The Coatings Guide™: An Online Information Resource

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ABSTRACT

The Coatings Guide™ is a free online information training resource that focuses on alternative, low-emission coatings for metal and plastic substrates. Developed cooperatively by the United States Environmental Protection Agency's (EPA's) Office of Research and Development and Research Triangle Institute (RTI), its purposes are to provide unbiased information about coating technologies, focus attention on low-emission coatings, and help businesses deal with the cost considerations of switching to a new coating system. Many technical assistance providers have used the Coatings Guide™ as a training tool. It is designed to be a one-stop shop for environmentally friendly coatings information on the Internet and provides several helpful tools for small businesses. These include:

- An *Expert System* to help users identify drop-in or readily applied coating alternatives that may be best for them based on answers to questions about their particular processes.

- A *Coating Alternatives Information* feature that summarizes information on over 30 generic coating types. For each coating type, users can find information about acceptable substrates, surface preparation, application methods, process considerations, curing, and performance.

- A *Cost Tool* to identify and calculate the annual and capital costs of converting from one coating technology to another.

- A *Source Category References* component, which is an Internet tool created to support New Source Review permit writers. The finder provides information on volatile organic compound

(VOC) and hazardous air pollutant (HAP) emissions associated with a range of commercially available coating technologies.

- A *Product Guide* featuring low-emission coating technologies available from vendors. This feature is provided only as an information dissemination service.

This paper follows the use of the Coatings Guide™ from the perspective of a fictitious small business user who is trying to identify an environmentally acceptable alternative for an existing coating system.

INTRODUCTION

I own a fictitious small business called Henry's Furniture Company and will summarize how I used the Coatings Guide[a] to help me select and analyze an alternative topcoat for a low-solids, solventborne baked alkyd currently used by my company. I learned about the Coatings Guide™ at a workshop given by the U.S. Environmental Protection Agency's (EPA's) Waste Reduction Research Center (WRRC) in Raleigh, North Carolina. In WRRC's *Pollution Prevention and the Internet* training session, all trainees were taken to the Coatings Guide™ website and led through a simple example. This helped me to understand how to use the Coatings Guide™ and its value. It energized me to apply it to evaluate changes at my facility.

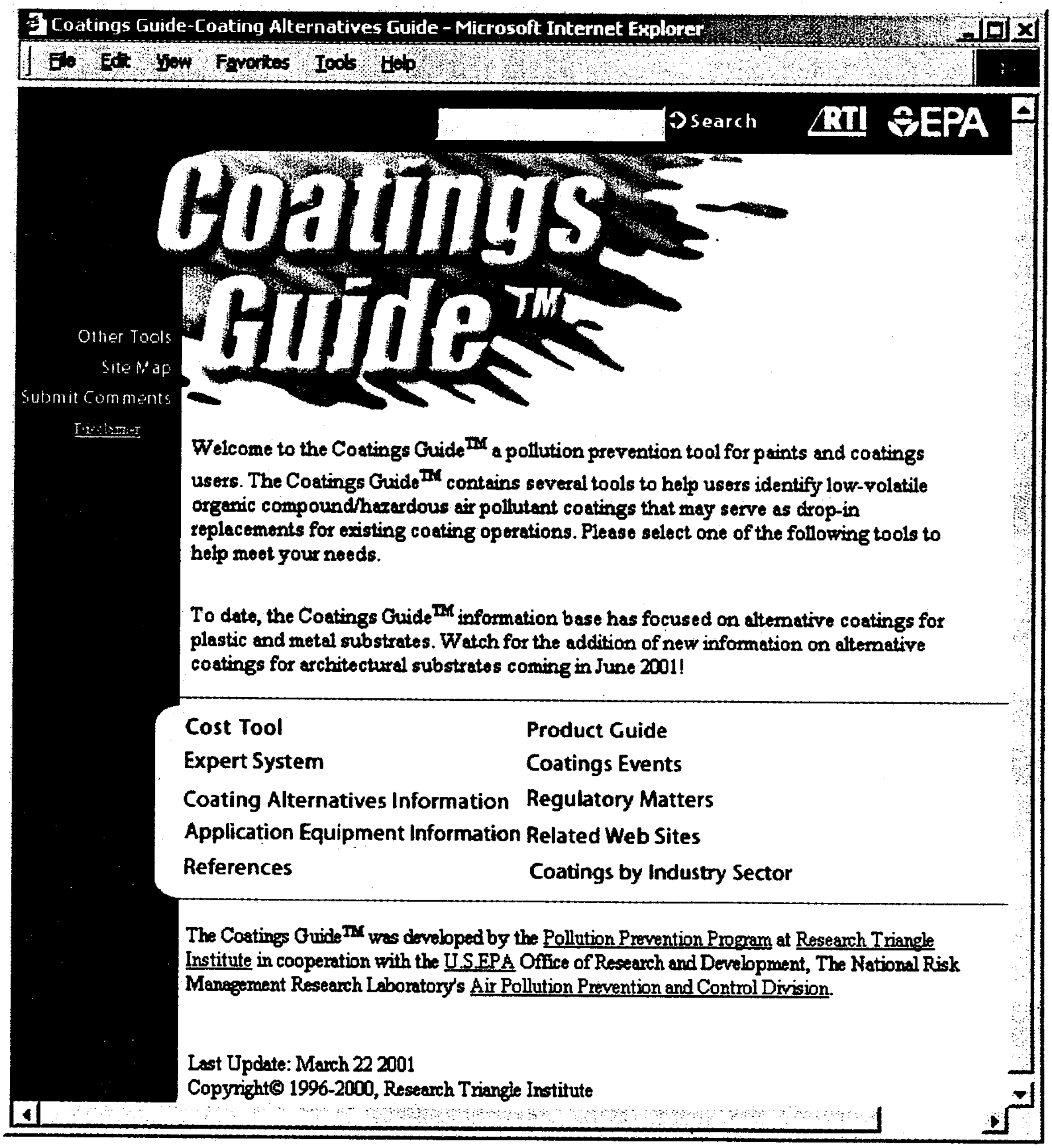
The Coatings Guide™ is a pollution prevention tool provided freely on the Internet and designed to help small-business coaters of metal and plastic substrates identify low-emission coating alternatives as potential drop-in replacements for existing operations. On the Internet, the Coatings Guide™ can be found at http://cage.rti.org.[1] The Coatings Guide™ was developed as a cooperative research effort between the EPA's Office of Research and Development and Research Triangle Institute (RTI).

