



Waste Minimization Workshop

Speaker Slide Copies

Notice

This material was prepared under contract to an agency of the United States Government. Neither the United States Government nor any of its employees, contractors, subcontractors, or their employees makes any warranty, expressed or implied, or assumes any legal liability or responsibility for any third party's use of or the results of such use of any information, apparatus, product, or process disclosed in this material, or represents that its use by such third party would not infringe on privately owned rights.

THE AUDIT PROCESS

Presented By:

Robert Pojasek, Ph . D .

ChemCycle Corporation

NOTES

AUDIT vs. OPPORTUNITY ASSESSMENT

- Work with management commitment
- Set overall assessment program goals
- Organize assessment team

NOTES

ASSESSMENT TASKS

- Staff assessment team
- Collect process and facility data
- Prioritize and select assessment targets
- Conduct site visit
- Communicate findings

NOTES

EPA WORKSHEETS

- Assessment team
- Site description & personnel
- Input materials summary
- Products summary
- Waste stream characterization
- Waste stream summary
- Option generation

NOTES

SARA SECTION 313(1)

(4) Mass Balance Definition

For the purpose of this subsection, the term "mass balance" means an accumulation of the annual quantities of chemicals transported to a facility, produced at a facility, consumed at a facility, used at a facility, accumulated at a facility, released from a facility, and transported from a facility as a waste or as a commercial product or by-product or component of a commercial product or by-product.

NOTES

STAFFING THE ASSESSMENT TEAM

- ◆ Facilities, environmental & process engineering
- ◆ Safety & health
- ◆ Materials control/scheduling
- ◆ Product/QA
- ◆ Purchasing

NOTES

STAFFING THE ASSESSMENT TEAM

(Continued)

- ◆ Legal
- ◆ Finance/accounting
- ◆ Personnel from other plants
- ◆ Outside assistance -- consultants

NOTES

MANAGING THE ASSESSMENT TEAM

Find a "cause champion", with the following attributes:

NOTES

MANAGING THE ASSESSMENT TEAM

- Familiar with the facility, production processes, and its waste management operations
- Familiar with the people
- Familiar with quality control requirements
- Good rapport with management
- Familiar with new production & waste management technology

NOTES

INFORMATION REQUIREMENTS

- Company policies on waste minimization (description of program)
- Process flow diagrams and facilities' layout
- Key facility personnel -- experience & training
- Operating manuals
- Contracts with equipment vendors and waste management firms

INFORMATION REQUIREMENTS

(continued)

- ◆ Purchasing records
- ◆ State and local regulations
- ◆ RCRA information -- manifests, annual reports, plans, and permits
- ◆ Hazards communication materials
- ◆ Enforcement proceedings

NOTES

WASTE STREAM INFORMATION

- ◆ Determine point of generation
- ◆ Detail subsequent handling
- ◆ "Hazardous" vs. non-hazardous
- ◆ Physical and chemical characteristics
- ◆ Quantities
- ◆ Potential variations in production rate
- ◆ Potential for contamination or upset
- ◆ True costs for management

NOTES

SITE INSPECTION GUIDELINES

- ◆ Establish agenda ✓
- ◆ Schedule when process in operation
- ◆ Monitor operation at different times
- ◆ Interview all operators and supervisors

NOTES

SITE INSPECTION GUIDELINES

(Continued)

- Photograph the area
- Use GOP checklist
- Assess organizational structure
- Assess administrative controls

NOTES

THREE PHASE ASSESSMENT

1. Good operating practices checklist
2. Checklist derived from process- and waste-specific information
3. U.S. EPA assessment checklist

NOTES

GOP ELEMENTS

- Management initiatives
- Inventory control
- Waste stream segregation
- Material handling improvement
- Scheduling improvements

GOP ELEMENTS

(continued)

- Spill/leak prevention
- Preventive maintenance
- Process documentation
- Employee training

INFORMATION-DERIVED CHECKLIST

- EPA assessment and industry report
- State waste minimization reports
- Trade organization efforts
- Literature

REPORTING RESULTS

- Detailed report to management with executive summary
- Summary to personnel
- Current status of off-site waste management
- Suggested options for implementation

REPORTING RESULTS (Continued)

- Estimated cost and time for implementation
- Recommendations for extending waste minimization efforts and keeping assessments current

USING AN AUDIT TO IDENTIFY WASTE MINIMIZATION OPPORTUNITIES

Presented by:

Donovan Duvall

PEER Consultants, P . C .

NOTES

WHAT DOES THE AUDIT TELL US?

