POLLUTION PREVENTION AT THE KANSAS CITY DIVISION THROUGH PROCESS WASTE ASSESSMENTS

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ABSTRACT

Allied-Signal Inc., Kansas City Division (KCD) is committed to the hazardous waste minimization requirements set forth under RCRA as amended by the Pollution Prevention Act and DOE Order 5400.1. To assure compliance with these regulations, the KCD has developed a comprehensive Pollution Prevention Program which focuses on the elimination or minimization of all material releases to all environmental media. The ownership of waste minimization is given to all of the waste generators through Departmental Pollution Prevention Plans. These plans include tools to achieve the waste minimization goals. One of these tools is the process waste assessment (PWA).

A PWA is a planned procedure with the objective of identifying opportunities and methods to reduce or eliminate waste. A material balance is performed around a specific process which qualifies and quantifies the materials entering and exiting the process. These materials are further defined to the hazardous component level. The exiting materials are separated into what goes into the product, sent to waste management, and what is released to the air (fugitive or point source). Next, opportunities are identified and evaluated for the ability to eliminate or minimize the waste streams exiting the process. Therefore, the PWA provides the basic tool for the creation of a comprehensive process baseline and identification of opportunities to eliminate/minimize the release of hazardous and non-hazardous wastes.

This presentation will describe the status and activities of the program conceived to initiate PWAs at the Kansas City Division (KCD) of Allied-Signal Inc.. This program is organized through business units which consist of manufacturing, quality, and engineering personnel from a specific product line. The departments that these business units represent are the generators of the major process waste at the KCD.

Included in the update will be a brief overview of the lessons learned from the methodology development and completion of pilot PWAs, cost analysis of the pilot PWAs, estimation of the time required for future PWAs, current total of processes requiring PWAs at the KCD, implemented waste minimization options from the PWA activity, current objectives of the PWA/Pollution Prevention team, and information on the current issues involved in the PWA program. These issues include relating process waste assessment data to production activity and the different approach required by non-manufacturing versus production departments.

INTRODUCTION

Allied-Signal Inc.,* Kansas City Division (KCD) is committed to the hazardous waste minimization requirements set forth under RCRA as amended by the Pollution Prevention Act and DOE Order 5400.1. To assure compliance with these regulations, the KCD has developed a comprehensive Pollution Prevention Program which focuses on the elimination or minimization of material releases to all environmental media. A key element or tool of this program is the process waste assessment (PWA). This paper will describe the status and activities of the program conceived to initiate PWAs at the Kansas City Division (KCD) of Allied-Signal Inc.. Included in the update will be a brief overview of the lessons learned from the methodology development and completion of pilot PWAs, cost analysis of the pilot PWAs, estimation of the time required for future PWAs, current total of processes requiring PWAs at the KCD, implemented waste minimization options from the PWA activity, and information on the current issues involved in the PWA program.

DEPARTMENTAL PLANS

The ownership of waste minimization is given to all of the waste generators at KCD through Departmental Pollution Prevention Plans. Figure 1 demonstrates the tools of the Departmental plan: Process Waste Assessments and the Inventory Tracking System. The PWA will feed information to the Inventory & Tracking system to fulfil the requirements of local, state, and federal regulatory reporting. The material balance information will also define the baseline from which future elimination and reductions can be monitored. Waste minimization opportunities identified in the PWA will be organized through the Waste Stream Coordinators at the KCD. Thus, information from the PWAs will generate the future waste minimization projects. In addition, Fig. 1 indicates that the generators of the waste, business units, have the ownership of Pollution Prevention. The business units are

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responsible for implementing the PWAs and waste minimization development projects, organizing departmental PWA teams, and setting goals and schedules for PWAs and pollution prevention activities. Finally, the departmental PP Plan helps define the operating envelope and is therefore referenced in the department's Operational Surety Plan.