The WRRC distributes pollution prevention information throughout the Southeast and Mid-Atlantic states in support of EPA Regions 3 and 4. WRRC is co-located with North Carolina's Division of Pollution Prevention and Environmental Assistance, a state technical assistance provider, in Raleigh, North Carolina. I understand that WRRC is only one of several organizations (*e.g.*, the Tennessee Valley Authority [TVA]), EPA Regions, and states (*e.g.*, Ohio, Massachusetts, and South Carolina) that have provided training on, or introduced the use of, the Coatings Guide™, particularly to state and local technical assistance providers that support small- and medium-sized businesses throughout the United States. The Northeast Waste Management Officials' Association (NEWMOA) used the Coatings Guide™ in developing its Pollution Prevention in Painting and Coating Operations: A Manual for Technical Assistance Providers.[2]

I learned a lot at the training session. As Figure 1 illustrates, the Coatings Guide™ features three

[a] Formerly known as the Coating Alternatives Guide (CAGE)

Figure 1. The Coatings Guide™ Allows Access to Tools Such as the Expert System, the Cost Tool, Coating Alternatives Information, and Source Category References (Coatings by Industry Sector)



major components: an Expert System, a Coating Alternatives Information feature, and a Cost Tool. Other tools include a Product Guide and a Source Category References section. The Expert System assists the process engineer in a coating operation by asking questions about the existing process and pointing to potential solutions. These solutions are qualitatively ranked coating alternatives that could serve as drop-in replacements. The Coating Alternatives Information feature supports the Expert System by providing access to information about alternatives and by identifying vendor contacts. The Cost Tool feature is designed to estimate the cost of converting to lower polluting processes.

This paper will summarize the use of each of the Coating Guide's features with respect to a proposed coating process change scenario for the fictitious Henry's Furniture Company to demonstrate the functionality of the Guide.

THE EXAMPLE SCENARIO

Henry's Furniture Company has a coating operation that manufactures high-end desks, credenzas, and filing cabinets. The company employs 350 factory workers, 25 of whom work in the finishing department. Production is 600 pieces per day, of many different sizes. Two 8-hour shifts operate per day to maintain this production rate. For the most part, the pieces to be coated are cold-rolled, oiled steel. The company has high quality control (QC) expectations, thereby meeting customer demands for high quality products. Some critical expectations include color, color consistency, coating appearance, and final film performance.

