SOLVENT SUBSTITUTION FOR POLLUTION PREVENTION

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THE SUCCESSFUL IMPLEMENTATION OF A SOLVENT RECOVERY PROGRAM

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ABSTRACT

This paper provides a step-by-step approach for obtaining the technical background and program support necessary for the successful implementation of a solvent recovery program based on an existing program at a Boeing Aerospace and Electronics (BA&E) site in the Puget Sound Area.

INTRODUCTION

It has become apparent that many of the solvents being used in our manufacturing processes today are not only harmful to the environment, but to humans as well. Presently, there are two options to choose from when addressing the problem of environmentally harmful solvents. The first, and more preferred option, is to replace these solvents and paints with substitutes which are as effective, but are not as harmful (eg., replace organic-based materials with aqueous-based materials). Unfortunately, substitutes have not been developed for all processes and may not be for many years. In the interim, harmful chemicals are being released into the atmosphere and disposal costs for these spent solvents are escalating. Until substitutes are available, recycling remains an option that minimizes the generation of hazardous waste and results in considerable cost savings.

PROCEDURE

Step One - Research Background

The first step is to determine the solvent which will best suit your company's needs and evaluate the technical and economic feasibility of recycling this solvent.

Conduct a shop survey. Find out which solvents the shop(s) are currently using. Ask the following questions:

- Would the shop(s) prefer using a substitute that works better, but may not be economically feasible at this time?
- Would it be feasible to change to the more desirable solvent if it was being recycled?
- If the shop(s) are generating different types of solvents, are they willing and able to switch to an universal solvent? (This will avoid the generation of small quantities of different types of spent solvents).

Review historical records (i.e., purchasing and disposal records). This data will help to determine what quantities were consumed and to illustrate trends. Historical records can also be used to verify the information supplied by the shops and other personnel.

After the type of solvent(s) to be recycled has been determined, obtain information on recycling equipment that will be used. Perform a literature search. Interview vendors and survey other organizations and companies that have processes similar to yours to find out if they already have a program in operation. Capitalize upon their past experience. This can save time and money by preventing future problems and duplication of work.

Investigate the regulations and restrictions that may effect this program. This should be done at the federal, state, local and company levels. Agencies at the federal level include the Environmental Protection Agency (EPA), Occupational Safety and Health Administration (OSHA) and National Fire Protection Association (NFPA). The state regulations may be more stringent than regulations on the federal level. Local restrictions would include city and county codes enforced by the fire department, building inspectors, the local air and water regulatory agencies and local transportation criteria. These codes may require permits for the equipment, the location, transportation of the materials and building additions or modifications. Larger companies may have their own fire department, fire protection engineering, safety, industrial hygiene and other governing organizations that will have some prerequisites for this program. Be sure to consult these organizations early and keep them informed.

A pilot scale study is recommended. This can be accomplished by renting, leasing or borrowing equipment from a vendor for several weeks to months depending upon the complexity and magnitude of the program. The pilot study will test the logistics of the entire system, determine the division of labor, and identify and troubleshoot any unexpected problems prior to the purchase of equipment. Samples should be taken during the pilot study to verify the quality of the recycled solvent. The pilot study will indicate the size of equipment necessary for full scale operation. When sizing equipment, it is recommended that the equipment be oversized to allow for additional streams in the future, errors in data and downtime due to maintenance and repairs.

Step Two - Develop Support

The second step is to develop support for the project to ensure its success. First, gain management support by demonstrating the economic and other benefits gained from the program. Show management that the process fits within the company structure, policy and philosophy. Management support is needed to obtain the necessary resources such as capital, labor, and space. Management can also mandate shop participation.

It is also important to continue working with the regulatory agencies. Work with the fire agencies to insure that equipment, procedures, installation and location are all acceptable. Use OSHA regulations or work with OSHA representatives within your company to develop safe operating procedures for the equipment and handling of recycled and spent solvent. Safety, hygiene and toxicology personnel can also be helpful in developing a Material Safety Data Sheet (MSDS).

Develop a good rapport with the shop(s) and its management. Make the project a team effort by keeping the shop(s) informed from the beginning, soliciting their suggestions and making them understand that it is ultimately their program. Shop support is crucial for the program's success.

Step Three - Implementation

Implementation of a program consists of coordinating and troubleshooting. The location of the equipment must now be determined. Ensure that the equipment will be accessible. The location should be acceptable to all parties involved (eg., the Fire Department, Fire Protection Engineering, the site environmental group, plant engineering, transportation, layout, the using organization and the organization(s) generating the spent solvent).

Training of personnel will also have to be coordinated. This includes the operator of the new equipment and the shop personnel generating the solvent. The shop management needs to concur on exactly what is expected of their personnel to support the program once it is implemented.

Construct a manual describing the process procedure and assigning responsibilities to each group involved in the program. Identify key personnel to contact in each organization. This will eliminate grey areas. In the future the manual will be a useful reference for new personnel.