- Some information that is obviously pertinent to waste minimization
- Some information that might not be considered in the context of waste minimization

NOTES

INFORMATION CONCERNING WASTES

- Volume (mass) of specific waste streams
- Costs for disposal
- Costs for internal management

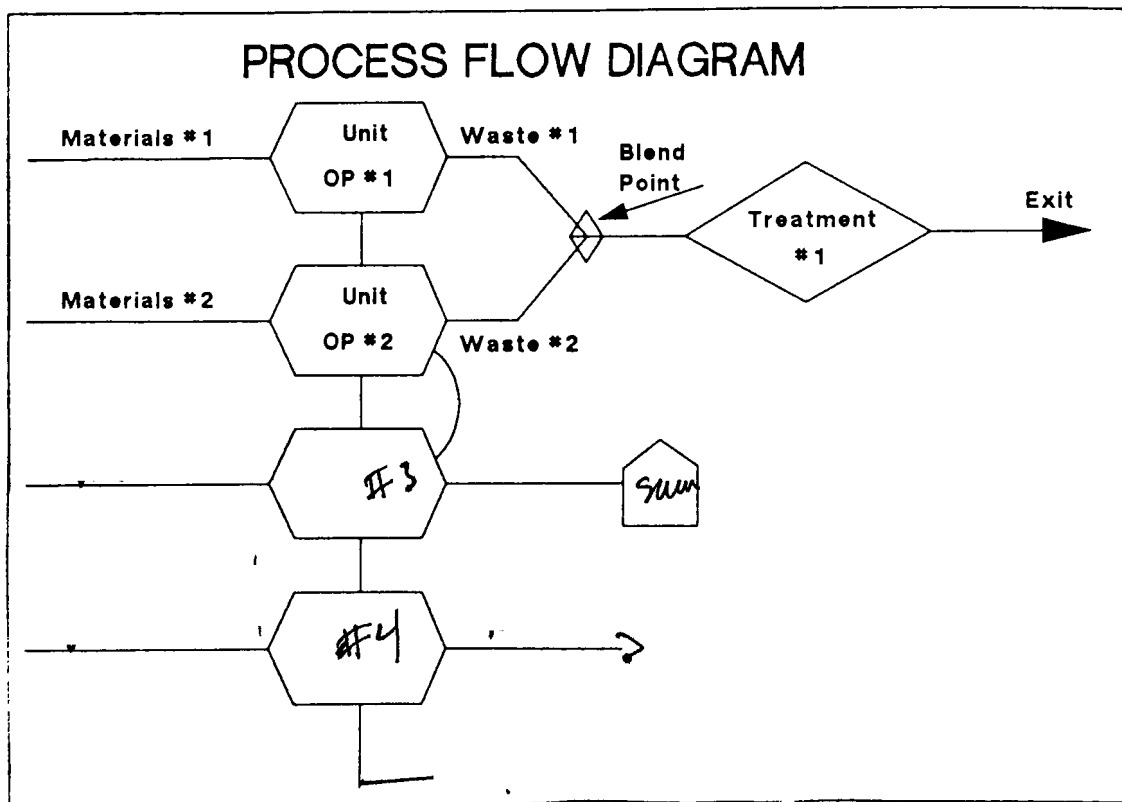
NOTES

SOURCES OF WASTE

- Production process related wastes
- Maintenance related wastes
- Inventory related wastes
- Internal waste management related waste

DEFINITION OF PROCESS AS INTERRELATED SET OF UNIT OPERATIONS

- Define the operation itself
- Define the input materials
- Define the product
- Define the waste stream



NOTES

REALISTIC OPPORTUNITY POINTS

- Some points may be judged as being clearly unrealistic
- Other points should be considered realistic

NOTES

CRITERIA FOR PRIORITIZING OPPORTUNITY POINTS

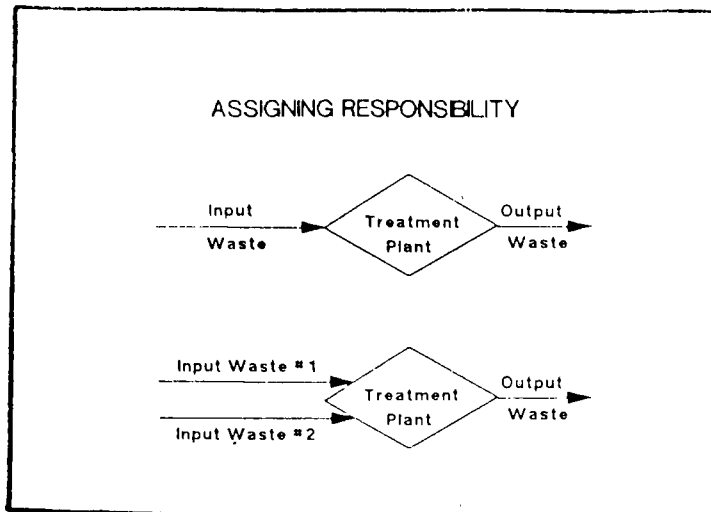
- Volume (mass) of waste
- Hazardous nature of waste
- Cost to manage waste

NOTES

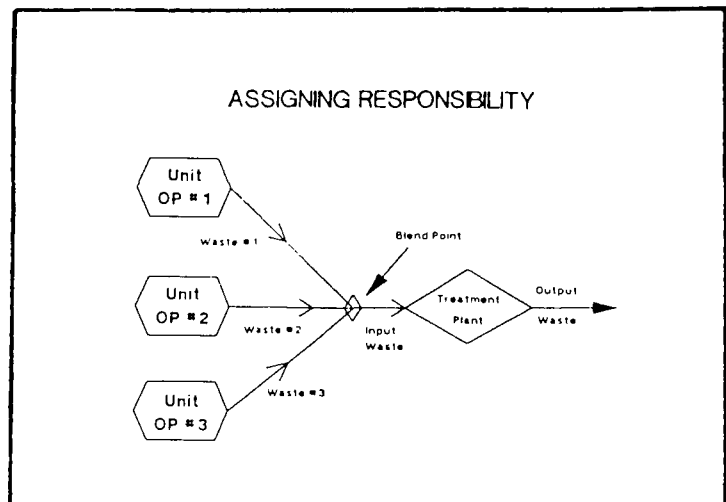
COST TO MANAGE WASTE

- Cost of internal treating operations
- Contribution of each waste to internal treatment costs
- Contribution of each waste to off-site disposal costs

