which it is not easy to assign the source of the waste back to a particular product or process unit. This is further illustrated by the pie chart given in Figure 4-1. A comprehensive list of liquid/solid wastes not assigned to product/process specific units is provided in **Appendix L (wmppdat8.xls).**

TABLE 4-1
PRODUCT/PROCESS SPECIFIC WASTES & EMISSIONS
DISTRIBUTION BY SOURCE

Description	TPY	MM lb/yr	%
Air	837	1.6	3
Liquid/Solid Assigned to Products	6,250	12.5	26
Liquid/Solid Not Directly Assignable to Products	17,350	34.7	71
TOTAL	24,437	48.8	100

FIGURE 4-1
PRODUCT/PROCESS SPECIFIC WASTES & EMISSIONS
DISTRIBUTION BY SOURCE



4.2.2 Generic Wastes & Emissions

The list of those generic wastes and emissions that were identified principally as a result of the brainstorming sessions is summarized as follows:

- Buckets & lab samples
- Drums
- Drums #1 (Drumming Flushes)
- Electricity
- Filtercakes
- Flushes, Process and Sample
- Pallets
- Plant Cleanups
- Process Water Use
- Solid Waste (Misc.) To Land Disposal
- Utility Use
- Vehicle Wastes/Emissions
- Waste Solvents

5.0 SCREEN & PRIORITIZE WASTES AND EMISSIONS FOR P2 OPTIONS ANALYSIS

As is common, the substantial number of diverse types and sources makes it necessary to screen and prioritize the wastes and emissions to be addressed during subsequent p2 options analysis efforts. Due to the significant number of diverse wastes and emissions, it was necessary to perform two levels of screening. The following briefly summarizes key characteristics of these two screening levels, as well as the screening criteria developed.

5.1 SITE SPECIFIC SCREENING CRITERIA

In order to screen & prioritize it was first necessary to determine the criteria to be used. This section provides information regarding....

- Criteria developed during session #1, and
- The USEPA's PBT list

5.1.1 Criteria Developed During Session #1

Site specific waste and emission screening criteria, and a methodology for using those criteria were developed by site employees who participated in brainstorming session #1. The criteria selected for this purpose are as follows:

- Quantity of waste or emission
- Potential for impact on employee health & safety
- Potential for impact on community health & safety
- Potential for environmental impact
- Potential to limit future production expansion
- Quantity of priority regulated chemicals (e.g., PBT's)
- Potential to exceed regulatory or permit limits
- Potential of current negative impact on public image
- Current cost of waste management
- Potential for existing technology to successfully reduce waste

Appendix O (1/D/p2_crt~2.xls) provides a comprehensive list of the criteria and weighting factors used for screening, as determined and developed by participants during session #1.

5.1.2 The USEPA's PBT list

The USEPA is drafting a Prioritized Chemical list of more than 800 chemicals based on the chemicals' **P**ersistence in the environment once released, their tendency to **B**ioaccumulate in animal tissues and their **T**oxicity. As part of the Project XL agreement, a 117 chemical list subset of the larger list of PBT's was provided by USEPA to help serve as reference for assisting the WM/PP Study Team in developing the list of significant waste streams to evaluate. (**Appendix P; wmppdat8.xls**) USEPA staff developed this subset based on OSil's hazardous waste codes from Notification of Hazardous Waste Activity.

The USEPA assigned each of the chemicals on the PBT list an overall score of between 6 and 18, and further categorized them as follows:

High = 15-18
Medium = 10-14
Low = 6-9

Inclusion of a chemical on this list in no way indicates that the particular chemical is present at the Sistersville Plant. In fact, as shown in Appendix P, the PBT list was not especially helpful for the purpose of focusing OSil's efforts to screen and prioritize wastes and emissions for further study. This is because:

- No high scoring chemicals are used in the facility.
- A few medium scoring chemicals on the PBT list are present in the facility's waste or emissions. One, nickel, is a component of a filtercake, produced as a waste stream in medium volumes. All other medium scoring PBT's are in waste streams at low volumes.
- Several low scoring chemicals, such as methanol and toluene are present and found ubiquitously across a broad range of wastes.

Note that the Sistersville Plant has identified p2 options that address some of the PBT chemicals at the facility. These p2 options are discussed in more detail in Chapter 9, and include:

- The nickel filtercake has, in the past, been sent to recyclers to recover the nickel. This was suspended due to regulatory and processing difficulties at the recycler. One p2 option to be evaluated is to attempt to find another recycler who could accept this waste stream.
- Methanol and toluene are used primarily as solvents. Many p2 options for reducing the use or recovering these solvents have been identified.
- Chloromethane is a low scoring PBT, produced as a waste in high volumes. Our XL Project includes installing a thermal oxidizer to treat and destroy chloromethane air emissions.

On November 9, 1998, EPA published in the Federal Register a new, shorter list of 53 PBT chemical categories that may be found in hazardous waste regulated by the Resource Conservation and Recovery Act (RCRA). The list will be used to "promote voluntary waste

minimization efforts that reduce the generation of PBT chemicals found in RCRA hazardous waste by 50 percent by 2005." Significantly, only one chemical on this new list is among the wastes generated by the Sistersville Plant – nickel -- already discussed above.

5.2 PRODUCT/PROCESS SPECIFIC WASTE & EMISSIONS SCREENING PROCESS -- LEVEL 1

The level 1 screening process was applied in order to screen and prioritize those product/process specific wastes and emissions described previously in **Section 4.2.1.**

5.2.1 Level 1 Screening Methodology

A brief summary of the key characteristics of the level 1 waste and emission screening methodology is as follows:

- Applied to product/process specific wastes & emissions
  - Air Emissions Assigned to 50+ Products/Process Units
  - Liquids/Solids Assigned to Products/Process Units

- Performed by EP using certain criteria developed previously during brainstorming session #1, with a focus on the following criteria
  - total 1997 lbs waste generated
  - lbs waste/lbs product
  - total 1996 fugitive air VOC emissions
  - total 1996 point source air VOC emissions
  - likelihood of future Hazardous Air Pollutant emissions regulation applying to the product/process

More details regarding the Level 1 screening methodology are provided in **Appendix Q (3/A/sess#2.xls)**

5.2.2 Level 1 Screening Results

The results of the level 1 screening process are summarized as follows:

- Original number of Product/Process Specific Wastes & Emissions
  - Air Emissions Assigned to 50+ Products/Process Units
  - 250+ Liquids/Solids Wastes (72 Liquids/Solids Assigned to Products/Process units)
- Reduced to -- 22 priority product/process units

A list of the twenty-two priority product/process units is provided in **Table 5-1**. Figures 5-1 and 5-2 further illustrate the distribution of air emissions (VOC) and liquid/solid wastes among product/process units, ranked in emissions and wastes quantity order. **(3/A/sess#2b.xls)** Clearly, the Pareto approach of concentrating effort on the few process units responsible for the majority of the wastes/emissions is valid for this study.

TABLE 5-1

22 PRIORITY PRODUCT/PROCESS UNITS

RANKING OF PROCESS UNITS BASED ON			
Process Unit ID	**Air**	**Waste**	**Total**
Esters	2.5	2.2	4.7
K-2	1.2	2.0	3.3
K-1	1.1	2.1	3.3
Vinyls	1.6	0.8	2.4
BMU	0.5	1.5	2.0
K-65	2.0	0.0	2.0
Capper	1.7	0.0	1.7
K-4	0.0	1.6	1.6
K-3	0.5	1.1	1.6
S-19/S-21	0.0	1.4	1.4
CEU	0.9	0.5	1.4
CNT	0.0	1.3	1.3
K-17	0.8	0.0	0.8
HVD II	0.0	0.7	0.7
K-18	0.0	0.7	0.7
K-83	0.6	0.0	0.6
K-45	0.0	0.5	0.5
K-5	0.0	0.5	0.5
K-20	0.5	0.0	0.5
K-56	0.5	0.0	0.5
K-57	0.5	0.0	0.5
Y-4326D	0.5	0.0	0.5

FIGURE 5-1

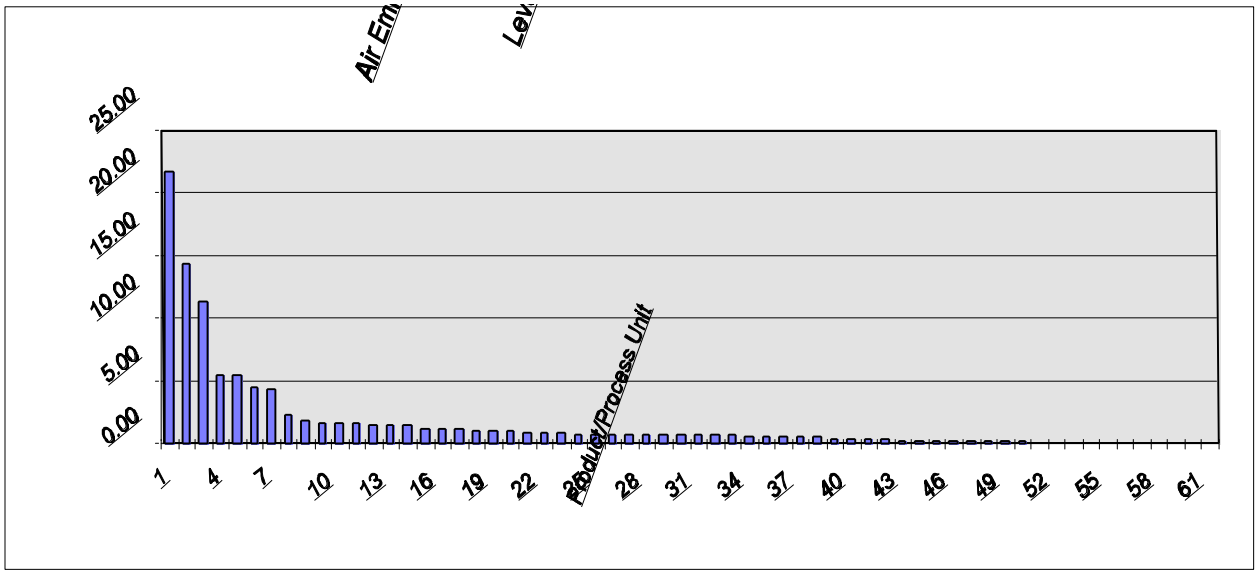
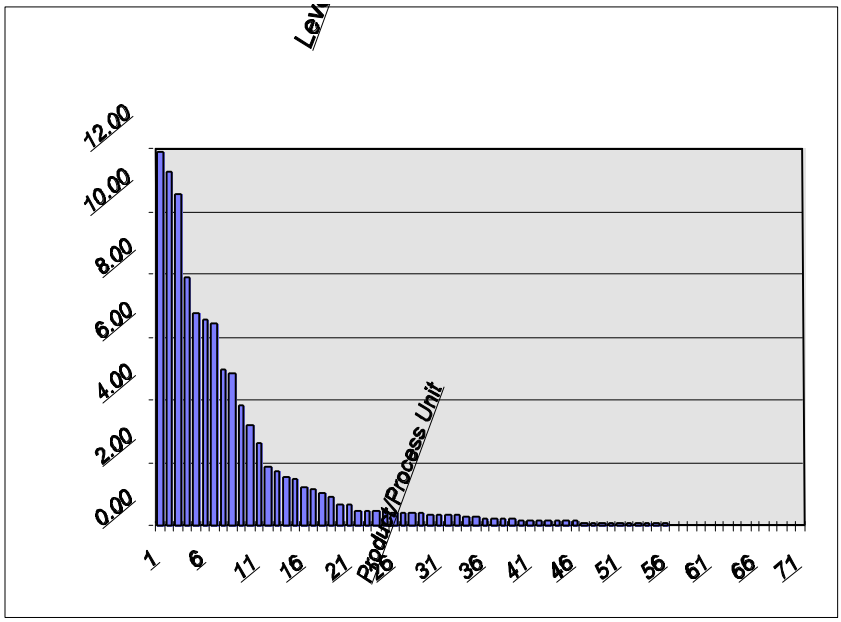


FIGURE 5-2



5.3 GENERIC WASTES & EMISSIONS SCREENING PROCESS -- LEVEL 2

The level 2 screening process was applied in order to screen and prioritize those generic wastes and emissions described previously in **Section 4.2.2.**

5.3.1 Level 2 Screening Methodology

A brief summary of the key characteristics of the level 2 waste and emission screening methodology is as follows:

- Applied to generic wastes & emissions -- those liquid and solid wastes not easily assigned to products/process units
- Performed by brainstorming session #2 participants using all criteria developed previously during brainstorming session #1

Appendix R provides the following documents associated with the Level 2 screening methodology

- Level 2 Waste & Emission Screening: Workbook Template **(3/A/scw~tmp.xls)**
- Level 2 Waste & Emission Screening: Workbook Sample **(3/A/scw~sam.xls)**

5.3.2 Level 2 Screening Results

A comprehensive summary of the waste and emission scores is provided in **Appendix S (3/A/sc_wesum.xls)**. The resulting ranking for the "Top 11 Generic Wastes & Emissions" is as follows:

1. Process Water Use
2. Waste Solvents
3. Drums
4. Drums #1 (Drumming Flushes)
5. Pallets
6. Buckets & Lab Samples
7. Filtercakes
8. Utility Use
9. Flushes, Process & Sample
10. Miscellaneous Solid Waste To Land Disposal
11. Plant Cleanups

6.0 IDENTIFY P2 OPTIONS

Identifying p2 options is at the heart of conducting a WM/PP assessment. In the process of identifying p2 options, there must first be established a clear, facility-wide definition of the term "Pollution Prevention". The definition given in **Figure 6-1** was used for this assessment.

FIGURE 6-1

POLLUTION PREVENTION DEFINITION

Pollution prevention is defined as the following ***integrated hierarchy*** for waste management decision-making:

1. ***First, consider source reduction options***

   Source reduction refers to the reduction or elimination of waste generation at the source, usually within a process. Source reduction measures can include process modification, feedstock substitutions or improvements in feedstock purity, various housekeeping and management practices, increases in the efficiency of machinery, and recycling within a process. Source reduction implies any action that reduces the amount of waste generated by a process.

2. ***Next, consider recycling and beneficial use***

   Recycling refers to the use or reuse of a waste as an effective substitute for a commercial product, or as an ingredient or feedstock in an industrial process. It also refers to the reclamation of useful constituent fractions within a waste material or removal of contaminants from a waste to allow it to be reused. Recycling implies use, reuse, or reclamation of a waste either on-site or off-site after it is generated by a particular process.

3. ***Next, consider treatment***

   Treatment refers to the methods, techniques or processes that are designed to change the physical, chemical, or biological character of waste in order to reduce its toxicity or volume, or otherwise reduce its impact on the natural environment. Treatment implies actions that render a waste safer to transport, dispose, or store.

4. ***Finally, and only as a last resort, consider disposal.***

   Disposal refers to the emission, discharge, deposit, injection, dumping, spilling, leaking, or placing of any waste into or on land, water, or air.

The "hierarchy" concept implies that the management options are ranked in order of preference. The use of the term "integrated" implies that all of the management options work together to form a complete system for proper waste management.

When pursuing activities to identify p2 options, it is important to focus one's thoughts on the elements at the top of the hierarchy, namely source reduction and recycling. The suggestions listed in **Figure 6-2** were offered and used throughout this study in order to help with that process. These concepts allow facilities to make sound business decisions.

FIGURE 6-2

IDENTIFYING P2 OPTIONS -- FOCUS ON SOURCE REDUCTION

Options should be considered in these areas:

1. Eliminate/Reduce/Modify chemical or process that creates waste
2. Are there raw material/product substitutions available?
3. Can waste be reused ?
4. Can waste be recycled ?
5. Are alternate treatments available ?
6. Are there alternate disposal options?

DO NOT limit your questions to...

- **"I have a waste, what do I do with it?"**

RATHER DO Remember to ask:

- **Why is this waste generated?**
- **Why are we doing this operation in this manner?**
- **Could we do this operation differently or less often to minimize the waste generated?**

It can be helpful to develop a list of leading questions in each of these categories to help thinking "outside the box". Examples:

- What if you didn't have to do that ?
- What if you use a different chemical

The remainder of this chapter summarizes the information sources and results of efforts within this WM/PP Study to identify opportunities for pollution prevention.

6.1 INFORMATION SOURCES

For the purposes of this WM/PP study, opportunities for pollution prevention were substantially determined from one of the following three sources:

- Facility Sources
- WRATT Survey
- Brainstorming Sessions

The remainder of this section provides a brief summary description of these information sources,

whereas **Section 6.2** summarizes the p2 options identified.

6.1.1 Facility Sources

Pollution Prevention has been a component of the OSil facility's operations for several years prior to this WM/PP Study. Indeed, the facility's process R&D department has progressively pursued p2 options within their research and development activities, and the facility's EP department has been promoting p2 throughout the facility. Consequently, numerous p2 options had already been identified prior to this WM/PP Study, and many have been implemented.