Following the guidelines discussed above will minimize problems. However, complications can arise. The equipment may fail. Contact the manufacturer to discuss troubleshooting and repairs should equipment malfunctions occur. Beware of misinformation from the vendor. As a rule, research all equipment associated with the process (i.e., chillers, pumps, heat exchangers, condensers, etc.) and if possible get guarantees on all purchases. If it is not practical to return malfunctioning or inapplicable equipment to the manufacturer, it may be necessary to make changes to the process, location or installation. For example, upon startup of this program it was discovered the chiller should not be operated outdoors or at ambient temperatures below 50°F. This system was located outside and was operated when the temperature was below 50°F. Unfortunately, this information was not known prior to purchase and installation of this equipment. During winter, the chiller began to malfunction and shut down. To solve this problem, the chiller was moved indoors.

Key personnel may become obstacles. The equipment operator may lack enthusiasm about his/her new duties. It may be necessary to spend additional time with the operator and provide information which will explain the purpose and goals of the program. The shop personnel may also cause problems. They may not care to participate or they may misunderstand the procedures. The shop personnel may also require additional training or monitoring during the initial months of the program until the procedures become a part of their daily routine. Changes in key personnel involved with the program may occur from the initial to the final stages of the project. Forming alliances with these new personnel and educating them on the program will require additional time and effort. Regulations change daily and as a result may require adjustments in the program and its procedures. Keep abreast of new or anticipated changes that may effect this program. Production may also change. Flexibility should be built into the program to cushion these production changes. The characteristics of the waste may change. The product quality can be verified by taking samples throughout the program.

By conducting the pilot study, other problems can be avoided. At the Boeing Aerospace and Electronics sites in the Puget Sound area, spent solvent and unused paint were combined and disposed of offsite. This combined waste stream was initially distilled during the pilot study. It was discovered that the concentration of paint in the solvent was too high to obtain a good separation via distillation. Segregation of spent paint and spent MEK prior to distillation was prescribed to solve this problem.

Different types of stills are available on the market. The conventional still is a cylindrical tank with a manhole at the bottom to shovel out the sludge. Removing this sludge is a chore, since it is a combination of waste paint and solvent that has been heated but has not completely evaporated. There are manufactures that have attempted to remedy this situation by adding polypropolene or Teflon bag liners to contain spent solvent and protect the walls of the still pots. This method is convenient as long as the pot is not too deep (bag liners in deeper stills tend to tear when being removed, therefore a shallow wide bowl is recommended for this technology). The waste should not contain constituents that will wear or dissolve the liner. This can be verified with the vendor.

Some vendors may try to incorporate other manufacturers' technology into their equipment. The utilization of bag liners in stills has been adopted by many manufacturers and vendors because it makes the still bottoms much easier to handle, causes less wear and tear on the still and reduces the chances for spills. Although manufacturers and vendors may be correct when stating that their equipment is capable of utilizing another company's technology (eg., bag liners, condensers, etc.), it is recommended to research if there are patents which would prohibit use of the technology or require royalties to the patenting company. It is less complicated to buy from the originator of the idea or patent (check on patents pending).

During the pilot study at BA&E it was determined that the recycled solvent can only be used for cleanup applications because of the stringent specifications for solvents used in production operations. Use of the recycled solvent for production would require costly and time consuming tests on each batch to verify its quality. Fortunately, the quantity of solvent needed for cleanup purposes exceeded the quantity of recycled solvent produced.

CONCLUSION

In organizations where waste solvent is generated, solvent recovery is critical to proactive waste minimization. Thorough research and an organized step by step approach are key to the success of a solvent recovery program. Implementation of a solvent recovery program requires obtaining technical information while gaining positive program support from management, shops and regulating agencies. Incorporating technical and persuasive skills in an organized manner is vital for the success of this program. Remember, the idea won't reduce hazardous waste or save money unless it is successfully implemented.

Case Study Boeing Aerospace and Electronics' Plant II site in Seattle, Washington was consuming 19,000 gallons of Methyl Ethyl Ketone (MEK) per year (based on a 1989 Sara 313 Report). The disposal cost of spent MEK and associated wastes was approximately $330,000 annually. A pilot study found that it was possible to recover up to 90% of the spent solvent. Based on this data, Boeing purchased a distillation unit which was installed at a central hazardous waste accumulation area at Plant II. The installed cost of this unit was approximately $55,000, including a closed-loop chiller. Boeing anticipates an annual savings of $200,000 with a payback period of less than 4 months. Once the program began, minimal problems were encountered. Some obstacles included minor equipment malfunctions, lack of enthusiasm from shop and other associated personnel, skepticism towards using recycled solvent, health related questions and batches of spent solvent that were not reclaimable. BA&E Plant II site is now recycling spent solvent and using this recycled solvent for cleanup operations.