NOTES



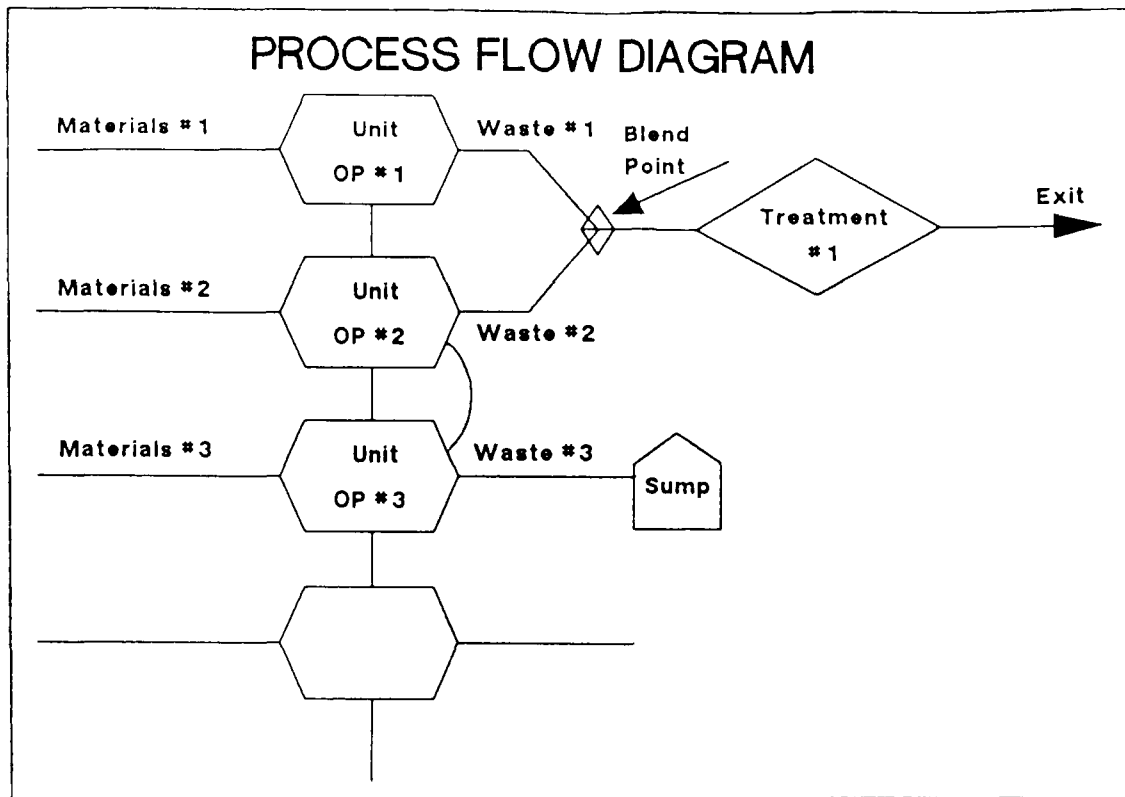
NOTES



NOTES

EVALUATION OF UNIT OPERATIONS

- Directly from inputs and outputs
- If not possible, start at waste leaving plant and work backwards
- Work through treatment plants, blend points, etc. until unit operations are reached



PROCESS FLOW DIAGRAM APPROACH FOR IDENTIFYING WASTE MINIMIZATION OPPORTUNITY POINTS

- Source of a waste flow
- Point at which waste streams join
- Any connection point between unit operations

NOTES

**ANALYSIS PROCEDURE TO IDENTIFY
WASTE MINIMIZATION OPPORTUNITIES**

- Consider all final wastes leaving the plant
 - must know volume and cost of disposal
 - individual unit operations contribution to final waste

NOTES

**ANALYSIS PROCEDURE TO IDENTIFY
WASTE MINIMIZATION OPPORTUNITIES**

Continued

- Backtrack each final waste stream to the unit operations
 - at treatment or blend point assign responsibilities for output waste
 - at each treatment, volume changes and costs added
 - assign some share (%) of output waste volume to each input waste
 - assign some share (%) of output waste cost to each input waste