A significant resource of data was initially provided by the EP Department in a three-ring binder notebook entitled Sistersville Plant Waste Minimization/Pollution Prevention Study Data. **Appendix L (2/C/wmppdat2.xls; 2/C/datarec1.doc)** provides a comprehensive list of documents contained within the three-ring binder notebook. The following documents contained within the notebook (and reproduced in **Appendix T**) were especially useful as key sources of information regarding historic and on-going activities to identify and implement p2 options:

- Sistersville Pollution Prevention Activities Index (4/D/pp_act.mdb) Updated to October, 1998
- Environmental Processes: 1997 Techno-Marketing Review, Process Research & Development, by Robert Kayser
- Witco OrganoSilicones Waste Minimization: What have we done? What are we doing?; Process Research & Development; 2/18/98; by Jim Ritscher
- Excerpts from Energy Systems Cost Savings Projects Studies; April 1997; by Nils Nilsen

Several p2 options in the Sistersville Pollution Prevention Activities Index, identified prior to the formal start of this WM/PP Study, are already in progress. Obviously, these options have already been determined to be at least preliminarily technically and economically feasible. Most of these options needn't be screened or prioritized (**Chapter 7**), nor feasibility-evaluated (**Chapter 8**) during the brainstorming sessions. These options are specifically discussed in **Chapter 9**.

6.1.2 WRATT Survey

As previously noted, a one-week survey was conducted by WRATT to identify waste and emission sources, and where possible, offer suggestions for options to reduce the waste or emission quantity or toxicity. The results of this survey are provided in a separate bound report entitled Waste Reduction Assessment Report: WITCO Corporation OrganoSilicones Group. In addition, individual reports were prepared to summarize observations made during the WRATT Survey by STV and Witco EP members of the WM/PP study team.

Appendix M provides a copy of each of the following WRATT Survey documents.

- WRATT Waste Reduction Assessment Report: Executive Summary

- WRATT survey; AJV summary of p2 ideas generated (4/A/p2idea0.xls)
- WRATT survey; JPG report on observations made (4/A/t1stvrpt.doc)
- WRATT survey; RLP report on observations made (4/A/t1report.doc)

6.1.3 Brainstorming Sessions

During each of sessions #2, #3 and #4, a segment of time was set aside during which participants were given opportunities during small group break-out sections to identify p2 options. These brainstorming sessions served as the principal source of ideas for both:

- Programmatic p2 options
- P2 options for generic wastes & emissions

A summary of those p2 options identified is provided in the next section.

6.2 SUMMARY OF P2 OPTIONS IDENTIFIED

The process of identifying p2 options was sub-divided into the following four p2 option categories:

- Establish An On-going Site P2 Council
- Programmatic p2 options
- P2 options for product/process specific wastes & emissions
- P2 Options for generic wastes & emissions

As will be seen in the following sections, a total of **332** p2 options were identified. **Table 6-1** provides a summary that illustrates the distribution of p2 options among the option categories.

TABLE 6-1
SUMMARY OF DISTRIBUTION
FOR IDENTIFIED P2 OPTIONS

P2 Option Category	# of P2 Options
P2 Council	Several Combined
Programmatic P2 Options	42
P2 Options For Product/Process Specific W&E	83
P2 Options For Top 11 Generic W&E	167
P2 Options For Remaining Generic W&E	40
TOTALS	332

The following sections provide a brief summary description of the process used to identify p2 options within these categories, and the results of that process.

6.2.1 Establish An On-going Site P2 Council

The need to establish an on-going site P2 Council was a significant and important p2 option identified by numerous participants throughout this WM/PP study. Significant discussion and suggestions were provided throughout the study regarding the following two P2 Council issues:

- P2 Council Membership
- P2 Council Charter

P2 Council Membership

Regarding P2 Council membership, a small group break-out brainstorming activity was conducted during session #4, in which participants were asked to identify those site personnel who should constitute the membership of the P2 Council. Six small groups participated in this exercise. **Appendix U (4/C/council1.xls)** provides a consolidated summary of the recommendations from all six small groups. A few characteristics of the P2 Council membership were common within the recommendations of most of the groups. These include:

- the plant manager, or his designated representative, should be a member or sponsor
- membership should be well rounded, and include a mix of managers, technical support, and operations
- as a minimum, membership should include representatives from:
  - EP/ES
  - maintenance
  - management
  - each of the production units
  - process R&D
- virtually all functions should be included -- was a common suggestion....which in turn suggests that more departments may have been listed by more small break-out groups if the groups had been given a list of departments to choose from, instead of simply being asked to brainstorm their individual list

As a result, the recommended P2 Council membership is as given in **Figure 6-3**

FIGURE 6-3

DRAFT P2 COUNCIL MEMBERSHIP

Membership on the P2 (Pollution Prevention) Council should be well rounded, representing many plant functions and all businesses. Diversity can help the Council focus on practical, high-impact issues.

The Plant Manager and SHEA Director are permanent members. Other's terms should be limited to one-year, except that one-half of the initial appointments should be for one year, one-half for 18 months.

The P2 Council should be first established with a two-year sunset provision: shortly before the end of two years' existence, the P2 Council should recommend to management whether the Council should continue, be modified, or go out of existence.

Representatives		
# of Reps	**Description**	**Comments**
1	Director of Safety, Health and Environmental Affairs	Sponsor, participant and liaison to businesses
1	Plant Manager	
1	Environmental Protection / Energy Systems	
1	Process R&D	
1	Engineering	
1	Maintenance	
2	Fluids Business	Salaried and Hourly
2	Silanes Business	Salaried and Hourly
2	U/A Business	Salaried and Hourly
1	Distribution	Salaried or Hourly
13	TOTAL MEMBERSHIP	

Chair chosen by the group

P2 Council Charter

Regarding the P2 Council Charter, during session #4 participants were asked in their small groups to also define the Council's initial charter, given first a draft from which to make additions, deletions or modifications. Six small groups participated in this exercise, and **Appendix U (4/C/council2.doc; and 4/C/progop3.doc)** provides a consolidated summary of the recommendations from all six small groups. **Figure 6-4** provides the recommended initial Charter based on the participants' input.

6.2.2 Programmatic P2 Options

The employee brainstorming small group break-out sections conducted during brainstorming sessions #2, #3 and #4 served as the principal source of ideas for programmatic p2 options. A total of forty-eight unique programmatic p2 options were identified. The following provides a few examples of these programmatic p2 options, which were grouped into five categories: (note: the programmatic related p2 option of establishing an on-going site P2 Council was addressed in

the previous **section 6.2.1**.) The categories are listed in priority order of importance, as judged by small groups' review in session #4, as will be discussed in section 7.3.

1. ***Economics*** -- Perform environmental cost accounting as is appropriate for the Sistersville facility. Define what costs should be captured at this facility, determine appropriate cost allocation procedures, and define how to address "avoided" costs for capital additions.

2. ***Communication & Implementation*** -- Communicate p2 concepts and ideas with increased frequency and emphasis. Pollution prevention thinking and action, such as turning off water hoses when not in use, should eventually become as natural and automatic as putting on one's hard hat for safety. A few communication tools which may be considered include:
   - signs, posters, banners
   - newsletter

1. ***Include P2 In New Process Design/Existing Process Modifications*** -- P2 checklists to be incorporated into reviews for process modifications & new process design.

2. ***ZRI Program*** -- Create a process for timely equipment repairs to meet ZRI (Witco's Zero Release Initiative) goals for the Global Incentive Compensation Plan (GICP).

3. ***Incentive System*** -- Establish employee incentives and recognition for continuous improvement in environmental performance through source reduction initiatives which also save money.

Appendix V (4/C/progop1.xls) provides a consolidated list of all identified programmatic p2 options.

FIGURE 6-4

DRAFT P2 COUNCIL CHARTER

Develop, implement, monitor and continuously improve a strategy designed to achieve a "best-in-class" facility-level pollution prevention program, which is eventually integrated and institutionalized into all facility operations. Be a communicating, deliberative, and delegating body. Do so by carrying out the following:

Implementation

- Ensure p2 is established and remains a core value of the facility
- Act as a clearing-house and incubator for p2 ideas
- Recognize, prioritize, recommend responsibility and accountability for, and submit, p2 projects to departments or businesses; though the businesses, be empowered to draw on resources (people throughout the plant, and money) as the council deems necessary to develop opportunities and implement p2 initiatives. Track projects and promote inactive p2 options that show potential. Establish a process to receive & review p2 improvement suggestions -- the "evergreen report"
- Ensure that p2 is considered early in project and process development; include in PACE process, prior to, and during project SHEA reviews, FOCR, PSSR
- Ensure WM/PP study process is reviewed, revised, repeated
- Recommend, as needed
    - area-specific p2/SR teams (on-going/short term)
    - issue-specific p2/SR task force (short term)
- Solicit management input to p2 program
- Recommend p2 goals for management to set

Communications

- Recognize and publicize the p2 hierarchy:
  Source Reduction
  Recycling / Reuse
  Treatment
  Disposal
- Monitor, report, status of a p2 culture
- Establish, maintain, continuously improve systems/procedures to routinely measure and report p2 progress (quantify/routinely/real-time)
- Promote p2 education for all facility employees, to further broaden the base of individual environmental responsibility , with increased emphasis and focus on source reduction
- Expand the UCR/ER report, to include p2 suggestions; communicate to employees how to do so
- Ensure progress reviews continue to closure
- Collect and communicate successes and failures to all employees (e.g. quarterly management reports) and up the Witco organization
- Annual reports of progress and opportunities
- Maintain an evergreen prioritized list of p2 opportunities available to the plant (e.g. plant common network drive); include lbs, $, environmental impact
- Integrate p2 into the ZRI (Zero Release Initiative) and communicate results widely

Economics

- Encourage work towards environmental cost analysis to capture the true cost of products
- Encourage that p2 aspects be included in new project cost estimates and justifications

6.2.3 P2 Options For Product/Process Specific Wastes & Emissions

Efforts to identify product/process specific p2 options have been an on-going process. Numerous were identified prior to this WM/PP, and a significant, indeed on-going effort has been expended in an attempt to capture that information. Some product/process specific p2 options have been generated by brainstorming sessions #2 and #3, and by the WRATT study. The need for programmatic procedures to continue this process is discussed in **Chapter 9**.

Thus far, a total of sixty-four unique p2 options have been identified for 16 priority product/process specific wastes and emissions, as summarized in **Table 6-2**.

Appendix W (w&e_opt.xls) provides a consolidated list of all identified p2 options for product/process specific wastes and emissions.

•TABLE 6-2

P2 OPTIONS IDENTIFIED FOR
PRODUCT/PROCESS SPECIFIC WASTES & EMISSIONS

REDACTED BUSINESS CONFIDENTIAL INFORMATION ARE IN ITALICS

	# of P2
Acid Alcohols, Alkyl Halides	1
Alkyl Halides	2
Boilers	8
Capper Air Emission	1
Capper Methanol	1
CFC Emissions	3
CNT/Esters Units	1
Distillation Lights & Heavies in General	3
HCl	1
K-62/K-63	2
Kiln	19
MeCl, CFC emissions	1
Oil Sheens	1
• *Product A*	5
Product B	4
Product C	4
Product D	3
Product E	1
Product F	2
Product G	1
Product H	2
Product I	2
Product K	1
Product L	1
Product M	3
Product N	1
Product O	2
Product P	4
Product Q	1
Product S	1
System 1	1
• TOTAL	83

6.2.4 P2 Options For Generic Wastes & Emissions

The employee brainstorming small group break-out sections conducted during brainstorming sessions #2 and #3 served as the principal source of ideas on p2 options for the eleven priority "top-tier" generic wastes and emissions. (As discussed previously in Section 5.3.2, the waste screening process served to prioritize the generic wastes into eleven "top-tier" and thirteen "bottom-tier" generic wastes & emissions. A total of **one hundred and sixty seven** unique p2 options were identified, as summarized in **Table 6-3.**

TABLE 6-3
P2 OPTIONS IDENTIFIED
FOR
"TOP-TIER" GENERIC WASTES & EMISSIONS

	# of P2
Process Water Use	26
Waste Solvents	25
Drums	29
Drums #1 (Drumming Flushes)	14
Pallets	7
Buckets & Lab Samples	14
Filtercakes	13
Utility Use	14
Flushes, Process and Samples	4
Misc. Solid Waste to Land Disposal	17
Plant Cleanups	4
TOTALS	167

The following provides a few examples of these p2 options identified for the "top-tier" generic wastes and emissions:

- ♢ Process water use
  - Department accountability -- meter/budget water use
- ♢ Waste solvents
  - Revise system piping to be clean-up friendly
- ♢ Drums
  - Reuse drums where possible
- ♢ Buckets & lab samples
  - Examine QC program to see if we can reduce the sampling effort
  - Install more in-line process analyzers
- ♢ Filtercakes
  - Process modifications to reduce generation of solids

Appendix X (w&e_opt.xls) provides a consolidated list of all identified p2 options for "top-tier" generic wastes and emissions.

The employee brainstorming small group break-out sections conducted during brainstorming sessions #2 and #3 also served to generate ideas on p2 options for the remaining thirteen "bottom-tier" generic wastes and emissions. A total of **forty** unique p2 options were identified, as summarized in **Table 6-4.**

TABLE 6-4

P2 OPTIONS IDENTIFIED
FOR
"BOTTOM-TIER" GENERIC WASTES & EMISSIONS

	# of P2
Air Emissions, Fugitive	1
Drag Inventory	2
Drinking Water	1
Electricity	8
Equipment Removals	1
Haz Mat Wastes Generated Off-Site	2
Hoses	2
Maintenance	2
Platinum Catalyst	3
Trailer Cleanup Wastes	5
Vacuum Pump Oil	2
Vehicle Emissions	4
WWTU	7
TOTALS	40

Appendix Y (w&e_opt.xls) provides a consolidated list of all identified p2 options for the "bottom-tier" generic wastes and emissions.

7.0 SCREEN & PRIORITIZE P2 OPTIONS

As in the case of screening and prioritizing wastes and emissions, it is often necessary to screen and prioritize p2 options for further consideration. As discussed in the previous chapter, 260 p2 options were identified during various phases of this WM/PP study. The fact that so many p2 options were identified is a tremendous accomplishment. However, this clearly suggests the need for further screening and prioritizing p2 options for further evaluation.

7.1 SITE SPECIFIC SCREENING CRITERIA

Site specific p2 option screening criteria, and a methodology for using those criteria were also developed by site employees who participated in brainstorming session #1. These criteria were refined in session #2. The criteria selected for this purpose are as follows:

- Quantity of waste or emission
- Impact on employee health & safety
- Position on p2 hierarchy
- Employee acceptance & involvement
- Expected change in environmental impact (including cross-media impacts)

- Potential regulatory & legal exposure
- Potential impact on public image
- Current technology status
- Required people resources
- Required $$ resources
- ROI - Economic feasibility

The Project XL Final Project Agreement called for this Study to consider any cross-media impacts or any anticipated transfers of risk associated with each p2 opportunities. The criterion above, “Expected change in environmental impact,” is intended to account for this consideration. Further, an unacceptable adverse environmental impact is cause for eliminating a p2 option from further consideration.

As can be seen, these criteria are slightly different from those selected for wastes & emissions screening. **Appendix O (1/D/p2_crt~2.xls)** provides a comprehensive list of the criteria and weighting factors used for screening, as determined and developed by participants during session #1.

As in the case of identifying p2 options, the process of prioritizing and screening p2 options was also subdivided into the following four p2 option categories:

- Establish an on-going site P2 Council
- Programmatic p2 options screening
- P2 options screening for product/process specific wastes & emissions
- P2 options screening for the top 10 generic wastes & emissions

The following sections provide a brief summary description of the process used to screen and prioritize p2 options within these categories, and the results of that process.

7.2 ESTABLISH AN ON-GOING SITE P2 COUNCIL

The need to establish an on-going site P2 Council evolved as the clear #1 Priority. This conclusion was virtually unanimous among all site personnel who participated in the Study. On further evaluation, as is discussed in detail in **Chapter 9**, it became clear that establishing of a P2 Council is an essential precursor to the implementation of many important p2 options.

7.3 PROGRAMMATIC P2 OPTIONS

The programmatic p2 options screening and prioritizing effort was performed by employee participants during brainstorming session #4.

As a first step, participants were asked to prioritize the five categories of programmatic p2 options, or to discuss whether such prioritization was even useful. Indeed, most participants believed the five categories of programmatic p2 options should proceed simultaneously. It was believed that the option categories may impact different plant functions, and the time of different plant employees would be needed to implement each category. Nevertheless, the resulting programmatic p2 options category ranking is as given in **Table 7-1**.