A process waste assessment (PWA) can be thought of as a process improvement tool. Figure 2 depicts a comparison of a PWA with another improvement tool, process characterization and control (PC&C). Both tools evaluate the input materials and parameters of a given process. However, the objective of PC&C is to optimize product quality and decrease the cost of non- conformance. The objective of a PWA is to study the process for opportunities to minimize/eliminate waste. This establishes a completely different view of the process. But this is not the only benefit, two others also result. The PWA also provides a baseline from which waste minimization can be measured. The baseline is important for the successful monitoring of a Pollution Prevention Program. Finally, the detailed hazardous component material balance provides the information required for federal, state, and local environmental reporting.

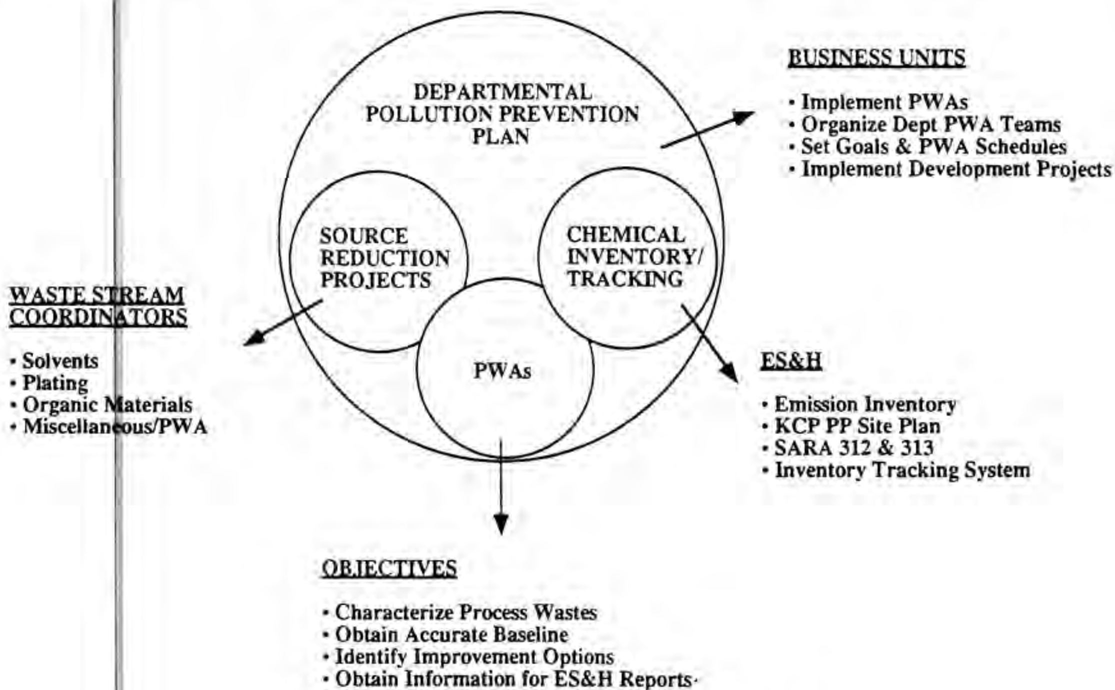

Fig. 1. Departmental pollution prevention plan.