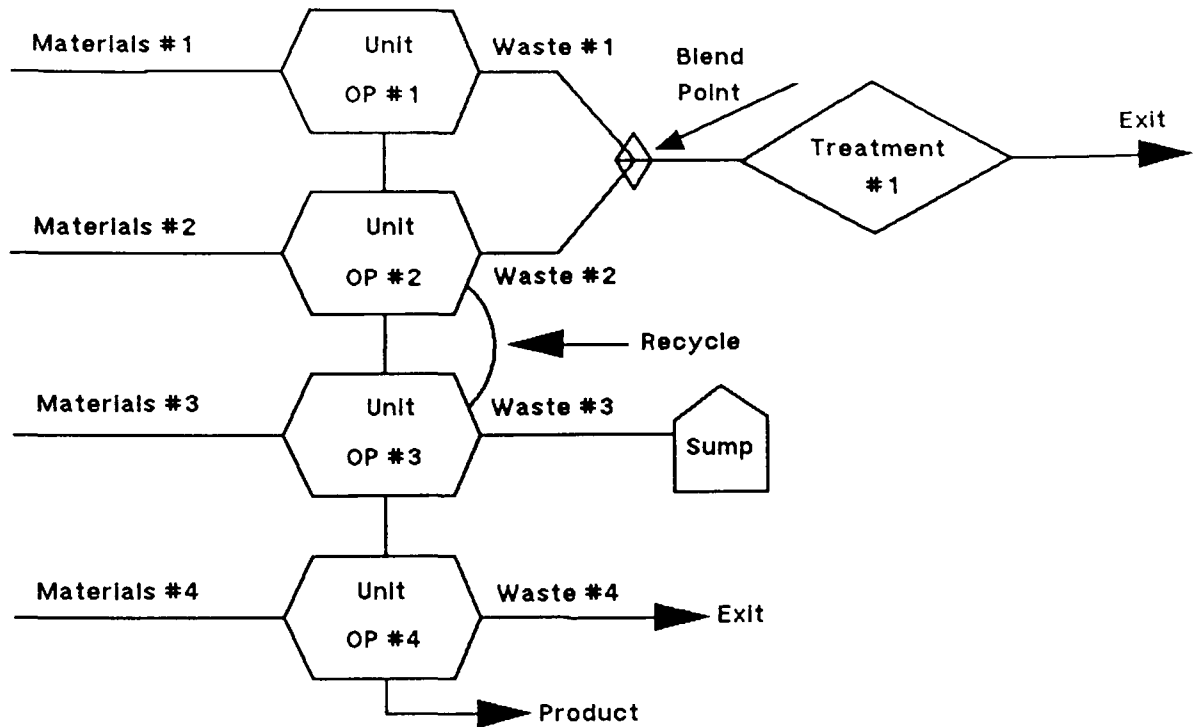
NOTES

**ANALYSIS PROCEDURE TO IDENTIFY
WASTE MINIMIZATION OPPORTUNITIES**

Continued

- Backtrack each final waste stream to the unit operations
 - continue stepping through intermediate treatment/blend operations until originating unit operation is reached
 - repeat this for all output "final" wastes and for all "recycled" material

PROCESS FLOW DIAGRAM



NOTES

COST/BENEFIT ANALYSIS

Presented by:

George Beetle

George Beetle Company

NOTES

BENEFIT-COST CONCEPTS

- Appropriate for public spending questions.
- Not relevant to industrial plant decisions.
- Plant managers must use more direct methods.

NOTES

PLANT-LEVEL FINANCIAL EVALUATIONS

- Direct estimation of local costs and gains.
- Consolidation of timing differences.
- Comparative assessment of alternative actions.

NOTES

OBJECTIVES

- To justify actions proposed or taken.
- To secure senior management authorization.

NOTES

ISOLATING RELEVANT COSTS AND GAINS

- Focus on actions proposed to reduce waste.
- Account for all affected costs & gains.
- Don't bother with anything not changed.

NOTES

WHERE ARE THE DATA YOU NEED?

- Company records, of all kinds.
- Personal experience of staff.

NOTES

HOW DO YOU START?

- Organize data on a process-specific basis.
- Be sure you are assessing local conditions.
- Define the problem in explicit terms.

NOTES

ESTIMATE UNIT COSTS

- Method simplifies comparisons needed.
- Assures consistency and completeness.
- Requires defining resources, units, costs.

NOTES

ESTIMATING DIRECT COSTS

- Start with base conditions as standard.
- Measure increases or reductions from base.
- Estimate resource quantities needed, base and differential.
- Keep annual and investment aspects separate.
- Be sure to include all effects.
 - Waste management costs
 - Liability exposure costs

NOTES

ESTIMATING GAINS

- Improvement of product.
- Secondary revenue sources.
- Reductions of material quantities or costs.
- Reductions of labor costs.

CONSOLIDATING COSTS AND GAINS

- Discount analysis; time value of money.
- Corporate or plant threshold interest rate.
- Use:
 - Present value of recurrent costs.
 - or
 - Annualized costs of investment.
- Annualized costs better if inflation matters.

ASSESSING MARGINAL ADVANTAGE

- Compare alternatives at prescribed interest rate.
- Calculate internal ROI for each alternative.
- Perform sensitivity analysis to test stability.
- Incorporate inflation effects where relevant.