TABLE 7-1
PROGRAMMATIC P2 OPTIONS CATEGORY RANKING

Programmatic P2 Options Category Descriptions	Group #						Group Total
	1	2	3	4	5	6	
Economics	1	1	1	3	2	1	9
Communication &	2	2	2	1	1	2	10
Include P2 in New Process Design/Existing Process	3	3	3	2	3	3	17
ZRI Program	4	4	4	4	4	5	25
Incentive System	5	5	5	5	5	4	29

During session #4, participants were also requested to select and rank their top five individual programmatic p2 options. **Appendix Z (4/C/progop1.xls)** provides a consolidated list of programmatic p2 options ranked using the results of the individual p2 options ranking exercise combined with the results of the category ranking discussed previously. A summary of these results is given in **Table 7-2**. The column "S#4 Indiv" lists which of the six small groups in session #4 chose the respective option as a priority.

TABLE 7-2
PROGRAMMATIC P2 OPTIONS - CONSOLIDATED & RANKED

S#4 Rank	Category	Establish P2 Team For.....	S#4 Indiv	Programmatic P2 Options
1	Economics	Environmental Cost Accounting -- Costs driven to department or process	1-5	Report card sys - periodic id of wastes & total costs to highlight for managers
			1-5	Costs - procedures to incorporate environmental cost accounting (ECA)
			1-5	Costs - drive to the department or process
			1	Costs - document (meter) utility usage
			4	Costs - document drum disposal, total cost of using drums for reject, etc.
			4	Customer contracts - negotiate longer term contracts
			5	Rate of return analysis - include cost of waste and utility use
				Costs - document steam leaks, N2 leaks
				Costs - include trailer $$ into CBR when it can be used instead of a tank
				Shutdown - gather and report cost of unplanned
2	Communication & Implementation	Employee Communication & Education	3	P2 presented to mgt at bus. team mtgs on product specific waste generation
			1-3	Employee Communication -- increased frequency & emphasis
			1-3	EC -- P2 progress/status communicated in some quantifiable form
			1-3	EC -- communicate that p2 = save money
			1-3	EC -- newsletters - monthly for all employees
			1-3	EC -- banners, signs & posters - frequently change (color, size, wording)
			1-3	EC -- P2 hierarchy project list (also see option PR23)
			1-3	EC -- radio system reminders
			3-4	EC -- Mgt quarterly presentation on p2 progress - increase mgr particip
			2	Programs and initiatives to promote employee ownership/empowerment....
				Every meeting begin with "minute for p2"....one real p2 success story
				Training for facility wide understanding of the definition of p2
				Training -- new hires - more info ($'s, lbs, examples)
				Training -- face to face sessions - use lots of examples
				Brainstorming - ongoing cross functional brainstorm "top ten" waste ideas
				OP's - revisit & follow/enforce
3	P2 In Process Design & Modifications	Incorporating P2 in process design and modifications	2-4	P2 hierarchy project list -- P2 hierarchy review for project reports, etc.
			3	"Sub-optimization" prevention -- changes that cause further problems, wastes
				include strong p2 checklist questions in project justification forms
				include strong p2 checklist questions in FOCR
				include strong p2 checklist questions in PSSR
				Isometric modeling - use to design new installations within existing
				Plant-wide review for candidates for continuous vs batch processes
				Set standards for waste generation (0 discharge)
				Require 95+% controls on air emissions
4	ZRI	ZRI	5	Communication - improve for ZRI to whole plant
			5	Repairs - create a process for timely equip. repairs to meet ZRI GICP goal
				Inspection regularly for ZRI equip leaks and log into work order sys
5	Incentives	Employee Incentives	5-6	GICP - include p2
				EQ-category for p2
				Monetary gift awards for those involved
				PFP's - include p2 to help increase awareness & accountability

				Employee recognition (e.g., awards)

7.4 P2 OPTIONS FOR PRODUCT/PROCESS SPECIFIC WASTES

We believe that, for product/process specific wastes, the process of completing the identification, screening and evaluation of p2 options should be performed by teams of product/process specialists assembled to further brainstorm and assess these issues. As is discussed in detail in **Chapter 9**, we suggest individual specialist sessions be scheduled in order to adequately address product/process specific p2 options. Establishing a P2 Council and carrying out some of the programmatic ideas will be key steps in helping to achieve some of these product/process specific options. The P2 Council will drive the process forward.

Nevertheless, in order to provide some sense of priority ranking for this effort, a preliminary product/process specific p2 options screening and prioritizing effort was performed by employee participants during brainstorming session #4.

During this session, participants were requested to select and rank their top five individual product/process specific p2 options from the list generated and discussed previously in **Section 6.2.3**. **Appendix AA (w&e_opt.xls)** provides a list of priority product/process specific p2 options that resulted from this individual p2 options ranking exercise. A summary of these results is given in **Table 7-3**.

TABLE 7-3
PRODUCT/PROCESS SPECIFIC P2 OPTIONS
RESULTS OF PRELIMINARY RANKING

•***REDACTED BUSINESS CONFIDENTIAL INFORMATION ARE IN ITALICS***

Wastes & Emissions	P2 Options	ID
• ***Product A***	*Catalyst recovery*	4
	Special reactor: might raise selectivity and reduce heavies	5
Product C	*R&D program to evaulate altrnate process in pilot unit.*	11
Boilers	Condensate return maybe from the big users? use PVC pipe to avoid corrosion?	23
	Supply - align better with demand, less steam and energy wasted	29
K-62/K-63	Esters filters - different type filters to minimize flush wastes	131
Kiln	Recycle water around the quench, using centrifugal separators; reduce water demand; evaporate more water to stack	142
System 1	Cleaning - improve procedure and eliminate dead areas in lines	172
Product M	*Alcohol lights--why not feed to Unox?*	216
	Recover the alcohol if possible and reuse or sell	217
Product P	*Modify equipment*	274
	Venting revisit	275

	Different process	276
Product L	*Heavies recycle*	277

Those p2 options provided in Table 7-3 should not be viewed as listed in any priority order. It is recommended any team of product/process specialists assembled for the purpose of pursuing a specific p2 option should consider and evaluate other p2 options which may have been generated for that product/process specific waste.

7.5 P2 OPTIONS FOR GENERIC WASTES & EMISSIONS

The generic wastes p2 options screening effort was conducted by site employees during brainstorming session #3. The following provides a discussion of the screening methodology and a summary of the results.

7.5.1 Screening Methodology

The generic waste p2 options screening methodology was very similar in nature to the "Level 2" method used to screen generic wastes and emissions (see **Section 5.3.1**). **Appendix AB** provides the following documents associated with the generic p2 options screening methodology

- Generic P2 Options Screening: Workbook Template **(5/A/scp2~tmp.xls)**
- Generic P2 Options Screening: Workbook Sample **(5/A/sc_opt1.xls)**

As can be seen by reviewing the documents in **Appendix AB**, each workbook consisted of the following:

- A cover sheet on which to list up to 8 unique p2 options for a single generic waste (e.g., process water)
- A Level 1 "Kick-out" screening sheet which may serve to eliminate the p2 option from further consideration. The following provides an example of criteria employed at this screening level
    - "Should the option be eliminated from further consideration because....it will have an unacceptable impact on employee health & safety"
- A Level 2 screening sheet on which the participant is required to enter a score for each of the eleven criteria for each p2 option listed.
- A Level 2 screening results sheet which automatically calculates the total weighted score for each p2 option using the score entered on the previous level 2 screening sheet.

As a result, a total of twenty decisions must be entered for each p2 option to be screened using this process. For each generic waste, anywhere from one to three small break-out groups completed workbooks that provided a numerical score for each p2 option. **Table 7-4** illustrates the total number of decisions made in this process

TABLE 7-4

GENERIC WASTE P2 OPTIONS SCREENING METHODOLOGY

	Groups which	Total #	# of P2	
Process Water Use	G1, G2	2	25	1000
Waste Solvents	G4,G5,G6	3	22	1320
Drums	G1, G3	2	26	1040
Drums #1 (Drumming Flushes)	G4	1	12	240
Pallets	G4,G5,G6	3	7	420
Buckets & Lab Samples	G4	1	14	280
Filtercakes	G1,G2	2	11	440
Utility Use	G1,G2,G3	3	14	840
Flushes, Process and Samples	G4,G5,G6	3	4	240
Misc. Solid Waste to Land Disp.	G4,G6	2	17	680
Plant Cleanups	G1,G2,G3	3	4	240
TOTALS				6740

Each workbook was electronically linked to another workbook which then calculated the average of the scores for each option for each of up to four groups. The following template files were created for that purpose.

- atempg1.xls -- Screening p2 options; workbook template; linked to workbook atempavg.xls; for group #1
- atempg2.xls -- Screening p2 options; workbook template; linked to workbook atempavg.xls; for group #2
- atempg3.xls -- Screening p2 options; workbook template; linked to workbook atempavg.xls; for group #3
- atempavg.xls -- Screening p2 options; workbook template; linked to workbooks atempg1.xls, atempg2.xls, & atempg3.xls which calculates the average of the scores generated by each breakout group 1-3

Appendix AC provides an example of the workbook which calculated the average of the scores generated by breakout groups 1, 2 and 3 for waste solvents p2 options (**5/D/wsolv1av.xls**). **Appendix AD** provides the workbook giving the combined summary of average scores for all p2 options linked to all average workbooks (**5/D/allopts.xls**).

7.5.2 Screening Results

As one might expect, the results of this screening process are complex. The following briefly summarizes a few general conclusions regarding the screening process.

♢ Results are suitable/useful to help prioritize and provide focus for subsequent p2 program activities

♢ Generalized conclusions can be drawn. For example one may conclude subsequent p2 program efforts should focus on process water, which conclusion may be drawn as a result of a combination of the following observations:

- the previous waste screening efforts assigned a rank of #1 to process water;
- the total number of p2 options identified for process water was significant (23) compared to other generic wastes; and
- a relatively more significant number of process water p2 options were ranked in the top 50% of all p2 options as a result of the p2 options screening process.

♢ However, the usefulness of the p2 options screening results generated within a single brainstorming session for the purpose of making detailed conclusions regarding specific p2 options is limited. One can not use the results to make specific conclusions such as...

- How many of the p2 Options meet or exceed the following criteria:
  - required $ resources -- no/low cost
  - required people resources -- insignificant or low
  - current status of technology -- demonstrated in other industries
- A given p2 Option is necessarily more worthwhile, or quantitatively better than another

♢ The principal characteristics of the process which contributed to this situation are believed to be:

- the total time allocated for the generic waste p2 options screening exercise was limited (each group had to make on the order of 1000 scoring decisions in about 3 hours)
- expertise and knowledge of specific options, especially with regard to cost and to a lessor extent with regard to technology status, varied considerably among the small breakout groups

The results of this screening analysis, combined with the waste & emission screening results from **Section 5.3.2**, suggest initial priority emphasis should be given to p2 option evaluation and implementation for the following generic wastes and emissions.

- Process Water Use
- Waste Solvents

- Drums
- Drums #1 (Drumming Flushes)
- Buckets & Lab Samples
- Filtercakes

This conclusion is based on the results of the sorting and screening analysis which is detailed in **Appendix AE (w&e_opt.xls)** and summarized in **Table 7-5**. As can be seen from this table, the combination of waste & emission rank and the quantity of "high ranking" p2 options served to establish the priority generic wastes for further evaluation.

In order to avoid confusion from this point forward, the "Top Tier" list will be divided into a "Top Tier" and a "Middle Tier" list of generic wastes with associated p2 options.

TABLE 7-5
GENERIC WASTE P2 OPTIONS
SCREENING RESULTS

W&E Rank	Waste & Emission	# of High Ranking P2 Options	Tier
1	Process Water Use	6	Top
2	Waste Solvents	12	
3	Drums	18	
4	Drums #1 (Drumming Flushes)	7	
6	Buckets & Lab Samples	10	
7	Filtercakes	8	
5	Pallets	5	Middle
8	Utility Use	9	
9	Flushes, Process and Samples	4	
10	Misc. Solid Waste to Land Disp	7	
11	Plant Cleanups	0	

A "High Ranking P2 Option" for the purpose of this analysis is defined as a p2 option which either:

- was rated to be both
  - "low cost" -- required $$ resources criteria was scored....
- a 10 -- no cost; or
- an 8 -- low cost (expense)
  - "little effort" -- required people resources was scored....
- a 10 -- insignificant; or
- an 8 -- low

- or had a total weighted score (that is, the sum of all the individual weighted scores for each of the ranking criteria) of 7 or higher (on a decile scale) -- in other words, the p2 option can be expected to have the greatest positive impact.

As a result, each of the "new" six top tier generic waste and emission p2 options were subjected to further review and evaluation during session #4. During one of the small group breakout activities, one of the new six top tier generic p2 option groups was assigned to each of the six small breakout groups, and the groups were asked to select and prioritize up to five individual p2 options for their assigned generic waste.

Appendix AF provides a listing of those selected priority individual p2 options selected for each of the six top tier generic wastes (**w&e_opt.xls**), which results are summarized in **Table 7-6**.

The remaining "high ranking p2 options" which were not selected during the session #4 breakout activity are provided in **Appendix AG** and summarized in **Table 7-7**. Middle tier generic p2 options are in **Appendix AH**.

TABLE 7-6

TOP TIER GENERIC WASTE P2 OPTIONS
LIST OF 1st PRIORITY P2 OPTIONS

•***REDACTED BUSINESS CONFIDENTIAL INFORMATION ARE IN ITALICS***

Wastes & Emissions	W& E Rank	P2 Options	ID	S#4 Rank	Establish P2 Team For.....
Process Water Use	1	Hoses running needlessly -- how to eliminate?	197	1	Programmatic water conservation
		Programmatic water conservation	201	2	
		Cooling towers - add more or tie into existing:	189	3	investigating cooling water quality
		Cooling towers - Improve efficiency e.g. elim algae	190		
		Cooling water - clean inefficient equip, remove crud	191		
		Solids in process water: Set up plant team to review process, including sources and how to handle	209		
		Solids in process water: Use centrifugal separators	210		
		Solids in process water: Use magnetic treaters to prevent precipitation	211		
Waste Solvents	2	More logical product scheduling to avoid incompat-ibility and higher vol solvent use (lower turnover)	255	1	planning production, sequencing, sampling
		Product sequencing - improve for p2	258		
		Review criteria for acceptable clean-up	261	2	Reviewing criteria for...
		Spray nozzles and recycle pump systems	264	3	Spray nozzles & recycle...
		Establish solvent recovery system – separate solvents; filter material; dedicated tanks; install / use more spray nozzles in sys for cleanups; capture / reuse solvent cleanups in dedicated systems	247	4	evaluating options for solvent reuse and recycle
		Tanks for storage of reusable/recyclable clean-ups	265		
		On-site -- off-site recovery of solvents for reuse	256	5	
Drums	3	Raw materials buy in bulk/totes instead of drums	70	1	Reducing wasted drums
		Dumpsters - buy & use more	59	2	
		Install line from Poly 1 to Poly 2 for Product J	63		
Drums #1 Product	4	Campaigns longer	89	1	Reducing Drum 1's waste
		Cleaning and flushing better methods	90	2	
		Sequence compatible products when drumming	98	3	
		Sell drum 1's internal or external customers	97	4	
		Sample drum 1's and blend	96	5	
Bucket & Lab Samples	6	In- process analyzer installations	37	1	In process/ in unit testing and analyze, and in line sampling
		Operators run analysis on some samples in area	41		
		In line sampling -- eliminates flush	35	4	
		Product by Process	43	2	Product by Process
		"Are we sampling too often and/or too much vol."	31	3	Reducing sampling frequency & volume
		Examine QC program to reduce sampling effort	34		
		Smaller samples -- 4 oz. or less	43		
		One sample to all labs	40	5	
Filter-Cakes	7	Filtering: Investigate plant-wide current methods and cake volume generation	114	1	Filtration evaluation

	7	Filter changing criteria--optim.; do we do it too often	113	2	
	7	QA/QC customers' requirements - Re-evaluate	119	3	

TABLE 7-7

TOP TIER GENERIC WASTE P2 OPTIONS
LIST OF 2nd PRIORITY P2 OPTIONS

•***REDACTED BUSINESS CONFIDENTIAL INFORMATION ARE IN ITALICS***

Wastes & Emissions	W&E Rank	P2 Options	ID	Weighted Score	Low Cost, Little Effort
Process Water Use	1	Department accountability: Budget water use	192	5	Y
		Insulation - improve on pipe and hose	198	3	Y
		Regulatory relief - negotiate, point out regulatory barriers to the regulatory authority, for water reuse	204	3	Y
Waste Solvents	2	Longer campaigns	252	10	Y
		Plan production -- smaller batch runs create more cleanups and more waste solvents	257	10	Y
		Minimize line flushing	253	9	Y
		Clean-up dumpsters at EP instead of transferring back to production	243	6	Y
		Completely empty system of product before cleanups begin -- this reduces amount of solvent necessary for cleanups.	244	6	Y
		Find better solvent – use less	248	3	Y
		Has all solvent-less technology been explored	249	9	
		Dedicated systems	246	7	
		System 2 – add spray nozzles	251	7	
		More efficient, less expensive, more environ. friendly solvent	254	7	
Drums	3	Raw material drums with deposit – actually return, not send to EP	58	10	Y
		Totes: Use returnable totes instead of disposable totes	82	10	Y
		Partials; avoid going to blow-by	64	8	Y
		Reuse drums for drum 1's	74	8	Y
		Reuse drums for like wastes	75	8	Y
		Reuse drums in intermediate service	76	8	Y
		Bulk containers use more - totes or t/t's or dumpsters	56	7	Y
		Batch size - scale to full drum quantities	55	6	Y
		Raw materials - Just in time deliveries and processes - reexamine (decreases drum usage, solvents, cleanups)	68	6	Y
		Reusable lined drums (replace liner on next prod/waste)	73	6	Y
		Find less expensive drums	60	4	Y
		Quit using drums to measure when totalizer will do for charging	65	9	
		Bulk storage examine	57	8	
		Intermediates - Hard pipe or transfer in bulk; Avoid drumming to go to another system	62	8	
		Raw material drums return to supplier	67	8	
		Rejects -- avoid drumming; use trailers, totes, dumpsters	71	7	
Drums #1 Product	4	Drumming stations dedicated	91	10	
		Lines - more dedicated	92	10	
		Lines - more shorter ones	93	9	
Buckets & Lab Samples	6	Drain non-hazardous samples down the drain	33	2	Y
		Consolidation of more samples in lab	32	1	Y
		Non-glass sample bottles	38	1	Y
		In tank analysis with remote access, i.e. in sampling	36	9	
Filter-cakes	7	Raw materials - Require vendors to provide quality	120	7	Y
		Cartridge type disposable filters (CUNO):	111	10	
		Filtration: need better filters, better cleaning operation (esp. NPD)	117	10	

		Plate / frame filters - eliminate, replace	118	9	
		Drains - examine possibility of recycling	112	8	
		Solids reduce via generic process improvements	121	7	

8.0 TECHNICAL & ECONOMIC FEASIBILITY

Following the initial screening, it is necessary to examine the technical and economic feasibility of implementing some of the p2 options identified. This chapter provides a summary of the current status and results of this analysis.