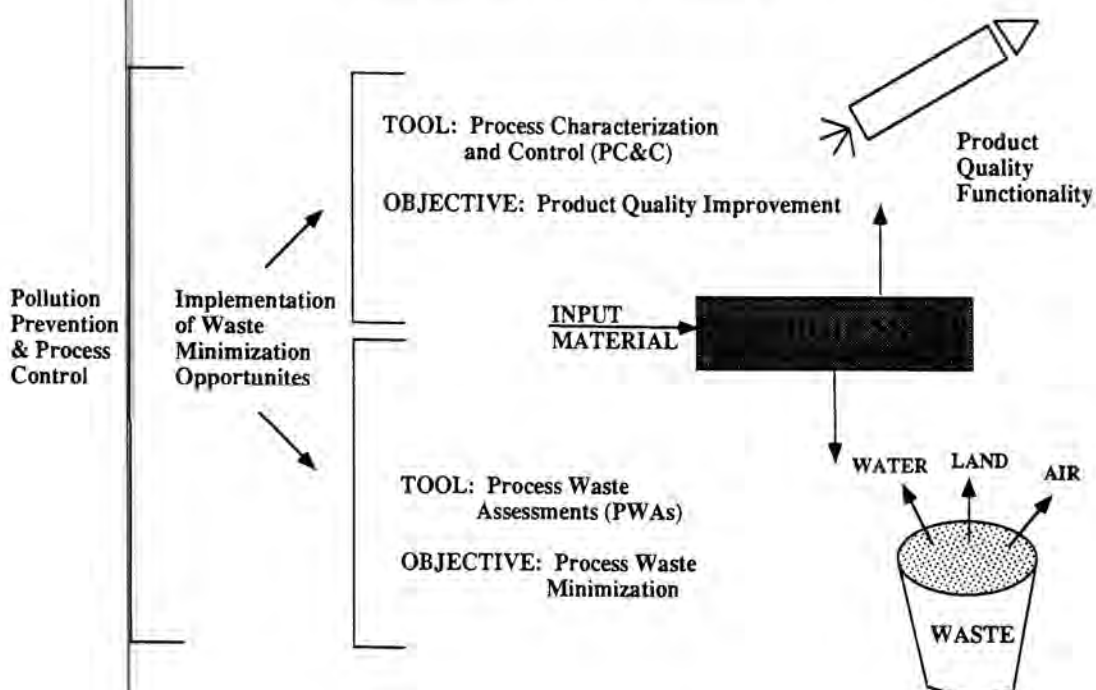

Fig. 2. Continuous process improvement tools.

Significant process changes should not be implemented until the effect on product quality is considered. Therefore, PC&C should be combined with the implementation of the PWA waste minimization options. This thought is expressed by the innermost brackets shown in Fig. 2. Together, the PWA and PC&C tools can produce a total quality process. The outer bracket indicates that Pollution Prevention and Process Control can and should be combined for new programs and processes.

INITIATION OF PWA PROGRAM

The program was initiated in November of 1990. The primary goals were to determine the methodology of process waste assessments (PWAs) and to develop departmental Pollution Prevention Plans. Implementation of Pollution Prevention (PP) and Process Waste Assessment (PWA) activity at the KCD was organized through managerial business units. Six major business units were chosen to form a team to initiate eight pilot PWAs and develop Departmental Pollution Prevention plans. This team consisted of the following KCD business units: Electrical, Firesets, Materials, Mechanical, Plastics, and Radars. Additional team members represented ES&H and Waste Management. ES&H personnel provided regulatory requirements; wrote the PWA Guidance, PWA Site Plan, Departmental PP Plan Guidance, and PP Site Plan; and participated in activities of the team to develop the PWA methodology, PWA training development, and interface of the PWA information with the Hazardous Material Inventory Tracking System (HMIS).

The PWA team consisted of personnel which coordinated the activities within their business unit and those which performed the pilot PWAs. The same person performed both roles in some of the organizations.

In December 1990, eight processes were chosen from the six business units of the PWA team. These eight processes were known as the pilot (initial) PWAs. No requirements were placed on the team as to which process should be chosen. Each investigator was told to use the PWA Guidance and worksheets to lead them through the methodology. The completion date required for the pilot PWAs was March 31, 1991.

The list below indicates the processes chosen for the pilot PWAs by the respective business unit.

- Electrical Business Unit:
  "Monomeric TDI Foam Process"
- Fireset Business Unit:
  "Spray Booths in Fireset Production"
- Materials Business Unit:
  "Cleaning of Reactors used in Polymer Processing"
  "Generic Lab Equipment Cleaning"
- Mechanical Business Unit:
  "Miniature Parts Cleaning in D/92"
  "Cleaning of Steel Parts Prior to Plating"
- Radar Business Unit:
  "Solder Pot Tinning"
- Rubber & Plastics Business Unit:
  "Polymeric Isocyanate Foam Process"

Each business unit coordinator on the PWA team organized the departments within their responsibility. This consisted of some initial training and information exchange so that each department could develop a list of processes which would require waste assessment. Once these were listed, then individual PWA teams were organized and processes were prioritized to the KCD Waste Stream Priority list. In addition, processes were also assigned an ID number according to the PWA Guidance and a completion schedule was developed. The PWA team then performed additional work.