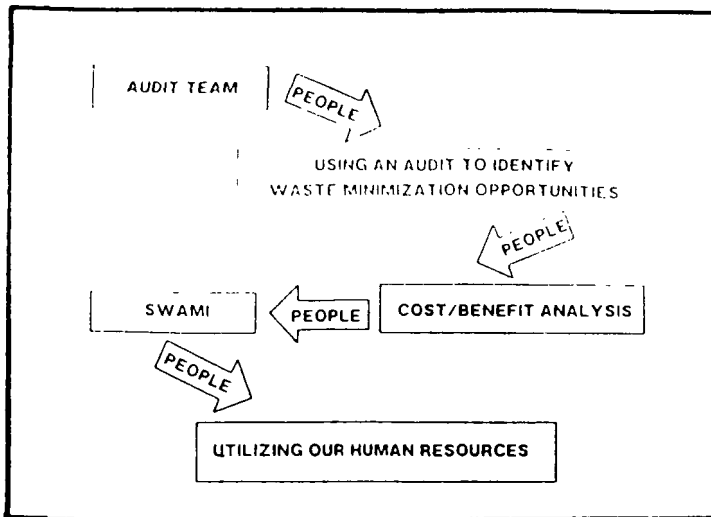
MANAGEMENT CONCEPTS FOR WASTE MINIMIZATION

"UTILIZING OUR HUMAN RESOURCES"

Presented by:

Kenneth Yost

NOTES



NOTES

**POLLUTION PREVENTION
DOES NOT USUALLY DRIVE
ORGANIZATIONAL OR MANAGEMENT
CHANGES**

NOTES

CHANGES USUALLY DRIVEN BY

- ◆ Profitability demands
- ◆ Quality needs
- ◆ Personnel needs

NOTES

**BUT CERTAIN MANAGEMENT
OR ORGANIZATIONAL CHANGES
GIVE POLLUTION PREVENTION AS
AUTOMATIC "FALLOUT"**

NOTES

**IN FACT, "WASTE" MINIMIZATION
MAY REQUIRE SOME MANAGEMENT
CHANGES**

NOTES

CONCEPTS

- Cell/focused processes
- Just-In-Time inventory
- Team management
- Doing it Right The First Time
- Access to "unusual" resources

THE "CONCEPTS"

- Can stand alone
- Apply equally to manufacturing plants and small offices
- But are extremely effective together

NOTES

CELL/FOCUSED PROCESSES

- Space concerns
- Time concerns
- Quality concerns

NOTES

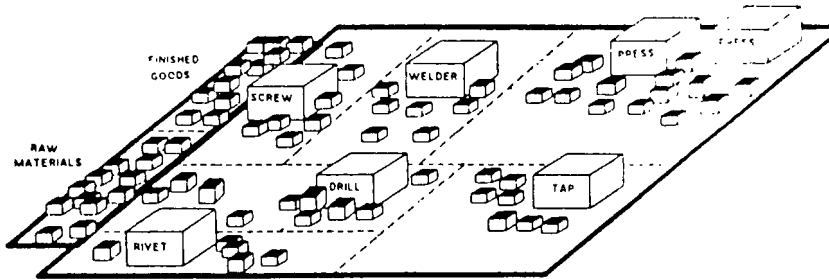
CELL/FOCUSED PROCESSES

Subplants Arranged For

- Worker convenience
- Minimum space/time between units
- Integrated (complete) process

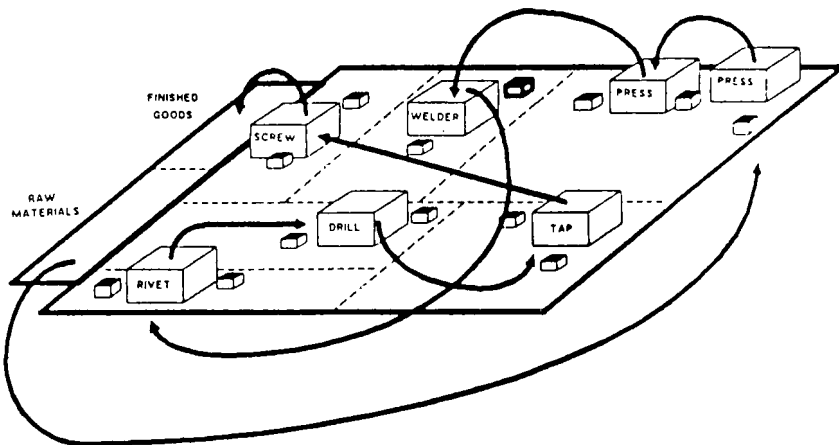
NOTES

NON-FOCUSED PLANT ARRANGEMENT
(Conventional)