8.1 TECHNICAL FEASIBILITY

For some p2 options, such as many of the programmatic p2 options, the technical feasibility is evident, and no further evaluation is required. However, some practices require a more detailed evaluation of technical feasibility. Issues typically considered when making this technical assessment include:

- effects on production capacity & product quality;
- physical plant limitations (e.g., space limits);
- specific equipment requirements and options;
- effects on maintenance requirements;
- utility requirements;
- creation of new wastes or by-products;
- physical and chemical properties of materials/wastes;
- potential health, environmental, or safety impacts; and
- effects on permit status (e.g., modifications, new permits).

Consideration of these and other technical issues can contribute to the selection of the best and most appropriate option to achieve a specific waste reduction goal. On the other hand, a technical feasibility evaluation may determine that it is not possible to achieve certain waste reduction goals at this time. Such options can be deferred to be re-examined during a future repeat of the p2 opportunity assessment exercise.

8.1.1 Technical Feasibility Criteria

Site-specific technical screening criteria were identified and weighting factors assigned during brainstorming session #1. In the final analysis, many detailed technical feasibility issues and criteria must be carefully assessed for some options. However, for the purpose of this task, the following four general categories of technical feasibility issues were considered.

- Current technology status (already working/field trials/lab only)

- Ease of implementing change (calendar time/staff time/equipment needs)
- Effects on product quality/production capacity/other processes
- Availability and/or effects on requirements for space/utilities/supplies/labor, etc.

Technical feasibility considerations at the waste screening level are naturally limited. In some cases, however, it may be well known at this level that a good reduction technology already exists for a specific type of waste or emission. For this reason, the following technical feasibility related criteria was applied during waste and emission screening activities:

- ***"Potential For Existing Technology To Successfully Reduce Waste"*** -- which during session #1 was assigned a weighting factor of 3 (on a scale of 1-5) by session participants, and scored according to the following rational:

  - 10 for "Very significant"
  - 8 for "Significant"
  - 6 for "Moderate"
  - 4 for "Low"
  - 2 for "Unlikely"

Technical feasibility considerations at the p2 options screening level included both a "kick-out" screening question to eliminate a p2 option, followed by two technical feasibility related criteria applied during the more rigorous scoring for p2 options screening.

At the "kick-out" screening level, a p2 option was eliminated if the answer was "Yes" to the following question:

- "Should the option be eliminated from further consideration because it is clearly not technically feasible"

At the more rigorous p2 option screening level, the following two technical feasibility related criteria were considered:

- ***"Current Technology Status"*** -- which during session #1 was assigned a weighting factor of 3 (on a scale of 1-5) by session participants, and scored according to the following rational:

  - 10 for "Demonstrated in similar plants"
  - 8 for "Demonstrated in other industries"
  - 6 for "Field trials in process"
  - 4 for "Bench scale - lab trials underway or required"
  - 2 for "New idea - no research available"

- ***"Required People Resources"*** -- which during session #1 was assigned a weighting factor of 5 (on a scale of 1-5) by session participants, and scored according to the following rational:

•10 for "Insignificant"
•8 for "Low"
•6 for "Moderate"
•4 for "Significant"
•2 for "Very significant"

Some p2 options would require more extensive technical feasibility studies. In particular, before any operational changes in the plant become operational, they must undergo the Facility or Operational Change Reviews (FOCR's) and Pre-Startup Safety Reviews (PSSR's). Those reviews must be approved by various plant managers, depending on the type of change. Managers whose approvals may be required include Department Leader, Process Engineering Group Leader, Process Technology Manager, Environmental Protection Department Leader, Safety/Health Department Head, and Global Operations Manager. The FOCR/PSSR procedure is in the Plant's Operational Safety Procedures Manual, policy OS-IV-1, and includes extensive check lists for reviewing the impact of a proposed change on personnel safety, process safety, environmental protection, plant operations, product quality, etc.

Significant changes in process technology require work by operations and Process R&D prior to these reviews, to determine all the outcomes of a proposed change. The most significant process technologies require an R&D Definition of Technology report that describes in detail all aspects of the technology and its ramifications.

8.1.2 Technical Feasibility Results

As a result of these various levels of technical feasibility determinations made throughout this study, **nine** p2 options were eliminated from further consideration. These options are identified in **Appendix AI** and summarized in **Table 8-1**.

TABLE 8-1
P2 OPTIONS DETERMINED NOT TECHNICALLY FEASIBLE

•***REDACTED BUSINESS CONFIDENTIAL INFORMATION ARE IN ITALICS***

W&E Category	W&E Rank	Wastes & Emissions	P2 Options	ID
Generic	2	Waste Solvents	Contact condensers with recycle cooler	245
Top	6	Buckets &	Non-glass sample bottles	38

Tier		Lab Samples	Plastic sample buckets	42
Product/ Process Specific		*Product H*	*Product H lights reuse / recycle*	17
			Process change	18
		Alkyl Halides	Alkyl halide (e.g. ethyl and methyl chloride) discharges to the process sewer should be eliminated at the point of origin; the need for a stripping operation thus would be eliminated	20
		Kiln	Kiln temperature increase: Better insulate and line kiln to keep heat in	137
			Kiln temperature increase: Install a roof over the kiln to keep rain off and keep heat in	138
			Uptime: In-line homogenizer installation at EP	145

A more detailed evaluation of technical feasibility is required for many of the remaining p2 options. Incorporating these analyses into the standard operating business practices at the plant is an important outcome of this WM/PP Study, and will be discussed further in **Chapter 9**.

For some p2 options, such as many of the programmatic p2 options, the technical feasibility is evident, and no further evaluation is required. For these options and others that have been determined to be technically feasible, it is necessary to address the issue of economic feasibility.

8.2 ECONOMIC FEASIBILITY

For most technically feasible options, it is necessary to address the option's economic feasibility. In some cases, the options are clearly economically feasible or not feasible without much analysis. For others, a more detailed economic analysis is required.

8.2.1 Environmental Cost Accounting

Environmental cost accounting practices are increasingly recognized as a useful tool for this purpose. Environmental cost accounting is a term used to refer to the addition of environmental cost information into existing cost accounting procedures. This practice recognizes embedded environmental costs and allocates those costs to appropriate products or processes. The installation of environmental cost accounting as a component of the facility's standard economic analysis procedures is one of the programmatic p2 options identified within this study.

8.2.2 Economic Feasibility Criteria

As a first step, it is useful to develop a site-specific list of environmental costs which should be considered for inclusion within the facility's standard economic analysis procedures, and to examine those procedures in order to identify costs which are currently captured as well as those which are not but should be.

A small group breakout exercise was conducted during brainstorming session #1 for this purpose. Employee participants were asked to brainstorm a comprehensive list of environmental cost factors, and then to rank those factors according to whether they believed the factors are:

- ♢ already captured by the existing cost accounting procedures
- ♢ not captured, but definitely should be
- ♢ not captured, but probably should be

Examples of those environmental costs which participants deemed important include the following:

- ♢ Direct materials
  - raw process materials
  - maintenance materials
  - containers (drums, skids…)
- ♢ Utilities (electricity, water, fuel, etc.)
- ♢ Direct labor
- ♢ Quality
  - rework, scrap or off-spec products, etc.
  - quality control function, sampling, etc.
- ♢ Equipment cleaning
- ♢ Insurance
- ♢ Income Tax
- ♢ Inventory storage
- ♢ Waste management
  - on-site handling
  - storage
  - treatment -- wastewater
  - treatment -- incinerator
  - hauling
  - disposal
- ♢ Regulatory compliance
- ♢ Future liability

Appendix AJ provides a comprehensive summary of the results of employee brainstorming activities performed in order to identify a site-specific list of economic feasibility criteria.

Economic feasibility considerations at the waste screening level are also somewhat limited. In many cases, however, a positive economic feasibility outcome is more likely for any p2 option which reduces a waste stream with a very high current cost of waste management. For this reason, the following economic feasibility related criteria were applied during waste and emission screening activities:

- ***"Current Cost Of Waste Management"*** -- which during session #1 was assigned a weighting factor of 4 (on a scale of 1-5) by session participants, and scored according to the following rational:

•10 for "Very high"
•8 for "High"
•6 for "Moderate"
•4 for "Low"
•2 for "Insignificant"

Economic feasibility considerations at the p2 options screening level included both a "kick-out" screening question to eliminate a p2 option, followed by two economic feasibility related criteria applied during the more rigorous scoring for p2 options screening.

At the "kick-out" screening level, a p2 option was eliminated if the answer was "Yes" to the following question:

- "Should the option be eliminated from further consideration because the cost to implement is clearly unacceptable"

At the more rigorous p2 option screening level, the following two economic feasibility related criteria were considered:

- ***"Required $$ Resources"*** -- which during session #1 was assigned a weighting factor of 4 (on a scale of 1-5) by session participants, and scored according to the following rational:

•10 for "No Cost"
•8 for "Low Cost (expense)"
•6 for "More Cost (expense)"
•4 for "Minor Capital"
•2 for "Major Capital"

- ***"ROI - Economic Feasibility"*** -- which during session #1 was assigned a weighting factor of 2 (on a scale of 1-5) by session participants, and scored according to the following rational:

•10 for "ROI is > 60%"
•8 for "30% < ROI < 60%"
•6 for "15% < ROI < 30%"
•4 for "0% < ROI < 15%"
•2 for "ROI is < 0%"

For p2 options requiring an even more rigorous economic feasibility evaluation, the company's Capital Project Analysis Guidelines are used. A copy is provided in **Appendix AK**. (This Appendix is regarded Business Confidential and is not included in the Public Edition of this report.) Witco's economic analyses include the following factors and concepts:

- financial projections over 10 years;
- expenses: capital, materials, operating, overhead, depreciation, inventory, taxes;
- income: sales, savings;
- measurements of the worth of projects: internal rate of return (in %), net present value (in $), payback (in years), value creation ratio (a measure of shareholder value).

Thus, these analyses take into account both one-time expense and savings, as well as recurring expense and savings.

One important outcome of this WM/PP Study is related to the issue of implementing future enhancements to the facility's standard economic analysis procedures in order to do a better job of including environmental cost information. Indeed, as discussed previously in **Sections 6.2.2 and 7.3**, the #1 Programmatic P2 Option Category (#2 P2 Option overall when including "P2 Council") is the following:

> ***"Economics*** -- Perform environmental cost accounting which is appropriate for the Sistersville facility. Define what costs should be captured at this facility, determine appropriate cost allocation procedures, and define how to address "avoided" costs for capital additions"

8.2.3 Economic Feasibility Results

As a result of these various levels of economic feasibility determinations made throughout this study, **ten** p2 options were eliminated from further consideration. These options are identified in **Appendix AL** and summarized in **Table 8-2**.

TABLE 8-2
P2 OPTIONS DETERMINED NOT ECONOMICALLY FEASIBLE

•***REDACTED BUSINESS CONFIDENTIAL INFORMATION ARE IN ITALICS***

W&E Category	W&E Rank	Wastes & Emissions	P2 Options	ID
Generic Top Tier	2	Waste Solvents	Longer campaigns	252
			Plan production – smaller batch runs create more cleanups and more waste solvents	257
	4	Drums #1 Product	Campaigns longer	89
	5	Pallets	Burn wood (shredded) pallets in kiln	173
	10	Misc. Solid Waste to LD	Paper - Consider shredding on site	161
			Paper; burn in kiln	165
Product/ Process Specific		*Product A*	NH3 scrubber: add Phosphoric acid there and form ammonium phosphate -- sell as a fertilizer?	2
		Product D	Lime: collect and sell as fertilizer	14
		Alkyl Halides	*Different process, less by products*	21
		Product P	*Improve distillation – add third column*	273

A more detailed evaluation of economic feasibility is required for many of the remaining p2 options. Incorporating these analyses into the plant's standard operating business practices will be discussed further in **Chapter 9**.

8.3 RESULTS: FEASIBLE P2 OPTIONS

Table 8-3 provides a summary of the results of technical & economic feasibility evaluations made throughout this study. As can be seen from **Table 8-3, fifty six** p2 options were determined to be the most feasible, top priority p2 options, to go along with **thirty one** options previously determined to be feasible. **Nineteen** have been determined not feasible. For the remaining **one hundred and eighty-four** p2 options, the feasibility remains undetermined.

Feasibility – both technical, and especially economic – can change at any time, due to many factors. Note that the options listed in **Table 8-3** have been deemed feasible based on the current understanding of the p2 options, current business conditions, and the analysis done to-date. Further, note that p2 options considered feasible here have not yet undergone detailed, formal economic analysis. And finally, the availability of capital funding can vary from time to time and may influence which options can be implemented.

TABLE 8-3
FEASIBILITY ANALYSIS SUMMARY

Description			# Of P2 Options
Not Feasible	Technically	9	19
	Economically	10	
Feasibility Undetermined			184
Are Feasible	Determined Feasible During This Project	56	87
	Previously Determined Feasible & In-Progress	31	

The fifty-six p2 options for which the feasibility is determined are identified in **Appendix AM** and summarized in **Tables 8-4 and 8-5**. A summary of potential cost savings and waste/emission quantity reductions is provided in **Table 8-6**. The previously determined feasible options are discussed in **Section 9.2.2**.

The one hundred and eighty-four p2 options, for which the feasibility is as yet undetermined, are identified in **Appendix AN**.

Obviously, on-going analysis, prioritizing, planning and implementation remains as the next step. Proposed implementation activities and other activities to continue this WM/PP Study within the context of an on-going, facility-wide p2 program are discussed further in **Chapter 9**.

8.3.1 P2 Options For Generic Wastes

Table 8-4 provides a summary listing of the generic waste p2 options which were determined to be technically and economically feasible. There are numerous other unique p2 options for each of the generic wastes for which the technical and economic evaluation is not yet complete. We believe it is advisable to consider all p2 options for each generic waste category as a whole, rather than trying to implement only those options that seem to be the best based only by the analyses done to date. Frequently, by considering all the ideas offered for a waste, one may find the very best solution is a combination and/or variation on the ideas so far.

As will be discussed further in **Chapter 9**, it is therefore suggested that a p2 team (formal or informal, as the need may be) be established for each specific waste issue in order to complete the analysis of the remaining p2 options, and to develop a comprehensive p2 implementation strategy specific to that issue. One of the functions of the P2 Council will be to prioritize the tackling of wastes, forming of teams, and championing implementation of p2 options.