The following list indicates the order and type of additional PWA team activities:

- Lessons learned from the completion of pilot PWAs,
- Implementation of waste minimization options from the pilot PWAs,
- Development of Departmental Pollution Prevention Plans,
- Projection of future resource needs for PWA activity at the KCD,
- Self-assessment of pilot PWA reports,
- Independent audit of pilot PWA reports and PWA Guidance,
- Identification of additional information needed to increase the efficiency of completing PWAs, and
- Revision of PWA Guidance and worksheets.

LESSONS LEARNED

After the completion of the pilot process waste assessments (PWAs) and initial business unit organization, a list of lessons learned from the PWA team members were generated. The comments are grouped within categories to indicate relationships. Lessons learned from the initial PWA Guidance, PWA procedure, and organization are briefly discussed.

Material Balances

Material balances can be operator, schedule, and part dependent. Averages must therefore be used and updates made to reflect the changes.

Care must be taken when analyzing stack gases because of the large volume of room air which dilutes the stack gas measurement.

The material balance is a very significant waste minimization tool because it forces a close look at the process which identifies the obvious and simple waste reduction efforts/options.

Material balances must involve the use of "best available" information until testing and analysis are conducted or until EPA-approved methodology is provided. All data and estimates should be documented with some kind of defensible rationale.

The resource for components of a material (hazardous or non- hazardous) should be found in the Material Safety Data Sheet (MSDS). Other sources available are:

1. calling the vendor of the material and requesting the data,
2. contacting the responsible Material's Engineer, or
3. having the material analyzed in the Analytical Sciences Laboratory.

NOTE: Chemical manufacturers were required as of January 1989 to list SARA 313 reportable chemicals in their MSDS. Therefore, if you are using an MSDS prior to this date, request the latest issue.

The following guidelines (taken from SARA 313 regulations and guidance) indicate what percent content should be used for hazardous chemical components found in the MSDS.

- When a material range (upper & lower percent) is given, use the average weight percent.
- When only the minimum percent content is stated, assume the upper is 100% (or request the upper value from the vendor) and take the average.
- When only the upper percent is stated, either contact the material vendor and ask for the minimum or use the upper percent as the value for the material balance. If the vendor supplies the lower value, again take the average. Whatever is used, document the information source.

Miscellaneous solid waste (kaydrys, toothpicks, finger cots, etc.) should be identified in the material balance and option brainstorming portions of the PWA.

Laboratories

A different approach is needed to perform PWAs in laboratories (and other non-manufacturing areas) than in manufacturing departments.

Since most laboratory processes are not consistently performed and have many personnel dependencies, experiments and assumptions had to be used to make the material balances.

Laboratory work can be viewed as daily or repetitive operations, development,or one- time services. PWAs can be initiated on the daily and repetitive operations where the quantity of waste material and hazards can be minimized. Material balance and regulatory reporting information is still required on the remaining development or one-time service processes.

General

There must be team involvement - everyone must think pollution prevention and/or waste minimization.

Future PWAs will not take as long as the pilot PWAs because of the lessons learned, contacts made, and resource information found. Familiarity with the worksheets will also significantly reduce the time required for succeeding PWAs.

ES&H was requested to send each department an annual updated listing of the prioritized, regulated materials to be placed in the appendix of the departmental plan. This will make each department aware of any relevant changes of regulated materials and wastes. It will also allow a change in directions to occur within the business units.

Final PWA reports should include estimates of the dollar savings and/or waste reductions expected from the options generated to minimize waste.

The process flow diagram and material balance should be included in the final report.

Establishing TMS requirements is difficult for the plating processes because of the large quantity of parts numbers which utilize the baths. Therefore, a task team should be initiated to handle the administrative problem of quality assurance requirements when a significant change occurs to a process which is utilized by a large quantity of part numbers.

Resource Information

Information sharing is key to increasing the efficiency of PWAs.

A materials/process expert list or contact is needed for PWA teams to use as a resource when process and/or material questions arise. The availability of a PWA contact will allow knowledge of the PWA information to be passed along instead of "reinventing the wheel".