The first step in Henry's production line is degreasing to remove mill oils from the pieces. This is followed by a five-stage iron phosphate pretreatment system. Next, pieces are conveyed to the first primer spray booth where a low-solids, solventborne polyester primer that requires baking is applied by an automated electrostatic disk to a dry film thickness (DFT) of 1.0 mil (0.001 in., 0.00254 cm, 0.0254 mm). A second primer spray booth follows, where the operator uses an electrostatic manual spray gun to touch up areas missed by the electrostatic disk. The primed parts then enter a convection bake oven with infrared (IR) heating to cure the primer at 350°F (177°C) for 25 minutes.

After leaving the oven and cooling to near ambient temperature, the primed parts enter a topcoat spray booth to receive a color coat of polyester enamel (a low-solids, solventborne alkyd that requires baking). Robotic electrostatic bells are used to apply the first color coat. In a second paint spray booth, an operator uses an electrostatic manual gun to apply the second color coat. A target DFT of 1.2 mils (0.00305 cm) is required. Topcoated parts are conveyed to a second (topcoat) convection oven where the coating is cured at 350°F (177°C) for 15 minutes. Topcoat color changes occur frequently during the day, especially when special colors are required. The company uses 4 standard and 15 special topcoat colors.

After cooling, the parts are removed from the conveyor and assembled into finished products. Approximately 24 hours after assembly, the finished products are packaged and shipped to our customers.

USE OF THE COATINGS GUIDE™

The Expert System

For my application, I had the Expert System of the Coatings Guide™ target the process step in which steel parts, already primed with a DFT of 1.0 mil (0.00254 cm) of baked low-solids polyester primer, are topcoated. The company's objective is to reduce process volatile organic compound (VOC) emissions while maintaining product quality and reducing or maintaining production costs. The Expert System feature identified coating options to replace the existing solventborne baked alkyd topcoat.

Much as a process engineer would, the Expert System feature of the Coatings Guide™ asked me questions about typical parameters of my coating process. Based on my answers, the Expert System ranked alternative coating technologies that would best suit my selected conditions. The key questions in the Expert System dealt with pretreatment, part dimensions, part properties, and performance requirements. It also asked questions about the current application method, process, and curing system. According to each answer provided to the Expert System, 22 different coatings were ranked on a normalized scale of zero to 100. Based on expert opinions embedded in the software, the coatings that matched well with submitted answers received the highest scores. The coatings that did not match well received scores closer to zero, but were still shown to me for comparison purposes. So, let's see what happened when I used the Expert System.

I entered the answers to questions asked by the Expert System about the current primer, topcoat, application system, and pollution control systems. After answering all of the Expert System questions, five major determining inputs were important:

1. Henry's Furniture wants to stay as close as possible to the existing topcoat,
2. We have no pollution control systems in place for our curing operation,
3. We have water wash curtains in place to capture paint overspray in the application area,
4. The current coating delivery system is made of carbon steel, and
5. We are unwilling to invest in changes to our application systems and pollution control equipment.

I was able to run multiple scenarios through the Expert System to see how the scores adjusted as different variables were selected or changed.