8.3.2 P2 Options For Product/Process Specific Wastes

Table 8-5 provides a summary listing of those p2 options for product/process specific wastes which have been determined to be technically and economically feasible. As with the generic wastes discussed previously, there are other unique p2 options which remain to be fully evaluated. We again suggest that a p2 team be established for each waste in order to proceed with the analysis and implementation strategy development.

Table 8-5 also identifies several specific p2 options for which implementation is already in progress. Obviously, the establishment of a p2 team is not applicable for these options.

TABLE 8-4
CURRENTLY FEASIBLE P2 OPTIONS -- GENERIC WASTES

•***REDACTED BUSINESS CONFIDENTIAL INFORMATION ARE IN ITALICS***

W&E Rank	Wastes & Emissions	Establish P2 Team For.....	P2 Options	ID	Implementa-ion Stage	Comments
1	**Process Water Use**	Programmatic water conservation	Hoses running needlessly -- how to eliminate?	197		
			Programmatic water conservation	201		
			Department accountability: budget water use	192		
			Department accountability: meter usage	193		
			Cooling towers -- expand use to reduce water use	46	Scoping	New cooling tower for Poly I / NPD in capital plan
		investigating cooling water quality	Cooling water - clean inefficient equip (heat exchangers, etc.), remove crud	191		
			Solids in process water: Set up plant team to review process, including sources and how to handle	209		
			Cooling towers review operation of : e.g. fans need not run in winter; algae growth in some of them	190		
2	**Waste Solvents**	planning production, sequencing, sampling	More logical product scheduling to avoid incompatibility and higher vol solvent use (lower turnover)	255		
			Product sequencing - improve for p2	258		
		Solvent reclaim / reuse	Reclaim / reuse	259	Evaluating	IPA Recovery program is in place, however more IPA ought to be recovered than is. 6/98
			Reuse of solvents -- last pass clean-up used for first pass on next batch / campaign	260	Evaluating	Is being done in some Poly I systems. Could do more??8/98
		Reviewing criteria for...	Review criteria for acceptable clean-up	261		
			Minimize line flushing	253		
3	**Drums**	Reducing wasted drums	Raw materials buy in bulk/totes instead of drums	70	Unknown	
			Totes: Use returnable totes instead of disposable totes	82	Inactive	Internal: ?? External: Our numbers continue to grow for one-way IBC's, driven more by business than recycling. 8/4/98
			Totes: recycle one-way totes via tote supplier	81	In-place & On-going	We have sent back 52 from the plant to our supplier/recycler using their program. 8/4/98
			Reuse drums for drum 1's	74	Unknown	The Fluids area is recovering material from drum 1's and partials. May become a quality issue especially in the emulsion area.7/8/98
			Reuse drums in intermediate service	76	Unknown	The Fluids area is recovering material from drum 1's and partials. May become a quality issue especially in the emulsion area. 7/8/98
			Install line from Poly 1 to Poly 2 for Product J	63	Implementing	
			Raw material drums with deposit – actually return, not send to EP	58		
			Quit using drums for measurement when totalizer will do for charging	65		
			Reuse drums for compatible wastes	75		
			Reuse drums when possible: recovery drums	77		
			Treatment/disposal efficiency maximize: Improve drum flush unit efficiency, may make more drums clean and able to be sent to metals recycling	84	Scoping	Evaluating ways to modify or replace existing drum flusher: cleaner H2O source, higher pressure; use steam to clean; => reduce cycle time and numbe of times handled 9/25/98

TABLE 8-4

CURRENTLY FEASIBLE P2 OPTIONS -- GENERIC WASTES (Continued)

W&E Rank	Wastes & Emissions	Establish P2 Team For.....	P2 Options	ID	Implementa-ion Stage	Comments
4	**Drums #1 Product**	Reducing Drum 1's waste	Cleaning and flushing better methods	90	Planning	Drumfilling procedures in Poly II are being revised to reduce the amounts flushed to waste before drumming. 9/23/98
			Sequence compatible products when drumming	98		
6	**Bucket & Lab Samples**	Product by Process	Product by Process	43.1	Scoping	Witco initiative to define products more so a head of time by the process that makes them, and less so by analysis after-the-fact. 9/23/98
		Reducing sampling frequency & volume	"Are we sampling too often and/or too much vol."	31		
			Examine QC program to reduce sampling effort	34		
			Operators run analysis on some samples in area	41	Scoping	In - Unit Testing Ad Hoc Team studying tests that may be performed by operators, or displaced by in-stream instrumentation. In stream instrumentat could potentially eliminate some samples; in-unit testing by operators may reduce sample size. 8/5/98
			In- process analyzer installations	37	Scoping	In - Unit Testing Ad Hoc Team studying tests that may be performed by operators, or displaced by in-stream instrumentation. In stream instrumentat could potentially eliminate some samples; in-unit testing by operators may reduce sample size. 8/5/98
			Smaller samples -- 4 oz. or less	43		
			One sample to all labs	40		
7	**Filter-cakes**	Filtration evaluation	Filtering: Investigate plant-wide current methods and cake volume generation	114		
			Filter changing criteria--optim.; do we do it too often	113		
			QA/QC customers' requirements - Re-evaluate	119		
			Plate / frame filters - eliminate, replace	118	Scoping	
5	**Pallets**	Reducing scrapped pallets	Reusable plastic pallets for drum flush -- eliminate disposing 2,000 wooden pallets per year.	177	Implementing	300 plastic pallets have been ordered and received 10/98. Plastic pallets can reused many times in the drum flusher, reducing the use of wooden pallets which must be disposed of.
10	**Misc. Solid Waste to Land Disposal**	Solid waste recycling	Aluminum cans - Recycle	155		
			Cardboard - recycle	156		

TABLE 8-5

CURRENTLY FEASIBLE P2 OPTIONS -- PRODUCT/PROCESS SPECIFIC WASTES

•***REDACTED BUSINESS CONFIDENTIAL INFORMATION ARE IN ITALICS***

W&E Rank	Wastes & Emissions	Establish P2 Team For.....	P2 Options	ID	Implementation Stage	Comments
	Product A	*Catalyst recovery*	*Catalyst recovery*	4	Unknown	
	Product C	*Product C* alternate process	*Alternate processes; reduce lights*	11	Scoping	*R&D program to evaulate altrnate process in pilot unit.*
	Boilers	examining condensate return	Condensate return maybe from the big users? use PVC pipe to avoid corrosion?	23		Needs detailed economic evaluation
		Examining boiler alignment	Supply - align better with demand, less steam and energy wasted	29	Scoping	Boiler modifications or new boiler being considered. Needs detailed economi evaluation.
	K-62/K-63	new esters filters	Esters filters - different type filters to minimize flush wastes	131	Inactive	
	Kiln	Removing solids from kiln effluent & recycle	Recycle water around the quench, using centrifugal separators; reduce water demand; evaporate more water to stack,	142	Inactive	Further investigate. Has potential.
	System 1	***System 1*** *cleanup*	Cleaning - improve procedure and eliminate dead areas in lines	172	Scoping	*The System 1 in capital plan will have a piping lay -out for easier cleanup and column spray nozzles. The column packing will also go from springs structured packing. 8/6/98*
	Product L	*recycling Product L heavies*	*Heavies recycle*	277		
	Product M	*Product M lights recycle*	*Alcohol lights--why not feed to Unox?*	216	Scoping	*Getting samples and analyses of lights. Should be fairly pure. Investigati purifying. 9/14/98*
		recovering alcohol from Product M lights	*Recover the alcohol if possible and reuse or sell*	217	Scoping	*Getting samples and analyses of lights. Should be fairly pure. Investigati purifying. 9/14/98*
	Product P	*Modify equipment*	*Modify equipment*	274	Scoping	Project being scoped and economically evaluated in detail
		Venting revisit	*Venting revisit*	275	Scoping	Project being scoped and economically evaluated in detail
	Product B	Not Applicable -- Already Done	*Raw material recycle after last batch of campaign (need storage)*	6	Implementing	*Process B lights kept in trailer for next campaign, done for the first time; ~5600 lbs raw material @ $0.99 + potentially reused and not discarded*
	Product C	Not Applicable -- Already Done	Installing pump for chlorosilanes, instead of nitrogen transfers to avoid need for degassing -- reduce chlorosilane losses in nitrogen vents	12	Implementing	*Installation of chlorosilane pumps is in progress. Expect 11/13/98 completion.*
	Product P	Not Applicable -- Done	*Different process*	276	Implementing	*Process to be implemented. Project kicked off 7/98.*

TABLE 8-6

POTENTIAL COSTS SAVINGS AND WASTE/EMISSION QUANTITY REDUCTIONS

•***REDACTED BUSINESS CONFIDENTIAL INFORMATION ARE IN ITALICS***

W&E Rank	Wastes & Emissions	Establish P2 Team For.....	P2 Options	ID	Potential Cost $$ Savings Neglecting Expense of Implementing Option	Potential Waste/Emission Quantity Reductions
	Product A	*Catalyst recovery*	*Catalyst recovery*	4		
	Product C	*Product C* alternate process	*Alternate processes; reduce lights*	11		
	Boilers	Examining condensate return	Condensate return maybe from the big users? use PVC pipe to avoid corrosion?	23		
		examining boiler alignment	Supply - align better with demand, less steam and energy wasted	29		
	K-62/K-63	new esters filters	Esters filters - different type filters to minimize flush wastes	131		
	Kiln	removing solids from kiln effluent & recycle	Recycle water around the quench, using centrifugal separators; reduce water demand; evaporate more water to stack,	142		
	System 1	***System 1*** *cleanup*	Cleaning - improve procedure and eliminate dead areas in lines	172		
	Product L	*recycling Product L heavies*	*Heavies recycle*	277		
	Product M	*Product M lights recycle*	*Alcohol lights--why not feed to Unox?*	216	$10,000 /year (100,000 lb at $0.10 / lb kiln cost)	Zero
		recovering alcohol from Product M lights	*Recover the alcohol if possible and reuse or sell*	217	$30,000 / year (100,000 lb/yr at $0.30 / lb) less cleanup costs	100,000 lb /year
	Product P	*Modify equipment*	*Modify equipment*	274		
		Venting revisit	*Venting revisit*	275		
	Product B	Not Applicable -- Already Done	*Raw material recycle after last batch of campaign (need storage)*	6	$22,000 / yr (4 x 5600 lb/yr at $0.99/lb)	22,000 lb/yr
	Product C	Not Applicable -- Already Done	Installing pump for chlorosilanes, instead of nitrogen transfers to avoid need for degassing -- reduce chlorosilane losses in nitrogen vents	12		
	Product P	Not Applicable -- Done	*Different process*	276		

9.0 DEVELOP IMPLEMENTATION PLAN

Building upon all of the information collected and work performed throughout this WM/PP study, this Chapter provides a discussion of the recommended plan to implement the results of this study. This implementation plan should be viewed as a flexible, "work-in-progress" to be continuously refined subject to the activities and decisions of the site P2 Council. The recommendations in this Chapter are just that, and are not necessarily commitments by the businesses to implement p2 options. Where options have already been, or are in the process of being, accepted and implemented are so noted.

9.1 IMPLEMENTATION STRATEGY DEVELOPMENT

The design of this process envisioned facility employees playing a significant role in developing the strategy and plan to implement the results of this p2 assessment. During brainstorming session #4 facility employees were asked to further evaluate and prioritize p2 options for implementation, and to participate in developing the implementation plan itself.

During each small group breakout activity in session #4, the participants were asked to select their priority p2 options, and suggest a strategy for implementing each specific p2 option. A one-page handout was provided for this purpose entitled "P2 Option Implementation Strategy Form". A sample of a completed form (which was also given to the participants) is provided in **Appendix AO (1/A/stratg01.doc)**

As illustrated in this handout document, for p2 implementation planning purposes it is helpful to consider implementation strategies at two different levels of detail. These are:

- Level 1 -- An implementation strategy based first on the need to establish a p2 team in order to perform further evaluation and selection of a number of different actions.

- Level 2 -- A strategy to perform a specific task (or list of tasks, or action items) in order to implement a specific p2 option.

Regardless of the level of analysis, the same classic implementation strategy approach was suggested, only the level of detail achieved would vary between levels. This implementation strategy development approach is centered on determining responses to the typical implementation issues which are summarized in **Table 9-1**.

TABLE 9-1
TYPICAL IMPLEMENTATION ISSUES

What?	Description of the action required
Where?	Departments & locations affected
Why?	Purpose/Goal
When?	Schedule
Who?	Person(s) responsible
How?	How will resources required to perform the action be obtained?

9.1.1 Level 1 Implementation Strategy

It is common at this stage in a typical WM/PP study to have several p2 options which show promise, though further detailed assessment is required in order to complete the evaluation of the options, and to define the specific actions required to implement the selected options. Using the example given in **Appendix AO (1/A/stratg01.doc)**, a typical level 1 implementation strategy for process water use reduction is provided in **Table 9-2**.

9.1.2 Level 2 Implementation Strategy

A level 2 implementation strategy can be developed where further detailed assessment is not required, and a strategy can be proposed to perform a specific task (or list of tasks, or action items) in order to implement a specific p2 option. Again, using the example given in **Appendix AO (1/A/stratg01.doc)**, a typical level 2 implementation strategy for process water use reduction is provided in **Table 9-3**.

TABLE 9-2
LEVEL 1 IMPLEMENTATION STRATEGY -- TYPICAL EXAMPLE

P2 IMPLEMENTATION STRATEGY FOR PROCESS WATER USE REDUCTION		
What?	**Description of the action required**	**Establish a Pollution Prevention Team For Process Water Use Reduction. The team will be tasked with the following:** **Performing a detailed assessment of pollution prevention options for Process Water Use Reduction. Such assessment will include the following** **define current baseline & status** **define actions to be taken** **define feasibility (technical, economic, administrative)** **develop method/mechanism to measure/monitor/document/communicate p2 progress/results (<lbs waste reduced>, <lbs waste reduced/lb product>, <$$ saved>, <lbs PPT chemical reduced>)** **Preparing detailed implementation plan, which the team recommends based on results of the assessment. This will include the following:** **Develop list of tasks (action items). For each task or action item determine the following** **What? -- description of the action required** **Where? -- department & locations affected** **Why? -- Purpose/Goal** **When? -- Schedule** **Who? -- Person(s) responsible** **How? -- How will resources required to perform the action be obtained** **Reporting Recommendations to the Plant-wide P2 Council**
Where?	**Departments and locations affected**	**Plant-wide**
Why?	**Purpose/goal**	**Reduce plant-wide use of process water by ww%**
When?	**Schedule**	**10/01/xx -- select team** **12/31/xx -- submit report to the plant-wide P2 Council** **03/01/yy -- begin implementing approved actions** **12/31/yy -- achieve target reductions**
Who?	**Persons responsible**	**Team Leader -- John J. Witco** **Team Member #1 --** **Team Member #2 --**
How?	**Resources: e.g., money, employee's time**	**Employee's time to be charged to xxxxxxxx** **XYZ Expert Consulting Inc. will be contracted for $dd,000**

TABLE 9-3
LEVEL 2 IMPLEMENTATION STRATEGY -- TYPICAL EXAMPLE

P2 IMPLEMENTATION STRATEGY FOR PROCESS WATER USE REDUCTION Department Accountability -- Meter/Budget Water Use		
What?	**Description of the action required**	**Purchase and install water meters**
Where?	**Departments and locations affected**	**In each of the following locations: location x; location y; .....**
Why?	**Purpose/goal**	**Implement p2 option "Department accountability: meter/budget water use in order to reduce water use by ggg gpm and to save $mmm,000 annually ($nnn,000 for water supply; $ooo,000 wastewater treatment, including avoided cost of increasing capacity)**
When?	**Schedule**	**01/01/yy Bids due** **02/01/yy PO issued** **12/31/yy All water meters installed**
Who?	**Persons responsible**	**Jim J. Witco**
How?	**Resources: e.g., money, employee's time**	**Employee's time to be charged to xxxxxxxxxxxxx.** **$dd,000 cost for contractor to supply and install water meters charged to xxxxxxxx**

9.2 IMPLEMENTATION PLAN

This site-specific strategy for implementing the results of the WM/PP Study naturally builds on the results of all work performed and information collected throughout the performance of this study. A brief summary of the recommended priorities for this site-specific implementation strategy is provided in **Table 9-4**.

TABLE 9-4
SITE-SPECIFIC IMPLEMENTATION STRATEGY SUMMARY

PRIORITY	DESCRIPTION
#1	Establish An On-Going Site P2 Council
#2	Pursue Full Implementation Of Recent P2 Initiatives
#3	Create P2 "Evergreen" List On Computer Network
#4	Establish System To Better Drive Costs To The Department, Process Or Product -- Environmental Cost Accounting
#5	Enhance Employee Communication And Education
#6	Establish P2 Teams For Evaluating & Implementing Remaining Priority P2 Options • Remaining Priority Programmatic P2 Options • Remaining Priority Product/Process Specific P2 Options • Remaining Priority Top-Tier Generic P2 Options
#7	Establish P2 Teams For Evaluating & Implementing Middle Tier Generic P2 Options
#8	Revisit P2 Options For Bottom-Tier Generic Wastes & Emissions

The following sections provide more description and information regarding these site-specific implementation strategy elements.