A major portion of the PWA workload is the accumulation of data concerning the operation and control of the process.

A tracking system (material inventory, usage and waste generation) must accompany the PWA program. Otherwise, the baseline information will have to be repeated to determine waste savings and reductions.

Computer aided tools are needed to increase the efficiency, technology exchange, and the success of the PWA program within KCP - a PWA network. There is an enormous volume of data to be factored, exchanged, calculated, and periodically changed. These are the tools necessary (in decreasing importance).

- Material Inventory Tracking
- Material balance database
- PWA information database
- (PWA Contacts, Options, Process Description)
- Worksheet generation
- Standard report format
- Artificial intelligence system

It would be helpful for the MSDS system to include references to the part number (production & support) and to the responsible Material's Engineer (production).

APPROACH FOR LABORATORIES & "DE MINIMIS" CRITERIA

Another lesson learned was that laboratories needed a different PWA approach than the manufacturing departments. Also, most non-manufacturing departments use a large number of chemicals in small quantities. Therefore "De Minimis" criteria were developed. The requirements are as follows:

1. The quantity of each hazardous material used in the process is less than one container size for each calendar year. There is a maximum limit of a 5 gallon container for liquids and 50 pounds for solids. Exceptions for gases may be made on a case by case basis.
2. The Threshold Limit Value (TLV) for each hazardous material component in the process must be 10 ppm or greater.

If a process meets both of the above criteria, then it is exempt from a "full" PWA - only sections 2 (material balance) and 4 (regulatory requirements) of the PWA need to be completed. In addition, process development work is also exempted from a "full" PWA.

Laboratories do not always have consistent, identified processes. Their activities many times consist of one-time services, development, and some frequent operations. In addition, most of these activities do not include specific instructions. Therefore, the following approach has been suggested and is adequate with respect to KCD's program.

1. Form PWA Team

2. Develop Material/Process Matrix List
   - Material Procurements
   - Equipment Lists
3. Divide Processes into the Following
   - Development, One-Time Services
   - Daily or Frequent Services
4. Prioritize Frequent Operation Processes Against KCD Waste Stream List
5. Apply "De Minimis" Criteria to Process List
   - Full PWAs
   - Material Balance and Regulatory Information
6. Develop PWA Schedule
7. Review Work Practices for Pollution Prevention and Document Activities

PWA RESOURCE ANALYSIS AND FUTURE PROJECTIONS

During the pilot PWAs, investigators were asked to track the amount of time spent on various steps of the PWA. The accumulative average was 225 hours per pilot PWA. Variance in the total hours required occurred because of the different process complexity and approach used by each investigator.

To determine future resource requirements for PWAs, each pilot PWA investigator was asked to estimate how much time the next PWA would take. (This was based on the information and experience gained from the pilot PWAs.) The average of these estimates was 120 hours and approximately 2-3 months per PWA. This average was used to determine PWA schedules within the departments of each business unit.

SELF-ASSESSMENT OF THE PILOT PWAS

Self-assessment of the pilot PWAs was completed through the exchange of pilot PWA reports. Several elements resulted from this effort: format and minimum requirements of the final report and identification of training needs. The training needs identified were initiation of a general Pollution Prevention Awareness Program, specific PWA training, and a Pollution Prevention Leadership Program for management.

The conclusions of the self- assessment evaluation emphasized the information included in the final report Summary and Activity sections which discuss the waste minimization options. The following information was identified as the minimum requirements for the final report.

1. Option description
2. Option score
3. Material usage quantity
4. Anticipated waste reduction quantity
5. Cost savings
6. Waste minimization option implementation costs
7. Waste streams affected
8. Production down-time during implementation of options
9. Feasibility of waste minimization option(s)

IMPLEMENTED OPTIONS

Waste minimization options were identified in each of the pilot PWAs. In addition, the options were ranked according to the feasibility of implementation. Several of the options which resulted from the pilot projects are briefly discussed below.

