



Hazardous Solvent Substitution¹

Kevin E. Twitchell
Idaho National Engineering Laboratory

RECEIVED
OCT 2 / 1995

The best way to deal with hazardous waste is not to generate it. This paper discusses the assistance that is available, primarily from the government, in the area of hazardous solvent substitution. **OSTI**

No matter what your line of work is, you have, and probably will use, hazardous cleaning solvents. For example, I am a software engineer, an occupation that should be relatively safe from hazardous cleaning solvents. However, at one time I was a system administrator of a mini-computer. One of my monthly duties was to clean the read/write heads of the magnetic tape drives. My cleaning process was to spray some freon from my pump spray bottle² onto a three-inch square of disposable material and then wipe it over the tape heads. After I finished cleaning the tape heads, I tossed the square of material into the trash. Then the new rules and regulations went into effect. My square of material had been contaminated with freon; it could no longer be placed in the trash. It was a hazardous waste stream! I had to place the used square of material in a satellite accumulation area. I had to log it. I had to report on my waste stream quarterly. Needless to say, I was motivated to stop using freon. I found an alternative cleaning agent.

The time has come for all of us to stop using hazardous cleaning solvents and to find replacements. There are four primary reasons to find alternatives for hazardous cleaning solvents:

- 1) We are concerned with the environment. We want to protect the environment not only for ourselves, but for future generations.
- 2) We are concerned with worker safety. Although there are undoubtedly exceptions, we want the best for our fellow workers. Employers are concerned with the health and safety of their employees. They are also concerned with potential liability lawsuits that could arise from not being sufficiently vigilant regarding health and safety.
- 3) We feel motivated to discontinue use of hazardous solvents because of state and federal regulation. We want to be law-abiding³ citizens. We also want to avoid the fines and penalties that are associated with the failure to comply with laws and regulations.
- 4) We want to maximize profit. Hazardous solvent substitution can improve the bottom line by reducing operating costs and avoiding potential costs. Ozone depleting solvents are becoming more and more expensive now that production has been terminated and the supply is dwindling. Because of required safeguards and of disposal costs, it can be more expensive to operate with hazardous solvents than with more

¹Work supported by the U.S. Department of Energy, Assistant Secretary for Environmental Management, under DOE Idaho Operations Office Contract DE-AC07-94ID13223.

²I certainly wasn't going to do damage to the ozone by using an *aerosol* spray can.

³This assumes, of course, that we can understand the laws and regulations that we should be complying with.

MASTER

benign solvents. The absence of hazardous solvents virtually precludes the possibility of fines for improper handling, storage, and disposal of the solvents.

Eliminating hazardous solvents is good for the environment, worker safety, and the bottom line. However, even though we are motivated to find replacements, the big question is "What can we use as replacements for hazardous solvents?" You, too, can find replacements for your hazardous solvents. All you have to do is search for them. Search through the vendor literature of hundreds of companies with thousands of products. Ponder the associated material safety data sheets, assuming of course that you can obtain them and, having obtained them, that you can read them. You will want to search the trade magazines and other sources for product reviews. You will want to talk to users about how well the product actually works. You may also want to check U.S. Environmental Protection Agency (EPA) and other government reports for toxicity and other safety information. And, of course, you will want to compare the product's constituent chemicals with the many hazardous constituency lists to ensure the safe and legal use of the product in your workplace.

If you feel reluctant to engage in this paper chase, you could use solvent substitution data systems to quickly search for information and find the appropriate solvent for your cleaning process. Many of these data systems are available from the government and, therefore, are free.⁴

A word of caution is in order when using solvent substitution data systems. Some systems simply list replacements (i.e. use this "good" product instead of that "bad" product). This approach doesn't work for two reasons.

First, hazardous solvents, such as ozone-depleting solvents, can be multi-purpose cleaners. For which of the many properties of the "bad" product is the "good" product being recommended? For example, when I cleaned the read/write heads of the magnetic tape drives, I used freon because it did not leave a residue. This was of critical importance. Freon is also an excellent degreaser, a trait that was not essential to my cleaning operation. Now, is the "good" product recommended because it does not leave a residue or because it is a superior degreaser? I needed an alternative product that met the needs of my cleaning process.

Second, while the replacement solvent may be safe by itself, it could be hazardous in your overall operation. What happens to the solvent during your cleaning process? Is it mixed with other chemicals that results in a hazardous mixture? What do you do with the spent solvent? One facility decided to extract and recycle potable water from its nonhazardous waste stream. While the recycling was certainly admirable, the remaining effluent was concentrated and became hazardous waste. It is crucial to look at your entire operation rather than just your clean process when deciding on a substitute solvent.

I recommend a process-oriented approach. Ask yourself, "What am I cleaning? What am I attempting to remove? What other considerations are important in my cleaning process and my entire operation?" Select only those solvents that provide satisfactory answers to these three questions.

The following is an overview of six sources of solvent substitution information. These systems are discussed because they will be the first to become part of an Integrated Solvent Substitution Data System (ISSDS).

⁴Of course, these data systems aren't *free*. You pay for them with your tax dollars. I use the term "free" to mean that you don't have to pay directly (or voluntarily) to use these data systems.

The EPA's Solvent Alternatives Guide (SAGE) is a stand-alone, PC-based system. It is free and can be downloaded from an EPA bulletin board, the Technology Transfer Network (TTN). It provides general advice on cleaning processes (e.g., low pressure spray, ultrasonic), as well as chemistries (e.g., aqueous, terpene). To use the system, you answer questions about part material, size, shape, coatings, soils, cleanliness requirements, etc. Based on your input, SAGE will generate cleaning process and chemistry recommendations. SAGE provides general and detailed information about processes and chemistries, case studies, environmental information concerning regulations and disposal, references, and safety information. It can also provide a list of products on the Significant New Alternatives Program (SNAP) list. And it will tell you who to contact in your state for additional assistance.