9.2.1 Priority #1 -- Establish An On-Going Site P2 Council

Clearly the first priority implementation strategy is establishing an on-going site P2 Council. Indeed, as of the date of this report, the P2 Council is being formed and expected to meet in January. **Section 6.2.1** provides information regarding the membership and charter of the P2 Council. Ultimately, the P2 Council will have the responsibility to pursue implementation of the results of this WM/PP Study, and to further define specific implementation actions as the program proceeds.

9.2.2 Priority #2 -- Pursue Full Implementation Of Recent P2 Initiatives

As discussed previously in **Section 8.3.2**, the feasibility analysis has already been completed for several p2 options, and implementation of those options is already in progress. Further, as discussed in **Section 6.1.1**, several p2 options identified prior to the formal start of this Study have been determined to be feasible and are also in progress. High priority will certainly be given to proceeding with full implementation and completion of these recent p2 initiatives, which are summarized in **Table 9-5**.

Note, however, that feasibility can change at any time, due to many factors. OSil is working towards completing these options below. However, that completion is contingent upon continued technical and economic feasibility and continued availability of the resources to carry them out.

The p2 options shown in Table 9-5 are anticipated to produce:

		Potential Cost $$ Savings *	Potential Waste/Emission Reductions
One-Time ("Complete") in 1998		$42,000	26,000 lbs
Expected Recurring ("On-Going")	XL Project Air Emissions Reduction and Methanol Recycle (Excludes capital savings from XL project)	$19,000/yr	770,000 lbs/yr
	Other P2 Options	$500,000/yr	990,000 lbs/yr
	TOTAL "ON-GOING"	$520,000/yr	1,800,000 lbs/yr

* Note that these savings do not consider the expense of implementing them. Hence net savings will be less. It is often difficult to assign that expense. For example, a totally new process unit may cost millions of dollars to construct. If that new process produces less waste, how much of the design and construction expense ought to be assigned to the p2 benefits? In the case of a process change being done explicitly for p2 reasons, the expense is more easily determined.

Potential reductions and savings have not been estimated for several of these options, so actual results may vary.

•TABLE 9-5

•IMPLEMENTATION IN PROGRESS -- RECENT P2 INITIATIVES

•*REDACTED BUSINESS CONFIDENTIAL INFORMATION ARE IN ITALICS*

	W&E Rank	Wastes & Emissions	P2 Options	ID	Implementation Stage	Status Details [Internal P2 Activity Code is in brackets]	Potential Cost $$ Savings Neglecting Expense of Implementing Option	Potential Waste/ Quantity Redu
1		***Product B***	*Raw material recycle after last batch of campaign (need storage)*	6	3-Implementing	*Raw material recycle after last batch of campaign (need storage)*	$22,000 / yr (4 x 5600 lb/yr at $0.99/lb)	22,000 lb/yr
2		***Product C***	*Alternate processes; reduce lights*	11	1-Scoping	*Alternate processes; reduce lights*	N/Av	N/Av
3		***Product C***	*Mixtee Process*	278	6-In-place & On-going	*Mixtee Process*	$13,400 / year (34,000 lb at $0.10 / lb kiln cost plus 34,000 lb ethanol raw material at $0.30/lb)	33,772 lbs/year Aci 1,488 lbs/year Ethy
4		***Product C***	*Installing pump for chlorosilanes, instead of nitrogen transfers to avoid need for degassing -- reduce chlorosilane losses in nitrogen vents*	12	3-Implementing	*Installing pump for chlorosilanes, instead of nitrogen transfers to avoid need for degassing -- reduce chlorosilane losses in nitrogen vents*	N/Av	N/Av
5		***Product E***	*Product E Recovery*	279	5-Complete	*Product E Recovery*	$7,000 (5,800 lb * $1.23/lb)	5,800 lbs
6		***Product F***	*Product F Production in different unit*	280	6-In-place & On-going	*Product F Production in different unit*	$115,000 / yr (150,000 lb at $0.10 / lb kiln cost plus 150,000 lb alcohol raw material at $0.66/lb)	150,000 lbs/yr alco
7		***Product F***	*Product F Recovery*	281	5-Complete	*Product F Recovery*	$35,000 (30,000 lbs recovered @ $1.18)	20,000 lbs (30,000 recovered)
8		***Product G***	*Product G crude process change*	282	6-In-place & On-going	*Product G crude process change*	N/Av	N/Av
9		**Acid Alcohols, Alkyl Halides**	***Acid Alcohols, Alkyl Halides***	283	6-In-place & On-going	*Different unit*	N/Av	N/Av
10		**Boilers**	Supply - align better with demand, less steam and energy wasted	29	1-Scoping	Boiler modifications or new boiler being considered.	N/Av	N/Av
11		**Capper Air Emission**	Install Thermal Oxidizer	284	6-In-place & On-going	Part of Project XL; started up 4/1/98	None	270,000 lbs/year
12		**Capper Methanol**	Recover and sell methanol for reuse	285	6-In-place & On-going	Part of Project XL; in place as of 10/17/97 [307-97-1]	$19,000 just from methanol sale. (500,000 / 6.6 lb/gal * $0.25/gal)	500,000 lbs/yr (esti
13		**CFC Emissions**	CNT / Esters Refrigeration Replacement	286	6-In-place & On-going	Replaced R-22 using unit with ammonia / IPA unit 9/9/97. [116-97-1]	HCFC and maintenance costs	8,000 lb/yr R-22 H
14		**CFC Emissions**	Replace CFC in Intermediates E-601 with HCFC	287	6-In-place & On-going	R-11 was removed, and Suva-123 charged into E-601 coolant loop on April 14, 1997. [149-97-1]	None	None; any losses ar less environmentall material

	W&E Rank	Wastes & Emissions	P2 Options	ID	Implementation Stage	Status Details [Internal P2 Activity Code is in brackets]	Potential Cost $$ Savings Neglecting Expense of Implementing Option	Potential Waste/ Quantity Redu
15		**CFC Emissions**	Replace CFC in NPD E-734 with HCFC	288	6-In-place & On-going	R-11 was removed, and Suva-123 charged into E-734 "Vilters" coolant loop on July 24, 1997. [449-97-1]	None	None; any losses ar less environmentall material
16		**CNT/Esters**	CNT / Esters Refrigeration Replacement - Improved Refrigeration	289	6-In-place & On-going	Replaced old refrigeration unit, better condenser performance; 9/9/97. [116-97-2]	None	2600 lb/year VOC emissions
17		***Product S***	Different unit	290	3-Implementing	*Different unit*	N/Av	N/Av
18		**HCl**	*Recover HCl from Continuous Process*	295	1-Scoping	*Recover HCl from Continuous Process*	N/Av	N/Av
19		***Product K***	*Different process*	296	3-Implementing	*Different process*	N/Av	Raw material effici increase of at least
20		**MeCl, CFC emissions**	New Poly I / NPD Refrigeration Unit	297	1-Scoping	Replace existing Poly I and NPD refrigeration units with a new modern ammonia refrigerant unit; in capital plan	N/Av	N/Av
21		***System 1***	Cleaning - improve procedure and eliminate dead areas in lines	172	1-Scoping	*Cleaning - improve procedure and eliminate dead areas in lines*	N/Av	N/Av
22		**Oil Sheens**	PetroGuard booms to prevent oil sheens to River	298	6-In-place & On-going	We are now using Petro-Guard in a boom or blanket form to absorb oil from the waste water treatment systems. This prevents oil sheens from escaping the WWTU into the River. Implemented 3/1998 [601-98-1]	Cost of booms per year about equal. Less labor cost for changing booms.	Low lbs per yr of oi 7000 lb of booms (new booms / year v of old booms; 48 fe 150 lb/set)
23		***Product M***	*Alcohol lights--why not feed to Unox?*	216	1-Scoping	*Getting samples and analyses of lights. Should be fairly pure. Investigating purifying. 9/14/98*	$10,000 /year (100,000 lb at $0.10 / lb kiln cost)	None
24		***Product M***	*Different process*	299	6-In-place & On-going	*Eliminates byproduct formation and emissions [204-97-2]*	None	162 lb/batch Ethyl
25		***Product M***	*Recover the alcohol if possible and reuse or sell*	217	1-Scoping	*Getting samples and analyses of lights. Should be fairly pure. Investigating purifying. 9/14/98*	$30,000 / year (100,000 lb/yr at $0.30 / lb) less cleanup costs	100,000 lb /year
26		***Product N***	*Uses for By-Product*	300	1-Scoping	*Investigating product applications for by-product*	N/Av	N/Av
27		***Product O***	*Different process*	301	1-Scoping	*Construction of new unit in capital plan; new process much more efficient*	N/Av	N/Av
28		***Product O***	*Uses for By-Product*	302	1-Scoping	*Investigating product applications for by-product*	N/Av	N/Av
29		***Product P***	*Modify equipment*	274	1-Scoping	*Project being scoped. 7/27/98*	N/Av	N/Av
30		***Product P***	*Venting revisit*	275	1-Scoping	*Project being scoped. 7/27/98*	N/Av	N/Av
31		***Product P***	*Different process*	276	3-Implementing	*Process to be implemented. Project kicked off 7/98.*	N/Av	N/Av
32		***Product Q***	*Different process*	306	1-Scoping	*Looking at different synthesis route*	N/Av	N/Av
33	1	**Process Water Use**	Cooling towers -- expand use to reduce water use	46	1-Scoping	New cooling tower for Poly I / NPD in capital plan ajv 9/23/98	N/Av	N/Av
34	2	**Waste Solvents**	*Different process for Product S*	303	3-Implementing	Less waste solvents, due to smaller unit	N/Av	N/Av
35	2	**Waste Solvents**	*System 3 -- Cleanup solvent mix change*	304	6-In-place & On-going	*Eliminate toluene from System 3 solvent cleanup mix. Implemented 12/1996 [104-97-1]*	$28,000 / year (107,000 lb at $0.10 / lb kiln cost plus 107,000 lb toluene raw material at $0.16/lb)	107,000 lb/year tol

	W&E Rank	Wastes & Emissions	P2 Options	ID	Implementation Stage	Status Details [Internal P2 Activity Code is in brackets]	Potential Cost $$ Savings Neglecting Expense of Implementing Option	Potential Waste/ Quantity Redu
36	2	**Waste Solvents**	Reclaim / reuse	259	4-Evaluating	IPA Recovery program is in place, however more IPA ought to be recovered than is. 6/98	N/Av	N/Av
37	2	**Waste Solvents**	Reuse of solvents -- last pass clean-up used for first pass on next batch / campaign	260	4-Evaluating	Is being done in some Poly I systems. Could do more?? 8/98	N/Av	N/Av
38	2	**Waste Solvents**	Solventless Copolymers	305	6-In-place & On-going	More products switched to solventless	N/Av	N/Av
39	3	**Drums**	Drumfilling and line flushing better methods in Poly II Drumfilling	307	3-Implementing	Drumfilling procedures in Poly II are being revised to reduce the amounts flushed to waste before drumming. 9/23/98	$34,000 / year Cost of drums (26 drums/week, * 52 wk/yr * $25 /drum) $7,000 / year Drum Disposal (26 drums/week, * 52 wk/yr * $5 lb/drum)	54,000 lb/year of d drums/week, 1350 drums/year, * 40 lb
40	3	**Drums**	Install line from Poly 1 to Poly 2 for HVO, use T-489	63	3-Implementing	Project in Engineering. 7/29/98	N/Av	N/Av
41	3	**Drums**	Totes: recycle one-way totes via tote supplier	81	6-In-place & On-going	We have sent back 52 from the plant to our supplier/recycler using their program. 8/4/98	N/Av	N/Av
42	3	**Drums**	Warehouse Layout Improvement	291	6-In-place & On-going	New layout of Warehouse reduces likelihood of overage products becoming wastes; reduces chances of damaging drums with forklifts	$15,000 / year in damaged drums; overage savings not quantified	24,000 lb/year of d ($15,000/yr * 40 lb $25 / drum)
43	4	**Drums #1 Product**	Drumfilling and line flushing better methods in Poly II Drumfilling	308	3-Implementing	Drumfilling procedures in Poly II are being revised to reduce the amounts flushed to waste before drumming. 9/23/98	$190,000 / yr Product Savings (8 dr/wk x 300 lb/dr x $1.50/lb x 52 wk/yr) $12,000 / yr Kiln disposal cost savings (8 dr/wk x 300 lb/dr x $0.10/lb x 52 wk/yr)	120,000 lb/yr Produ savings (8 dr/wk x 52 wk/yr)
44	4	**Drums #1 Product**	New Intermediates Drum Pad	292	5-Complete	Area to collect drums for recovery; facilitates recovery, lessens chance of material becoming a waste; enhance groundwater protection.	N/Av	N/Av
45	5	**Pallets**	Reusable plastic pallets for drum flush -- eliminate disposing 2,000 wooden pallets per year	177	3-Implementing	300 plastic pallets have been ordered and received 10/98. Plastic pallets can be reused many times in the drum flusher, , reducing the use of wooden pallets which must be disposed of. 9/24/98	Expense: $24,000 (300 plastic pallets x $79) Savings: $24,000 / yr (2,000 pallets/yr x $12/pallet)	200,000 lb/yr (2,00 pallets/yr x 100 lb/p
46	6	**Buckets & Lab Samples**	In- process analyzer installations	37	1-Scoping	In - Unit Testing AdHoc Team studying tests that may be performed by operators, or displaced by in-stream instrumentation. In stream instrumentation could potentially eliminate some samples; in-unit testing by operators may reduce sample size. 8/5/98	N/Av	N/Av

	W&E Rank	Wastes & Emissions	P2 Options	ID	Implementation Stage	Status Details [Internal P2 Activity Code is in brackets]	Potential Cost $$ Savings Neglecting Expense of Implementing Option	Potential Waste/ Quantity Redu
47	6	**Buckets & Lab Samples**	Operators run analysis on some samples in area	41	1-Scoping	In - Unit Testing AdHoc Team studying tests that may be performed by operators, or displaced by in-stream instrumentation. In stream instrumentation could potentially eliminate some samples; in-unit testing by operators may reduce sample size. 8/5/98	N/Av	N/Av
48	6	**Buckets & Lab Samples**	Product by Process	43.1	1-Scoping	Witco initiative to try to define products moreso a head of time by the process that makes them, and less so by analysis after-the-fact. 9/23/98	N/Av	N/Av
49	7	**Filtercakes**	*Different process for Product R*	293	3-Implementing	Filter cartridge vs. filter press	N/Av	N/Av
50	7	**Filtercakes**	NPD Filtration Improvements	294	6-In-place & On-going	Eliminate use of filteraids during filtration and reduce solvents needed to clean filter, by changing to cartridge filters. [405-97-1]	N/Av	N/Av
51	7	**Filtercakes**	Plate / frame filters - eliminate, replace	118	1-Scoping	K-3/K-5 Filter Replacement project -- looks like large cartridge filter system will not work technically; eventual solution would improve safety, might reduce filtercake waste loads; results could apply to other process units -- 8/11/98	N/Av	N/Av

N/Av = Not Available

9.2.3 Priority #3 -- Create A P2 "Evergreen" List On Computer Network

High priority will be given to creating and installing on the computer network (plant common "N" drive), a prioritized list of waste problems along with a list of p2 projects which have been proposed in order to resolve those problems. The prioritized list of waste problems will include, a description of problem, lbs. of waste generated (and/or potential to be reduced), $$ lost or to be saved, and environmental impact. It is believed that this will help establish and perpetuate awareness of needs for resources to implement p2 options. The usefulness and accuracy of information provided by this list will be enhanced by implementation of a system to drive costs to the department, process or product -- as discussed in the next section.

9.2.4 Priority #4 -- Establish System To Better Drive Costs To The Department, Process or Product

Another programmatic p2 option, deserving high priority attention, is development of a system to better drive costs to the department, process or product. OSil's current systems do this only at a very high level. There is a significant quantity of liquid and solid wastes for which it is not easy to use the existing data collection system in order to assign the source of the waste back to a particular product or process unit. In the past, such waste tracking has not been necessary for waste management purposes.

The importance and true value to be derived from improved systems to drive environmental costs to the department, process or product has become increasingly evident as a result of this WM/PP study. Participants frequently have suggested that this is critically important to encouraging p2. Just a few of the examples mentioned by participants include:

- evaluating true costs/savings of a p2 project would help with evaluation of ROI
- highlighting costs to decision makers
- understanding gross margin by product would allow us to prune low margin products, increase capacity

The results tend to support the philosophy "that which is not measured is also not managed." Reliable "real time" information on waste and emission ***sources*** is essential to establish credible and practical metrics for setting priorities, tracking progress, communicating results, and to encourage continual assessment and improvement.