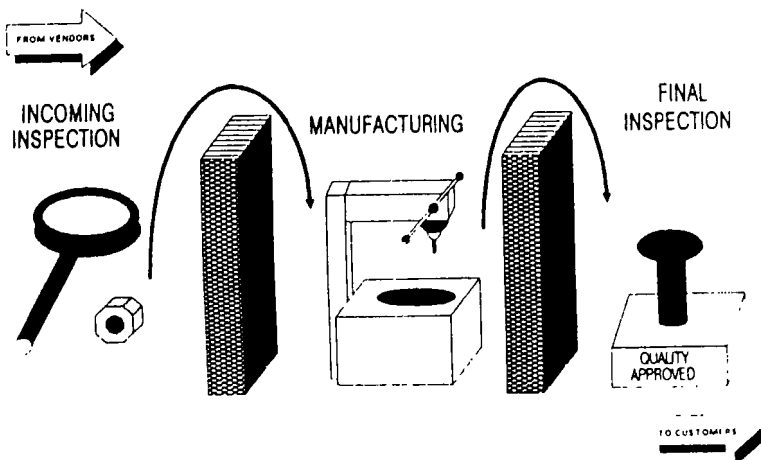
NOTES

TYPICAL MATERIAL FLOW IN
NON-FOCUSED PLANT



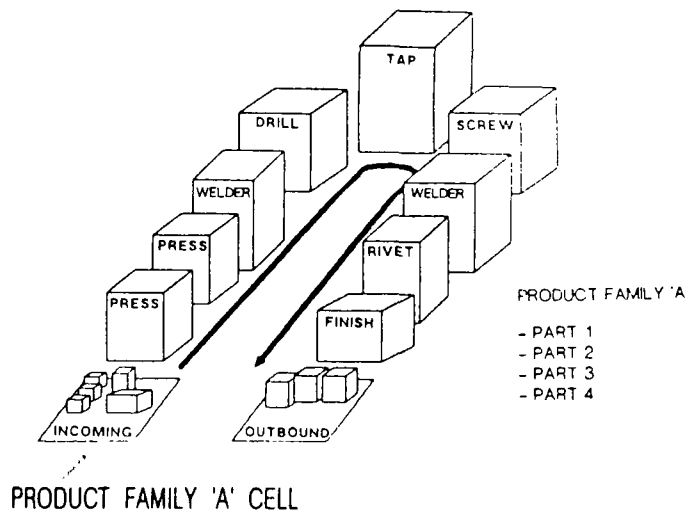
NOTES

TRADITIONAL PRODUCTION / Q.C. RELATIONSHIP



FOCUSED MANUFACTURING CELL

NOTES



NOTES

CELL/FOCUSED PROCESS BENEFITS

- Minimization of material movement
 - fewer spill/damage losses
- Improved product quality
 - less "off-spec" product wastage
- Minimization of materials "in the queue"
- Minimization of space
- Leads into J-I-T inventory control

NOTES

HOW TO IMPLEMENT CELL/FOCUSED PROCESS CONCEPT

Rearrange Process Equipment Work Areas & Storage Areas Using Input/Guidance From:

- Process engineering
- Production labor force
- Support staff (e.g., plumbers, electricians, etc.)

IMPLEMENTATION GUIDELINES

Cell/Focused Processes

- Minimize space between unit operations
- Minimize number of transfer points
- Design for "management by eye"
- Integrate production & Q.C. into one concept

NOTES

JUST - IN - TIME INVENTORY CONTROL

Match Output Required:

- To throughput ability
- To customer requirements

NOTES

WHAT IS J-I-T?

An Inventory Control Concept Which

- Prevents overproduction
- Allows fast response to customer needs
- Minimizes materials inventory
- Allows rapid Q.C. checking of input and output
- Prevents aging or damage losses in inventory

NOTES

HOW TO IMPLEMENT J-I-T

- Determine production rate required
 - usually is market driven
- Determine realistic process throughput rate
- Match process operation to required production
 - e.g., more process lines or reduced operation time

NOTES

HOW TO IMPLEMENT J-I-T (Continued)

- Determine material input rates required
- Determine "container size" for process needs
- Specify your requirements to vendor/supplier

NOTES

J-I-T BENEFITS

- Minimization of product inventory
 - less aging or damage losses in storage
- Minimization of input material inventory
 - faster quality check of material spec's
 - less over-age material wastage
- Input material "container" matches your process needs
 - material delivered when and how you need
 - less "dried-out-can" wastage

NOTES

Cell/Focused Processes

Merge Well With

J-I-T Inventory Control

NOTES

**Both Concepts Call For
Increased Worker Responsibility
And Accountability**

NOTES

CONCEPTS REQUIRE:

- Use of group technology
- Cross-training of workers
- Heavier emphasis on scheduling
- Preventive maintenance

NOTES

**Concepts Are Implemented
Best By Change
In Organizational Structure
And Management Approach**

NOTES

TEAM MANAGEMENT

- Give responsibility to those who really have it anyway

NOTES

TEAM MANAGEMENT

- Trust
- Empowerment
- Rewards

NOTES

TRUST

- We're all in this together

NOTES

TRUST

- Labor and management have equal, however, different responsibilities
- Dependent on each other for survival

NOTES

" THE CONCEPT "

Management and Labor Share Information

- Profit/loss
- Future business potential
- Status with competition
- What waste management costs
 - direct
 - hidden

NOTES

EMPOWERMENT

- Delegate authority
- Delegate responsibility
So that employees can
TAKE ACTION

NOTES

EMPOWERMENT

- Employees determine how to manufacture
- Inspection is built into the manufacturing process

NOTES

REWARDS TO MATCH RESPONSIBILITY

- Employment now
- Improved security for future
- Profit sharing
- Pride

NOTES

IMPLEMENTING TEAM MANAGEMENT

"Crawl Before You Walk"

- Start with small "bites"
 - one operation or small process
- Build on success
 - expand to a full process or product
- Go to logical conclusion
 - establish the concept throughout the plant

NOTES

SMALL BITES GIVE YOU

- Good control
- Quick results
- Minimal risks

NOTES

EXAMPLE OF WHAT CAN BE DONE

Going from
"Trust me" management
through
"Negotiations" approach
to
"Mutual trust" management

NOTES

PROBLEM:

- Make the product we have always made
- Outsource (foreign suppliers)

NOTES

WHAT HAPPENED:

Step 1

- Management developed a production approach "of their own"
- Outsource supplier's price was 60% of best price estimate