The Hazardous Solvent Substitution Data System (HSSDS) was created at the Idaho National Engineering Laboratory (INEL), a facility operated for the U.S. Department of Energy (DOE). Currently, you must register as a user to access HSSDS. Upon registration you will receive a reference manual, a tutorial, and connection information. You access HSSDS as a remote user by means of the Internet or a modem. As with SAGE, this system is free. To query HSSDS, describe your cleaning process ("What are you cleaning? What are you attempting to remove? What other considerations are important?"). The system then searches vendor literature to find appropriate products. Material safety data sheets (MSDS's) are available, as well as other available information (e.g., toxicology data, constituent chemicals, usage information). The documents describing products are scored based on relevance to your query. This makes reviewing the results of your query easier since the most relevant documents are at top of the results list. HSSDS provides the vendor literature for suggested products; however, the buyer should beware! The vendor information has not been verified or validated for accuracy.

The Department of Defense (DoD) Pollution Prevention (P2) Technical Library was prepared by the Naval Facilities Engineering Service Center (NFESC). Until recently, it was available only to the DoD community. It is now available, at no charge, on Enviro\$en\$e (which will be discussed later). The P2 Technical Library contains information on ozone-depleting substances (ODS); solvent substitution and alternative products; painting and repainting technologies; electroplating and bath life extension; wastewater management and reuse; petroleum, oil, and lubricants recycling and reuse; solid waste management; hazardous material management; and hazardous waste management.

The Solvent Handbook Database System (SHDS) is another free system created at the INEL (for the DOE). As with HSSDS, access is free, but you must register as a user to receive a user manual and connection information. You access SHDS as a remote user by means of the Internet or a modem. SHDS contains between \$2 and \$3 million of laboratory test data. Testing was conducted using 111 degreasers and 13 paint strippers with 26 metal alloys and 16 contaminants. Available information includes cleaning efficiency, corrosivity, air emissions, product safety, and recycling/recovery information.

Two systems from the National Center for Manufacturing Sciences (NCMS) will be included in the ISSDS. While these systems did not originate with the government, NCMS is generously making these systems available as part of the solvent substitution data system integration effort. Currently, both are PC-based, stand-alone systems. One system is the Solvent Alternatives Database. It provides information on 320 pure solvents and trade mixtures. It offers environmental fate information, health and safety data, regulatory status information, chemical and physical properties, and information about suppliers. You query the system by specifying the desired properties of the solvent. For example, you could search for (and find) solvents with a flash point less than 140°F and that are not SARA 313 listed. The other system is the Materials Compatibility Database. It contains approximately \$1 million of laboratory test data. It has information on seven non-ozone depleting chemicals (ODCs) and two ODCs (included for purposes of comparison) with 124 materials commonly used in electronics manufacture.

The preceding six solvent substitution data systems will be integrated and made available from a system called EnviroSense. EnviroSense is funded by the Strategic Environmental Research and Development Program (SERDP) through the EPA, DOE, and DoD. It is the successor to the EPA's Pollution Prevention Information Exchange System (PIES). The information on PIES has been updated and merged with information from the EPA's Federal Facility Leadership Exchange (FFLEX). There are currently two versions of EnviroSense: (1) a computer bulletin board system (BBS) and (2) a World Wide Web (WWW) site. There are no charges to users of either version of EnviroSense. Both systems offer users the ability to browse and search for specific information. Users may download files from both systems. Access to the EnviroSense/BBS system is by means of modem. The BBS version offers a text-based interface. First time BBS users register on-line — be prepared to enter (and not forget) a password. BBS users may upload files as well as send and receive messages. EnviroSense/WWW users access the system by means of the Internet (direct dial-up modem access may be added later). The WWW version offers the same information as the BBS version. In addition, the WWW version offers a graphical user interface (point-and-click) as the primary interface; a text-based interface is also available. Uploading files and messaging will be added to the WWW version in the future. EnviroSense/WWW offers links to other systems on the Internet, such as the Great Lakes Information Network (including information from the P2TECH list server), the Pollution Prevention Research Projects Database, the Energy Efficiency and Renewable Energy Network, and the Department of Energy Pollution Prevention Information Clearinghouse.

As is evident from the above discussion of the six solvent substitution data systems, you, as a user, face a major problem: learning how to use each system. Each of the six systems offers a different user interface with a different command syntax. Each offers different information and requires a different way to access that information. The purpose of the integration effort is to provide users with a data system, the ISSDS, with a single command structure. The ISSDS will include an intelligent engine to extract and synthesize information from the distributed component data systems. In addition, existing solvent test data will be collected and made available as part of the integration effort.

You will need an Internet connection to access ISSDS. This connection could be a direct connection (such as many universities and federal government agencies have) or it could be by means of modem (e.g., to an Internet service provider). You will also need TCP/IP software, which allows your computer to talk to the Internet. You will need a WWW browser (Mosaic and Netscape are two popular browsers). You will also need a computer with sufficient capacity to handle graphics.

The modem telephone number for EnviroSense/BBS is (703) 908-2092.⁵ The URL (Uniform Resource Locator) for EnviroSense/WWW is <http://wastenot.inel.gov/envirosense/>. There is a section on solvent substitution data systems available from the first page of EnviroSense/WWW. For additional information, please contact

Kevin E. Twitchell
Idaho National Engineering Laboratory
P.O. Box 1625
Idaho Falls, ID 83415-3730
twi@inel.gov
(208) 526-6956

⁵Set your communications software to 8 data bits, no parity, 1 stop bit. Emulate an ANSI or VT-100 terminal. Your modem speed may range from 2,400 to 14,000 Kbs.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.