The following is offered just as examples of opportunities and issues, which may be considered for enhancing the site's materials, emissions and waste tracking management procedures:

- Installation of a computerized barcode system which can track waste from the point of generation through disposal.

- Any materials, emissions and waste tracking management system must be simple yet reliable, easy to operate, user-friendly, flexible, and comprehensive yet limited to the collection and reporting of relevant and important statistical data to support the facility-

specific pollution prevention program.

- A facility's baseline statistics on purchasing, waste generation, and recycling are important for the development of any pollution prevention plan. Such baseline information allows for assessment of pollution prevention opportunities, contributes to the establishment of priorities for action, and helps define the impact of pollution prevention initiatives.

Appendix AP (4/c/progop1.xls) provides a complete list of all implementation strategy recommendations for programmatic p2 options offered by participants in brainstorming session #4. A consolidated summary of those specific to the "economics" category, is given **Table 9-6**. Recent implementation of all new information and accounting systems may delay allocating resources to this work for the near future.

TABLE 9-6
IMPLEMENTATION STRATEGY RECOMMENDATIONS --
PROGRAMMATIC P2 OPTIONS -- Economics

Establish P2 Team For.....	Description Of The Action Required What	Departments & Locations Where	Purpose/Goal Why	Schedule When	Persons Responsible Who	Resources & Other Requirements How
ECA -- Costs driven to department or process	• Incorporate ECA (Environmental Cost Analysis) into procedures & economic reviews • Determine means to drive costs to plant processes and implement • Evaluate other economic programmatic p2 options	Plantwide	• Evaluate true costs/savings of a p2 project which would help with evaluation of ROI • Determine actual product costs • Highlighting costs to decision makers • Understand gross margin by product to prune low margin products, increase capacity	?	• Accounting Department • Department managers Operations managers	• Training • Departments technical • IS
	• negotiate longer contract as incentive to develop more efficient process	All 3 businesses	• Improves impetus Share economic incentive/savings to reduce waste	9/98 Business Team mtgs (Has been done.)	• R&D Director	• Present idea (slides)

9.2.5 Priority #5 -- Enhance Employee Communication & Education

Communication of information is essential when implementing any program that involves all levels of employees. Employees should be routinely reminded of the program goals and accomplishments in order to feel part of the program and to understand how they can affect goals and accomplishments.

Opportunities will be examined in an effort to continue and expand the site's efforts to educate and involve its employees in order to further broaden the base of pollution prevention emphasis from environmental specialists to all site personnel. In this way pollution prevention thinking and action will become further integrated and institutionalized into the current best approaches and continuous improvement process for managing all site business.

Opportunities and benefits of creating multiple topic-specific source reduction teams to address high priority goals of the plan will continue to be examined. Creating integrated evaluation teams comprising employees and management with direct responsibilities and knowledge of particular process operations is one effective approach to identify and implement additional source reduction opportunities.

Efforts will be continued and expanded to create an environment of support and encouragement for the development of new source reduction ideas by individual employees. The facility employees themselves can be encouraged to further develop pollution prevention ideas, identify solutions, and implement actions to achieve results. In many ways, facility employees are best qualified for this purpose, and "employee ownership" of the pollution prevention program's outcome is often crucial for implementation success.

A proactive, on-going employee education and involvement program is vital to the success of any source reduction program. Employees cannot be an effective part of a pollution prevention program unless they know the source reduction components of their workplace. Emphasis will therefore be given to considering an on-going employee education and involvement program designed so that employees:

- Gain a heightened awareness regarding the potential impact of waste management practices on business operations.
- Understand the source reduction "way of thinking" or "problem solving approach" to waste management — with special emphasis on the difference between the source reduction versus the end-of-pipe treatment approach.
- Understand how to participate and be motivated to take part in source reduction activities.
- Are informed as to the results of their source reduction efforts -- sharing such information with employees can allow them to see how their individual and department efforts contribute to the facility's overall environmental goals.
- Are encouraged to make suggestions for new source reduction initiatives.
- Are recognized and given credit for proactive environmental actions and ideas.

Appendix AP (4/c/progop1.xls) provides a complete list of all implementation strategy recommendations for programmatic p2 options offered by participants in brainstorming session #4. A consolidated summary of those specific to the “employee communication and training” category, is given **Table 9-7**.

TABLE 9-7

IMPLEMENTATION STRATEGY RECOMMENDATIONS --
PROGRAMMATIC P2 OPTIONS -- Communication & Implementation

Note: These are only suggestions from brainstorming groups.
The ideas and timing need to be more carefully evaluated before action will be taken.

Establish P2 Team For.....	Description Of The Action Required What	Departments & Locations Where	Purpose/Goal Why	Schedule When	Persons Responsible Who	Resources & Other Requirements How
Employee Communication & Education	• Presenting data (product specific) on p2 projects and status		• Educate higher mgt. & gain support for p2 projects	At scheduled bus. team mtg.	• Ops Mgrs	• TBD by P2 Council
	• Design and implement a means for employee communication	Plantwide	• Change our culture around p2	begin implementation by 12/31/98	• P2 Council - initially	
	• banners, reminders, announcements (similar to safety program) • plant mgr letter out 4Q98 to start filtering down process to opts	Plantwide	• Raise awareness of p2 in everyday operations - encourage p2 in thinking	ongoing - plant mgr letter out 4Q98	• Dep. team leaders; P2 Council;	
	• Bring total understanding of p2 to all plant personnel	Plantwide	• Gain buy-in, ownership, cooperation	EOY 1998	• P2 Council	
	• Various communication & education efforts	Plantwide	• Raise awareness. Increase use of UCR/Env. Forms • Communicate to 100% of people -- more is better!	4Q; Get info to people in a more timely fashion - faster is better	• P2 Council	
	• P2 hierarchy project list	Plantwide	• Establish & perpetuate p2/source reduction awareness	ongoing	• P2 Council	
	• Quarterly presentation on p2 progress by management	Plantwide	• Communicate to 100% of people; show mgmt commitment • Maintain awareness	Quarterly	• Plant Mgr • Ops Mgrs • R&D? • P2 Council?	
	• Programs and initiatives to promote employee ownership/empowerment	Plantwide	• Promote ownership & empowerment & instill pride in plant	As necessary but at least annually	• Plant Mgmt.	

9.2.6 Establish P2 Teams For Evaluating & Implementing Remaining Priority P2 Options

The following sets forth additional implementation activities and actions suggested to continue this WM/PP Study within the context of an on-going, facility-wide p2 program. Although numerous p2 options have been determined to be feasible as a result of this study, there are many other unique p2 options for which the technical and economic evaluation is not yet complete. It is therefore suggested p2 teams be established to complete the analysis of the remaining p2 options, and to develop a comprehensive p2 implementation strategy specific to that issue. These will include those for implementing the following:

- Remaining priority programmatic p2 options
- Remaining priority product/process specific p2 options
- Remaining priority top-tier generic p2 options

The following discussion does not suggest an order of priority for implementing these remaining actions. Establishing such priorities will be the responsibility of the new site P2 Council.

REMAINING PRIORITY PROGRAMMATIC P2 OPTIONS

Throughout this study, certain programmatic p2 options have consistently been identified as critical to ensure implementation of p2 activity is sustained and eventually integrated into ordinary business practices site-wide. **Appendix AP (4/c/progop1.xls)** provides a complete list of all implementation strategy recommendations for programmatic p2 options offered by participants in brainstorming session #4. Section 9.2 provided implementation recommendations related to the following two programmatic p2 option categories

- Determining means to drive costs to the department, process or product
- Employee communication and education

Remaining priority programmatic p2 options include:

- Incorporating p2 in process design and process modifications
- Incorporating p2 in the ZRI program
- Employee incentives for pursuing p2 solutions

It is worth noting the participants believed incentives were least- and un-important, because most employees are already self motivated to do the right thing environmentally.

A consolidated summary of implementation strategy recommendations from brainstorming session #4 for these remaining priority programmatic p2 options is given in **Table 9-8**.

TABLE 9-8
IMPLEMENTATION STRATEGY RECOMMENDATIONS --
REMAINING PRIORITY PROGRAMMATIC P2 OPTIONS

Note: These are only suggestions from brainstorming groups.
The ideas and timing need to be more carefully evaluated before action will be taken.

Establish P2 Team For.....	Description Of The Action Required What	Departments & Locations Where	Purpose/Goal Why	Schedule When	Persons Responsible Who	Resources & Requirements How
Incorporating p2 in process design & modifications	• P2 hierarchy must be established in new product development	R&D w/NPD, Engineering assistance	• Ensure new products, processes minimize waste generation, optimize use of waste generated	by 12/31/98	• Process R&D	• Primarily peoples time
	• Develop a reproducible product process with focus on p2	Plantwide	• Incapable process causing reject/waste generation	EOY 1998	• Process R&D	
	• P2 hierarchy project list -- see option PR01	On computer network	• to maintain awareness of needs	ongoing (P2 council agenda)	• P2 Council	
	• Modify FOCR procedure to include wastes		• Prevent changes that might increase wastes without understanding impact		• Dept team leaders • Environmental Review Board or P2 Council	
Incorporating P2 in ZRI	• Examine list of possible p2 options	Plantwide	• Add p2 focus to ZRI program			
Employee P2 Incentives	• Include p2/SR goals in GICP • Examine other p2 options	Plantwide	• increase awareness & ownership	next yr & ongoing	• Plant Manager	• TBD by P2 council

REMAINING PRIORITY PRODUCT/PROCESS SPECIFIC P2 OPTIONS

Previous ranking efforts identified **fourteen** product/process specific wastes, which deserve priority attention with regard to p2 options implementation. **Appendix AQ (w&e_opt.xls)** provides a complete list of all implementation strategy recommendations for product/process specific p2 options offered by participants in brainstorming session #4. A consolidated summary is given **Table 9-9**.

TABLE 9-9

IMPLEMENTATION STRATEGY RECOMMENDATIONS -- REMAINING PRIORITY PRODUCT/PROCESS SPECIFIC P2 OPTIONS

Note: These are only suggestions from brainstorming groups.
The ideas and timing need to be more carefully evaluated before action will be taken.

REDACTED BUSINESS CONFIDENTIAL INFORMATION ARE IN ITALICS

Waste Category	Establish P2 Team For.....	ID	Description Of The Action Required What	Departments & Locations Where	Purpose/Goal Why	Schedule When	Persons Responsible Who	Resources & Other Requirements How
Product A	Installing a dedicated unit and	4	• *Catalyst recovery*	silanes ---- could we filter out in the CUNO	• recover catalyst			
	Catalyst recovery	5	• *installing a dedicated unit for Product A* • *Special reactor*		• will give better selectivity and reduce heavies	in capital plan		
Product C	Alternate process	11	• *R&D program to evaluate continuous reactions in pilot unit*		•		•	•
Boilers	Examining condensate return and boiler Alignment	23	• examining condensate return – maybe from big users	large users such as Poly I & II, Esters	• save $ on water treatment and energy -don't have to raise heat as much	eng. anal. --- IRR anal.	• Plant engr & energy sys. engr	• time
		29	• examining boiler alignment • align supply better with demand, less steam and energy wasted	energy systems	• reduce energy losses - currently water is filtered, softened, treated, heated and then thrown away.	Develop team ASAP	• energy sys. Engineer	• time to analyze
K62-K63	new esters filters	131	• replace esters filters	Silanes K-63/K-63	• eliminate large solvent use for cleaning filters	12/99 possible	• Engineering Silanes	• money • time
Kiln	Removing solids from kiln effluent & recycle	142	removing solids from kiln effluent & recycle water around the quench	EP	• reduce demand on plant water supply	trial by 9/99	• EP • Engineering	• R&D support • capital • engineering for design
System 1	***System 1***cleanup	172	• Improve procedure and eliminate dead areas in lines	NPD	• more efficient distillation - less time between products - less backup	ASAP, when $ in budget	• NPD engineers / dept. head	• $$$
Product M	***Product M*** lights	216	• Treat alcohol waste in Unox	polymers 1, EP, R&D	• Ttreat ethanol in Unox system		• EP Proc R&D	• Time
		217	• recover ethanol via absorption of contaminants	Poly 1 -- migrate elsewhere if possible	• recycling of ethanol • cost savings	by 12/31/98	• Process R&D	• Time for R&D experimental work • $ for equipment and material if it works
Product P	*Modify equipment*	274	• Modify equipment		•	Scoping	•	•
		275	• Venting revisit		•	Scoping	•	•
	Different process	276	• Different process		•	will be done	•	•
Product L	*Heavies recycle*	277	• hold heavies from last batch & recycle to first batch of next campaign	Poly I	• waste elimination, cost savings	by 12/31/98	• Process R&D • Poly I	• time • a vessel to hold heavies

It is believed that work on some of these p2 option categories can and should proceed simultaneously, and that work in many areas should be well underway by the end of the year 1998.

REMAINING PRIORITY TOP-TIER GENERIC P2 OPTIONS

Previous ranking efforts identified **six** generic wastes, which deserve priority attention with regard to p2 options implementation (designated as the "new" top tier). As explained in Section 7.5.2, participants during brainstorming session #4 also selected their "1st priority" p2 options for the new six top tier generic wastes, and provided implementation recommendations for those "1st priority" p2 options. **Appendix AR (w&e_opt.xls)** provides a complete list of all implementation strategy recommendations for generic p2 options offered by participants in brainstorming session #4. A consolidated summary is given **Table 9-10**.

It is believed that work on some of these "1st priority" top tier generic p2 options can and should proceed simultaneously, and that work in many areas should be well underway by the end of the year 1998.

In addition, many of the "2nd priority" top tier generic p2 options deserve further evaluation. It is therefore suggested that the p2 teams which are established in order to implement the "1st priority" options should also at the same time complete the analysis of the remaining associated "2nd priority" options. In this way, a more comprehensive p2 implementation strategy will be developed specific to that top tier generic waste.

9.2.7 Priority #7 -- Establish P2 Teams For Evaluating & Implementing Middle-Tier Generic P2 Options

In addition to the six "top-tier" generic wastes, numerous p2 options were also identified for the five "middle-tier" generic wastes. Implementation strategy recommendations were not yet developed for these p2 options. Rather it will be the responsibility of the P2 Council to convene p2 teams for this purpose. **Appendix X (w&e_opt.xls)** provides a complete list of middle-tier generic p2 options.

9.2.8 Priority #8 -- Revisit P2 Options For Bottom-Tier Generic Wastes & Emissions

A few p2 options were identified for the "bottom-tier" generic wastes, however this was not a focus effort of this WM/PP study. It is therefore recommended that the activity of identifying, evaluating and implementing p2 options for bottom tier generic wastes & emissions be revisited during a future repeat of this WM/PP study effort. **Appendix Y (w&e_opt.xls)** provides a complete list of p2 options identified for bottom-tier generic wastes and emissions.