NOTES

WHAT HAPPENED:

Step 2

- Management & labor negotiated (a "what will you give up" approach)
- Best price = 90% of original estimate (still could not beat outsourcing)

NOTES

WHAT HAPPENED:

Step 3

- Labor asked for opportunity to develop an approach
 - "Give us all the info and see what we can do."
- Labor came back with a bid based on the worker's having both authority & responsibility
- Price estimate fully competitive with outsource

NOTES

BOTTOM LINE

- Employees volunteer
- Employees are trained
- Dedicated work units

NOTES

BOTTOM LINE

(Continued)

- Employees determine how to improve process
- Employees solve material & quality concerns
- Employees find and develop opportunities to minimize waste

NOTES

BOTTOM LINE
(Continued)

- Management provides support and resource people to assist as requested

NOTES

SUMMARY

- Small groups
- Responsibility at the most effective level
- Rewards that match responsibility

NOTES

YOU WILL ACHIEVE:

- 5-20% productivity improvement: without increased staff or capital requirements
- Much of this productivity improvement will be accompanied by (or even caused by) a reduction in waste streams
- Employees will feel good about their contributions
- Your customers will see you as a stable efficient and innovative person/company

NOTES

**DOING IT RIGHT
THE FIRST TIME**

NOTES

CONCERNS

- Deadlines
- Resources
- Budgets
- Technology
- Waste and its liabilities

NOTES

HISTORIC SOLUTIONS

- Extend Timetables
- Overrun budgets
- Lack of resources as an excuse
- Lack of technology

NOTES

HISTORIC RESULTS

- Program delays
- Not meeting expectations
- Loss of profits
- Request new programs to correct deficiencies

NOTES

THE " DIRTFT " CONCEPTS

- Invest time & energy up front to specify requirements
- Communicate the requirements and obtain feedback on understanding

NOTES

" DIRTFT " CONCEPTS (Continued)

- Research technology--- do not legislate invention
- Establish an agreed budget & timetable with all participants

NOTES

BOTTOM LINE!

- You will accomplish difficult assignments.
- You will be regarded as a "make it happen" person.
- You will be assigned the important projects.

NOTES

**WASTE MINIMIZATION INVOLVES
PEOPLE**

NOTES

ACCESSING

- Unusual resources

EXAMPLE

- Co-op students given the challenge to reduce waste

NOTES

STUDENTS INVOLVED IN WASTE MINIMIZATION

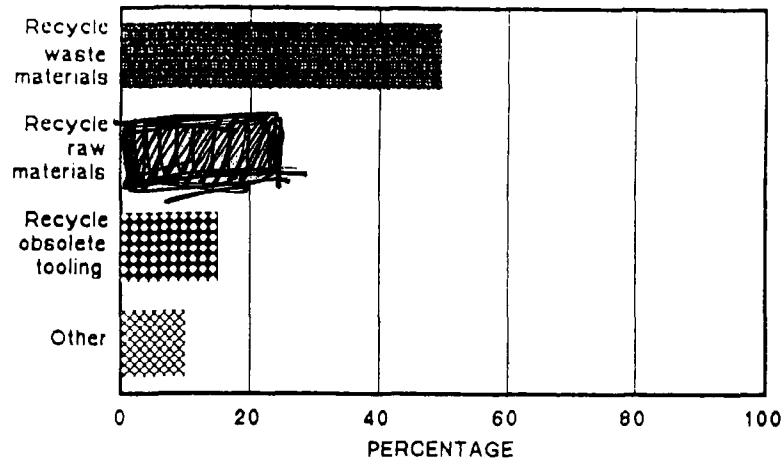
- Management invested 10% of student's time to work on waste minimization
- \$1,000,000 of waste minimization savings were obtained year after year

NOTES

LIMIT

- Students not allowed to change plant process
- Therefore, savings all related to changes in waste management

WASTE MINIMIZATION SAVINGS



THESE " CONCEPTS " FOSTER

- Waste minimization
- Material maximization
- Quality maximization
- Productivity maximization
- Profit maximization

SUMMATION

Presented By:

Robert Pojasek, Ph . D .