- "Polymeric Isocyanate Foam Process" - One of the options implemented from this PWA was the separation of the raw material part number from a kit to two separate numbers. The raw materials were not used at the same rate and one was being discarded when the other was used up.
- "Spray Booths in Fireset Production" - In this PWA it was discovered that the spray booth required retrofitting because the solvent pooled at the bottom. The bottom slope of the spray booth was not high enough to allow the solvent to drain to the recycle container below the booth.
- "Cleaning of Reactors used in Polymer Processing" - In this PWA a circulation system was identified as an option to decrease the cleaning solvent needed to remove polymer residues. This option decreased the amount of solvent needed by 60%.
- "Solder Pot Tinning" - Several options generated from this PWA were a reduction in solder pots and a solder pot specification change. In the first option the department did not require the number of operating solder pots that were available for use. In the latter option, the solder pot shelf life was set at 30 calendar days which included weekends and other days of non-use. This specification was changed to 30 days of use and a record of use was initiated.

CURRENT TEAM OBJECTIVES

The current objectives of the PWA team include the development of training programs to promote pollution prevention and the completion of non- manufacturing pilot PWAs.

The self-assessment of the pilot PWAs identified the need for three training programs - General Pollution Prevention Awareness, Pollution Prevention Awareness and Leadership for Management, and PWA Team Training. The former program is being developed internally, while the other two are being delivered by outside sources.

A new program of pilot PWAs has been organized to further define the PWA methodology for non-manufacturing departments. The following business units are involved in this activity: Human Resources, Tool & Test Equipment, Maintenance, Quality, Purchasing Operations, and Stockpile Support. These pilot projects will be completed by March 31, 1992.

CURRENT TEAM ISSUES

The current PWA team issues include the different approach needed for non-manufacturing departments and normalizing waste data to production activity. The former issue is being pursued through the non- manufacturing pilot PWAs.

Information from a waste assessment will give a baseline to the process from which to measure waste reduction/elimination. However, this data must be normalized to decreases or increases of production activity. A subcommittee was established to develop and evaluate a production activity index. The conclusions and recommendations from this subcommittee are as follows.

Plant-wide:

1. Earned standard hours (ESHs) could be used as a consistent production activity index throughout the KCD. However, several disadvantages exist with this index.
   - Only manufacturing departments have ESHs. Engineering laboratories, maintenance, etc., do not.
   - Development and other activities outside of WR which generate waste are not included in ESHs.
   - Some ESHs do not generate waste.
2. Waste attributed to development activity in the manufacturing departments could be achieved through the aggregation of direct labor hours changed to development. Disadvantages:
   - Direct labor hours are not on the same scale or units of ESHs.
   - Non-manufacturing departments would not have this data.
3. A suggestion is made to change the accounting system at the KCD to include a code which could be added to any charge number to indicate when waste is being generated. For example: One could differentiate between managing a project and when work is conducted which generates waste.
4. Another suggestion made for the accounting system at the KCD is the addition of a charge-back system for waste. This would not only help track the waste, but would help to identify the real costs associated with handling, transferring, storing, and treating the waste at KCD.
5. An alternative suggestion for accounting changes would be the Industrial Engineering accounting system. Waste hours or waste credits could be used to track waste generated. Disadvantage:
   - Only manufacturing departments would be involved.

Departmental:

1. Earned standard hours (ESHs) could be used as an activity index in a manufacturing department. However, the following shortcomings exist.
   - Product mix changes in a department will not be reflected in the ESHs.
   - Development and rework activity is not included in ESHs.
   - Non-manufacturing departments are not included.
   - Some ESHs don't generate waste.
2. Individual departments (or business units) would like the freedom to report their waste reductions by alternative methods other than ESHs. Two examples are shown below. (The differentiation of active and passive materials is made - see definitions.)

$$Index_{Active} = \frac{QuantityWaste}{QuantityUsed}$$

$$Index_{Passive} = \frac{QuantityWaste}{QuantityActiveUsed}$$

   Waste reductions are more clearly seen with this method, however, consistency is lost when departments are compared which have different indexes.
3. An activity index for non-manufacturing departments could be LTRs, work orders, etc., or waste-generating laboratory hours. Currently, the latter data is not collected and therefore past data is not available.