TABLE 9-10

IMPLEMENTATION STRATEGY RECOMMENDATIONS --
REMAINING PRIORITY TOP-TIER GENERIC P2 OPTIONS

Waste Category	Establish P2 Team For.....	Description Of The Action Required What	Departments & Locations Where	Purpose/Goal Why	Schedule When	Persons Responsible Who	Resources & Other Requirements How
Process Water Use	Programmatic water conservation	• determine why hoses are running • examine other process water use p2 options	Plantwide	• hoses may be running for valid reasons	one of first P2 Council projects	• team of operators; ES engineers	• TBD by P2 Council
		• add water conserv. & utility use to Env. Rev. Board charter for future projects	Plantwide - mainly silanes	• reduce need for a new well			
	investigating cooling water quality	• remove algae, solids & dissolved solids -- define what is needed • examine other process water use p2 options	Plantwide	• water quality causing many inefficiencies	start now	• team – operators, ES, engineers	
Waste Solvents	planning production, sequencing	• plan production for longer runs and product sequencing	Plantwide	• reducing cleanups reduces solvent usage		• supply mgmt. & business teams	• Total cost analysis on opera just in time mode. Compar economics. Up time analys
	Reviewing criteria, equip. and methods used for acceptable clean-up	• for new product cleanup procedures & criterion offline for new chemicals • all cleanup criterion are reviewed for applic. and methods defined for min. acceptance and chemicals • review procedures & provide training as means to reduce solvent use	Plantwide	• reduce cleaning time & solvent usage -- improve product quality	by 1/31/98	• R&D tech staff	•
		• reduce solvent use by using spray nozzles/pumps for cleanups • This is done now in Poly-2 on some systems	all production departments / EP (dumpsters)	• reduce solvent amt. used to clean production equipment & reduce amt. of time for cleanups		• production engr / specialist & engineering	• capital for design/purchase installing testing equipment in use of equipment
	evaluating options for solvent reuse and recycle	• establish solvent recovery system - dedicated tanks capture/reuse solvent cleanups in dedicated systems	Poly-1, Poly-2, silanes, NPD	• reduce solvent purchased for cleanups and/or production	evaluation to be completed for one dept. each 6 months	• dept leaders (format & tag), R&D, quality mgr.	• capital needed to install rec systems (e.g. IPA recovery) • Peoples time to analyze sit • Analytical data will be need • Would be a good project fo intern. Customer notificati
		• recovery -- reuse of clean-up solvents • separate solvents; filter material	Plantwide	• save money on disposal costs & virgin solvent purchases		• production -- R&D	• funding for solvent recovery that is already engineered • commitments from opns. to cleanups to make recycling more attractive
Drums	Reducing waste drums	• buy selected raw materials in bulk • buying and using more dumpsters • examine other p2 options to reduce waste drums	Plantwide	• reduce number of drums		• purchasing, production, distribution	•

TABLE 9-10 (Continued)
IMPLEMENTATION STRATEGY RECOMMENDATIONS --
REMAINING PRIORITY TOP-TIER GENERIC P2 OPTIONS

Waste Category	Establish P2 Team For.....	Description Of The Action Required What	Departments & Locations Where	Purpose/Goal Why	Schedule When	Persons Responsible Who	Resources & Other Requirements How
Drums #1 Product	Reducing Drum 1's waste	• longer campaigns	Plantwide	• reduce wastes -- less drum 1's		• bus. mgrs. opns . mgrs. dept. heads	
		• better cleaning and flushing methods • study how much flush needed	Plantwide	• reduce waste -- drums and product	9/1/98 -- change notes	• dept. heads, warehouse engr	•
		• Sequencing compatible products when drumming	Plantwide	• reduce waste -- smaller number of drum 1's	9/1/98 -- change notes	• dept. heads	• foreman schedule drumming as to minimize cleanup betv
		• Selling drum 1's	Plantwide	• reduce waste		• sales people, lab.	
		• Sampling drum 1's and blending	Plantwide	• to save cost of disposal		• production engineers	• follow most procedures alre place
Buckets & Lab Samples	In process/ in unit testing and analysis, sampling	• Determine where in-line testing is appropriate, determine where in-unit testing is appropriate; Implement in-line or in-unit testing where feasible	Plantwide	• Eliminate sample, increase throughput and efficiency	partial implementation by 3Q99	• Ad-hoc team already formed	• R&D lab resources to evalu effectiveness, suitability; • $ for analytical equipment; • time to implement
		• Evaluate where in line sampling can be applied	Plantwide	• Eliminate sample waste	Run concurrent with in process/ in unit testing	• Unit engineers, lab	• Peoples time • $ for sampling devices
	Product by Process	• Define process parameters which influences product quality; operate within those parameters	Plantwide	• Eliminate need for samples	Initiate by 2Q99	• Unit engineers, R&D, QA, Engineering, Maintenance	• Time • Money
	Reducing sampling frequency & volume	• evaluate where frequency, volume of sampling can be reduced •	Plantwide	• Eliminate sample waste	by 12/31/98	• unit engineers, lab, and QA	• Time for personnel involvec • potentially buying new sam containers
		• Develop a means of sharing one sample between all labs	Laboratory	• Eliminate sample waste	by 12/31/98	• Lab manager	• Time
Filtercakes	filtration evaluation	• evaluate type & efficiency of filters throughout the plant to reduce amount of filtercake & product loss	Plantwide	• throwing away product is throwing away money.	1 year -- for large volume	• R&D, UA, fluids, silanes operators /engr quality	• TBD by P2 Council
		• evaluating filter changing	energy sys. -- air filtration	• evaluate necessity of changing air filters on predetermined schedule	immediately	• Don Archer	• timers? • quality of air
		• evaluating QA/QC customer requirement	manufacturing reps., sales	• loosen requirements for filtering	ASAP	• marketing & quality	• time

10.0 IMPLEMENT, MONITOR & COMMUNICATE RESULTS... AND REFINE & REPEAT PROCESS

This chapter provides a few comments regarding the final elements of a conventional WM/PP assessment. These are:

- Implement, monitor & communicate results
- Refine & repeat process.

In addition, at the conclusion of this chapter, we offer a brief, concise summary of OSil's and STV's significant observations made regarding the WM/PP process itself.

10.1 IMPLEMENT, MONITOR & COMMUNICATE RESULTS

In order to gain the identified benefits, the best recommendations of the program must be implemented. For some options, changes in operating procedures, including changes in purchasing procedures for raw materials, may be needed. These options can often be implemented through modifications to existing "standard operating procedures" combined with careful training on the new procedures, and follow-up to ensure new procedures are carried out. For other options, revised approval procedures for new projects, products, or purchase of new raw materials, may be needed. Installation of new equipment or production processes will typically follow standard design, specification, bidding, contractor selection, and construction procedures already established for facility projects. In the final analysis, management commitment and employee participation will be vital for implementing a successful p2 program.

10.1.1 Management Commitment

The most successful pollution prevention programs result when the program is institutionalized into the facility's on-going continuous improvement process. This in turn requires on-going continuous management commitment to provide necessary resources to support pollution prevention activities.

Even an excellent pollution prevention project may have to compete for scarce time (people) and financial resources against several other important projects -- many of which may provide other valuable benefits such as new jobs, improved process safety, and improved product quality. As a result, management must set priorities.

This is not to say that pollution prevention should supersede all other priorities -- it should not. Rather management should establish an appropriate priority for pollution prevention, and must actively communicate to all employees its commitment to that priority.

Indeed, simply communicating commitment to pollution prevention as ***one of several important priorities*** will serve to raise all employees' awareness level regarding the importance of pollution prevention. In turn, many facilities find that individual employees then help to identify pollution prevention options, which concurrently satisfy numerous other facility priority needs.

As evidenced by "best-in-class" facility-level pollution prevention benchmark facilities, to be successful, pollution prevention must be a core value at the facility -- beginning with management.

The implementation plan set forth in **Chapter 9** offers several actions related to the issue of management commitment. These include:

- Establish an on-going site P2 Council -- with substantial management commitment reflected in its membership and charter.
- Implementing the economic programmatic p2 option will help highlight the true environmental costs for the business decision-makers
- Implementing the employee communication & education programmatic p2 option will both
  - educate higher management and gain support for p2 projects by presenting product specific data on p2 projects and status at scheduled business team meetings
  - communicate management commitment to all employees through quarterly presentation on p2 progress to employees by management.

10.1.2 Employee Involvement

The critical importance of employee involvement cannot be overemphasized. Employee involvement is critical for successful implementation of the WM/PP program results. Efforts should be continued and expanded to educate and involve site employees in order to further broaden the base of pollution prevention emphasis from environmental specialists to all site personnel. In this way pollution prevention thinking and action will become further integrated and institutionalized into the current best approaches and continuous improvement process for managing all site business.

Again, employee communication and education is a very significant programmatic p2 option recommended for the implementation strategy set forth in **Chapter 9**. In addition, the site P2 Council membership is intended to be well rounded, representing many plant functions and all businesses. Furthermore, a substantial component of the implementation plan is continuing implementation actions which rely on the establishment of employee p2 teams to further evaluate and implement many of the remaining priority p2 options.

10.1.3 Monitor Results

In order to know whether the identified benefits have actually been realized, the progress of the program must be monitored and documented. Measuring progress is a basic and vital tool for evaluating current and past programs, and helpful for developing future ones. Opportunities which continue and expand efforts to track and communicate pollution prevention progress will be actively pursued, again in recognition and support of the philosophy “that which is not measured is also not managed.”
An important element of the site P2 Council Charter is to ensure that p2 progress is tracked and communicated. Other important p2 monitoring related implementation actions set forth in **Chapter 9** include:

- the "economics" programmatic p2 option for the development of a system to drive costs to the department, process or product will encourage the development of methods to measure p2 progress

- regarding the establishment of employee p2 teams to further evaluate and implement many of the remaining priority p2 options, one of the key requirements of the employee p2 teams is to "develop method/mechanism to measure/monitor/document/communicate p2 progress/results" related to implementation of that p2 option.

10.1.4 Communicate Results

Obtaining commitment and support generally is a product of good communication. When people are made aware of the importance of environmental compliance and waste reduction, realize how effectively they can contribute to the cause, and how easy it is to contribute, most will cooperate.

Remember, environmental compliance through improved environmental management systems requires a new attitude about pollution control. The new focus makes it everyone's' responsibility. It will be the employees themselves who must make it succeed in the workplace. Management commitment and employee participation are vital for promoting attitude changes and implementing a successful environmental management program.

Discussion can be held with appropriate persons, such as office managers and industrial supervisors. When appropriate, group meetings can be held, with discussions led by management representatives and operating/maintenance personnel. Memoranda, bulletins, newsletters, and posters can also be effective communication tools.

Facility personnel should also be advised on progress as it is achieved. Again, meetings, graphs illustrating success posted in employee break areas, newsletters, and employee recognition programs can be very effective to encourage on-going participation and support for the program.

Basic attitude change is at the heart of expanding voluntary environmental compliance. Changing basic attitudes takes time and cannot be achieved overnight. However, the process of changing attitudes must begin, and environmental management must become an on-going, integral part of the day-to-day business decision-making process.

Four of the first five priority implementation actions described in **Chapter 9** relate substantially to the issue of communicating results. Communicating results is an important component of...

- the on-going site P2 Council Charter
- installing a p2 "Evergreen" list on the computer network
- developing a system to drive costs to the department, process or product
- employee communication and education.

10.2 REFINE & REPEAT PROCESS

As stated previously, the p2 assessment process should be viewed as a "work-in-progress." The process itself should be subject to on-going review and evaluation, and refined as necessary for continuous improvement.

Finally, the assessment process should be repeated periodically. Environmental compliance requirements change. Production processes change. The costs of waste management increase yearly. New technologies and waste reduction practices are developing rapidly. Repeated p2 assessments will identify new waste reduction options previously missed or considered too costly. P2 should become an ongoing part of doing business.

It will be the responsibility of the P2 Council to determine when the process should be repeated. A tremendous quantity of information has been generated during the performance of this WM/PP Study. It is believed that at least one year will be required to make sufficient progress implementing the results of this study before considering repeating the process. It will be necessary at that time to revisit the "Plan and Organize" section of this report (**Chapter 3**).

10.3 OBSERVATIONS ABOUT REGULATORY BARRIERS TO AND INCENTIVES FOR P2

During the course of this study, several suggestions have been raised concerning how federal or state regulations can or do inhibit industry efforts to pollution prevention. We offer the following ideas as food for thought for the regulatory community.

- Make the XL process more user-friendly, less expensive and a faster process. This is the biggest barrier to more participants. We are aware that EPA is working with various stakeholders, including OSil, to improve the XL process.

- The time involved in permitting at both a state and federal level is too long to effectively make changes to meet market demands. All design work needs to be completed before an application can be submitted and facilities take chances if they proceed with equipment purchases prior to permit issuance.

- The mixture and derived-from rules regarding Hazardous Wastes codes are a disincentive to reusing or recycling materials. For instance, the Sistersville Plant recycles a large portion of its process sewer wastewater back to the plant's scrubbers. The WV DEP has recently informed us that they believe that if any recycle water leaks onto the ground, that water and soil are interpreted as being hazardous wastes, due to landfill leachates and incinerator water effluents flowing into the process sewer. Such potential consequences may discourage other facilities from implementing water recycle programs.

- Hazardous waste permitting regulations can be a barrier to facilities interested in recycling. A materials recycler must be permitted under RCRA in order to process and recover useful products from a waste that happens to be classified as a Hazardous Waste. Many facilities

prefer to remain out of the RCRA program and its permitting and regulatory complications. Hence, it can be difficult to find recyclers.

- The definition of Hazardous Waste can cause significant regulatory difficulties where no practical, common sense, distinctions exist. Among the definitions of a characteristic flammable waste (D001) is a liquid with a flash point less than 140ºF. This means that a drum of otherwise non-hazardous solids, with a small layer of free liquid on top, which liquid has such a low flash point, is a Hazardous Waste. Conversely, a similar drum of solids with the same liquid totally absorbed, is non-hazardous. Recyclers who are not permitted to handle Hazardous Wastes could accept the drums without free liquids, but not those with free liquids.

- Environmental protection, and pollution prevention, must be encouraged across all media. For instance, the Sistersville Plant has been required under wastewater regulations to strip small amounts of pollutants from its wastewater into the air. This is counter to most peoples' common sense. If only the regulations would have allowed it, the plant could have implemented much more environmentally beneficial projects, rather than spending money and effort on installing and operating the strippers. Project XL itself could be a successful vehicle to achieving such common sense solutions to environmental concerns.

- Placing additional RCRA restrictions (Subparts AA and BB) on organic (e.g. solvent) recovery processes over and above those that are likely required under the CAA (NSPS's) is a deterrent. For example, a methanol recovery still could be regulated by AA and BB as well as a CAA standard. The hassle of having to interpret/comply/document etc. under more that one rule is not worth the effort at times.

- Requiring RCRA permits for some types of recovery processes will stop them from proceeding.

- Difficulty in reading and interpreting regulations and the fear of missing something can be a roadblock for trying to put together a successful project. Simplify the regulations and standardize interpretations (region to region and state to state) in order to give industry a comfortable feeling that all applicable requirements have been identified. Spending thousands of consulting and legal dollars to tell a facility what regulations apply to it should not be necessary.

- CAA NSPS Subpart YYY as currently proposed (and potentially applicable to process changes made since 1994) may require controls on WWT systems upon construction of a waste recovery/recycle operation. This is a disincentive to implementing p2 projects.

- Incentives from the government (e.g. tax breaks) for recovered/recycled or reduced volumes of waste may raise more interest from industry.

- Fear of inviting EPA into your facility can stifle ideas. If regulators would be more willing to come in and work with industry jointly to identify problems and opportunities, we would be much more receptive to their visits. Fear of regulators discovering violations and leading to enforcement actions keeps us from working as partners.

- More recognition from EPA and the state for a job well done gives us incentive to look for more or to keep up with our peers.

10.4 SIGNIFICANT OBSERVATIONS

As stated, this report provides a comprehensive summary of the process and results of a Waste Minimization Pollution Prevention (WM/PP) Study recently completed at Witco Corporation OrganoSilicones Group's (OSil) specialty chemicals manufacturing plant located near Sistersville, West Virginia. In general, this report has provided, as called for in the Project XL Final Project Agreement, the following:

- The results of the WM/PP Study;
- Identification of the WM/PP opportunities OSil has determined to be feasible;
- Discussion regarding the basis for excluding other opportunities as not feasible; and
- Recommendations as to whether the WM/PP Study should be continued.

Of special value for the purpose of refining and repeating the WM/PP study, are significant observations regarding the WM/PP process itself. The following provides a brief, concise summary of those observations.

♢Involving facility-level personnel "up-front", even in the development of the ***process*** itself, is valuable. This involvement will, we believe, in the long run help to instill a facility-level culture in which individual employees are trained and empowered to continuously identify and implement new p2 opportunities and strategies... thereby helping to continuously improve upon the facility's already excellent environmental performance record.

♢Employee brainstorming sessions in which a broad spectrum of site functional areas, departments and activities are consistently represented are a key component of the process.

♢ The employee brainstorming sessions themselves served as a valuable tool for employee training on p2. They also provided increased awareness to many participants regarding other plant operations.

♢ It is time well spent to ensure ample instruction is provided for each small group breakout brainstorming activity. Specific examples are helpful.

♢ It is time well spent to ensure time is set aside for report-outs from the small group breakout brainstorming activities.

♢ Insufficient time was provided for the generic p2 options screening small group breakout brainstorming activity. Either a reduced number of p2 options should have been presented to be screened, or the amount of time dedicated to this activity should have been increased.

- ◊ To be effective, this approach requires a significant investment of site employee time resources...especially that of employees with a high level of knowledge regarding production processes and site operations. Up-front management support to commit these resources is essential.

- ◊ Obtaining funding for new initiatives can be a challenge. Developing creative funding mechanisms, especially those that only involve variations to existing funding mechanisms, may be an effective approach to address this challenge.

- ◊ A tremendous quantity of detailed information is often available, and substantially more is often generated during the process of performing a p2 opportunity assessment. The tendency is ever present on the part of many participants to "over analyze", or attempt to incorporate all available information into a perfect and comprehensive analysis. Such over analysis will typically serve to paralyze the process. It is necessary to be diligent to ensure that the entire process does not become overwhelmed by detail.

- ◊ Expertise availability is also a reason for not identifying and pursuing ideas. More organizations like the WRATT Foundation, who can provide educated suggestions at low cost, are needed.