ChemCycle Corporation

WASTE MINIMIZATION PROCESS

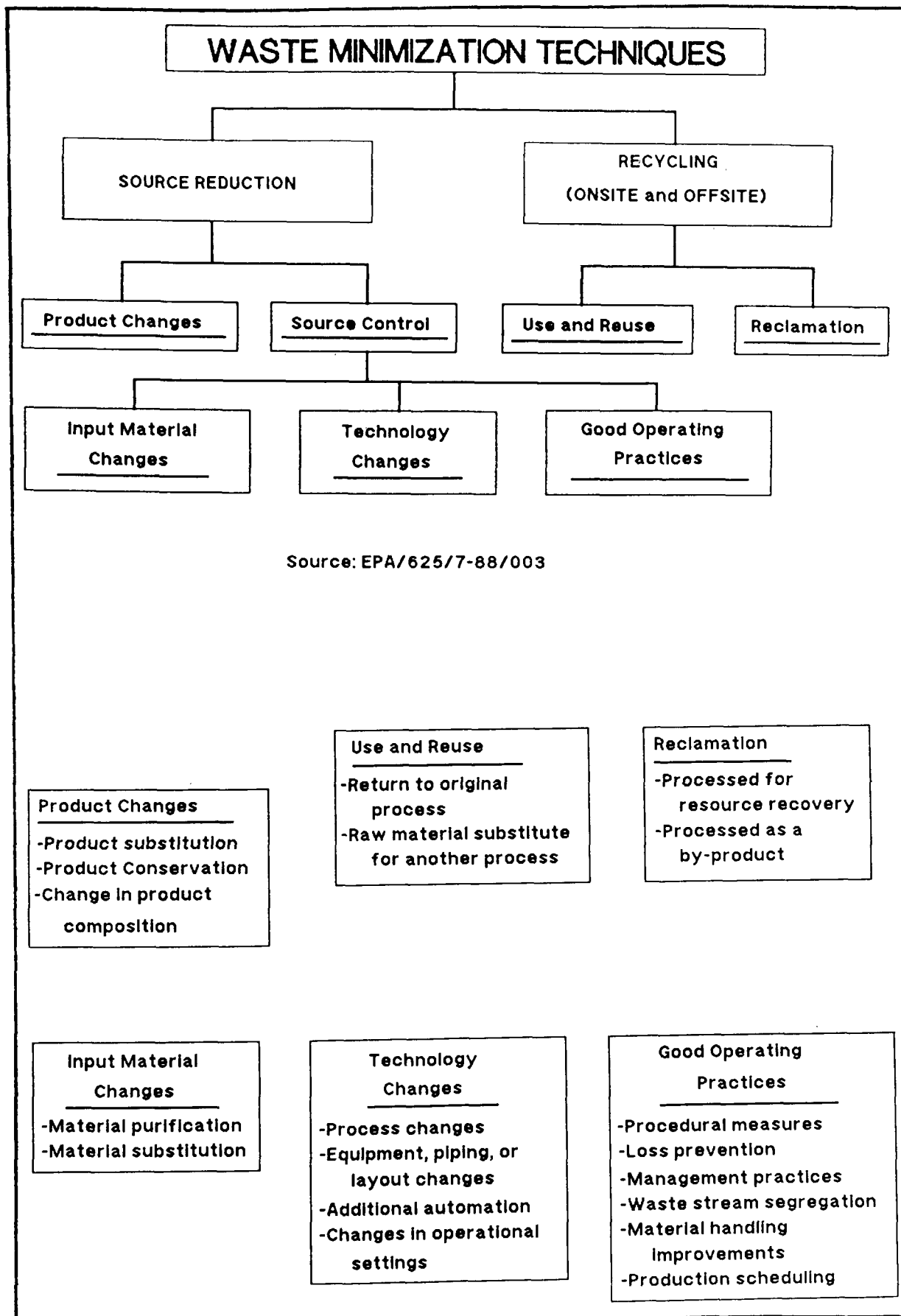
- ♦ Planning
- ♦ Assessment
- ♦ Feasibility study
- ♦ Implementation
- ♦ Communication

COLLECTING INFORMATION ON YOUR INDUSTRY

- ♦ EPA case histories
- ♦ State program information
- ♦ Trade organization programs
- ♦ Literature
- ♦ Equipment vendors
- ♦ Consultants

TIPS FOR SUCCESSFUL FEASIBILITY STUDY

- ♦ Complete information base
- ♦ Full menu of options



TECHNOLOGY EVALUATION PHASES

- ♦ Feasibility study
- ♦ Treatment/treatability testing
- ♦ Pilot-scale testing
- ♦ Full-scale implementation

NOTES

TESTING REQUIREMENTS

- ♦ Scale - bench & pilot
- ♦ Unit availability
- ♦ Test parameters
- ♦ Number of tests
- ♦ Amount of material required
- ♦ Testing to be conducted

NOTES

IMPLEMENTING TECHNOLOGY OPTIONS

- ♦ Prequalify equipment suppliers
after search
- ♦ Prepare plans and specifications
- ♦ Conduct bidding
- ♦ Select and contract with
supplier/contractor

NOTES

PLANS & SPECIFICATIONS

- Instructions to bidders
- Technical proposal format
- Schedule of prices
- Standard form of agreement
- General conditions of contract
- Supplementary conditions
- Division 1 - general requirements
- Division 2 - sitework

NOTES

OTHER IMPLEMENTATION STEPS

- Construction management/shake-down
- Operation & maintenance manuals
- Documentation of results - amount saved per unit production
- Update program

NOTES

WORKING WITH A VENDOR

- Make sure your engineer agrees to, or develops vendor plans and specifications
- Avoid use of "free" engineering from vendor especially to estimate and contain costs
- Watch specification of peripheral equipment
- Should have independent value engineering
- Confidentiality considerations

VENDOR CAPABILITIES

- ◆ Development of other technologies
- ◆ Completion of pilot-scale tests
- ◆ Personnel experience, dedication and credentials
- ◆ Testing program capability for your application
- ◆ Capability of scaling equipment
- ◆ Certification against equipment failure, service

COMMUNICATIONS

- ◆ Detailed report to management with executive summary
- ◆ Summary to personnel
- ◆ Current status of off-site waste management
- ◆ Suggested options for implementation
- ◆ Estimated cost and time for implementation
- ◆ Estimated savings
- ◆ Recommendations for extending waste minimization efforts and keeping audits current