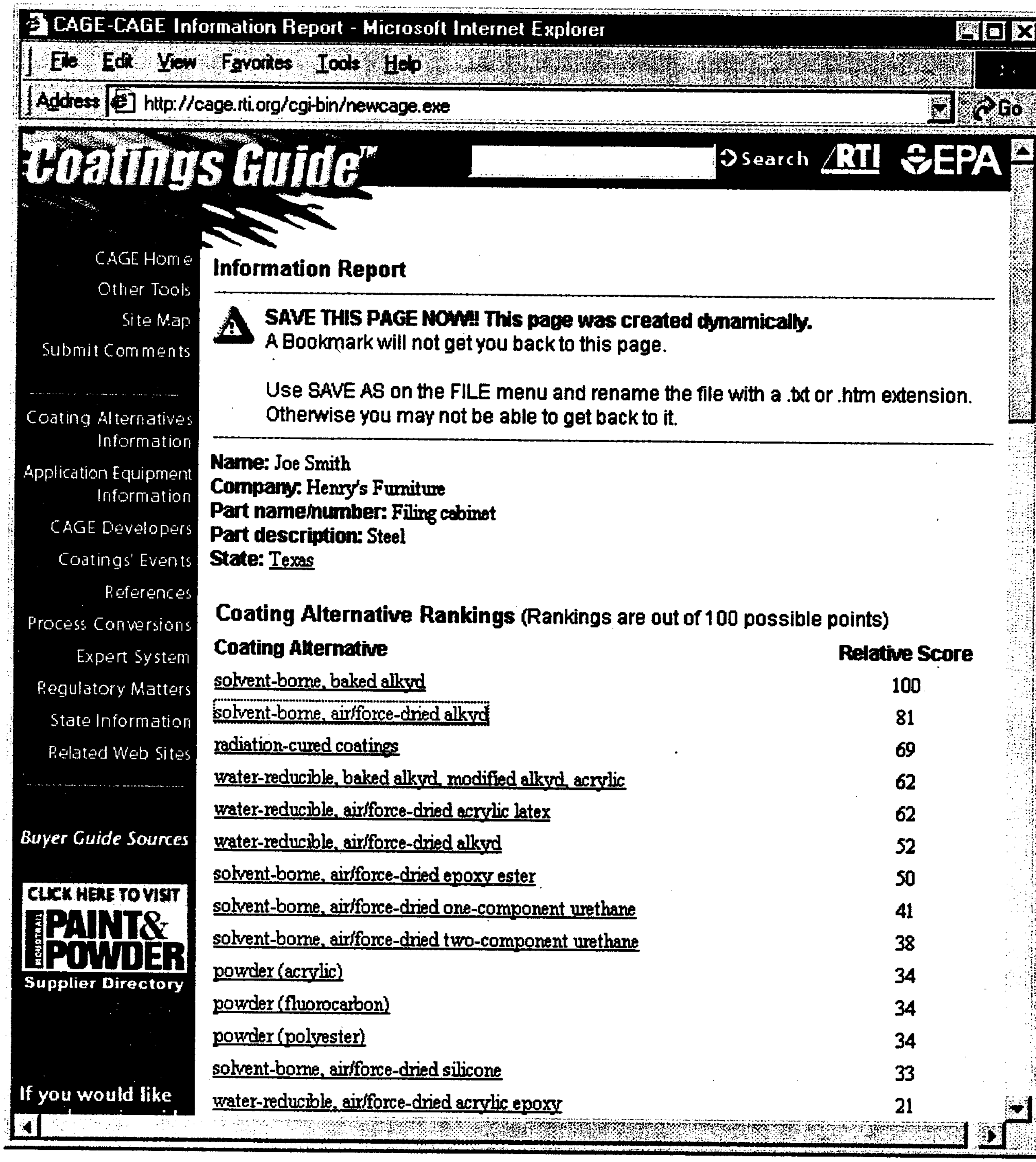
For my particular scenario, the top results provided by the Expert System are shown in Figure 2.

They were:

solventborne baked alkyd (score of 100),
solventborne air/force-dried alkyd (score of 81),
radiation-cured coatings (score of 69),
water-reducible baked alkyd coatings (score of 62), and
water-reducible air force-dried coatings (score of 62).

Powder coatings, along with other technologies, would have ranked higher; however, I indicated that we did not want to change our application equipment. Since we use a solventborne baked alkyd, and want to reduce VOC emissions, the most likely drop-in candidate was the waterborne baked alkyd. The Expert System feature served its purpose as a first-cut decision support tool for

Figure 2. Results from the Coatings Guide™ Expert System for Henry's Furniture Company



me before I spoke with coating vendors, equipment vendors, or consultants to determine possible replacements for our existing solventborne coating. The Expert System provided questions and answers that helped me narrow down coatings that might be most appropriate for the conditions selected, and allowed me to test multiple scenarios to see how coatings would be ranked, based on different variables. While in our case we wanted to change only our topcoat, the Expert System has a built-in system that automatically adjusts rankings for all alternatives if the user is willing to change its cleaning, pretreatment, primer coat, application, coating delivery system, curing, or air pollution controls and treatment systems. It helped me to understand how other coatings might be ranked.

Other features of the Coatings Guide™ will help me determine if the waterborne baked alkyd is a feasible, cost-efficient replacement.

The Coating Alternatives Information Feature

The Coating Alternatives Information feature contains knowledge about 31 generic coating chemistries, including one- and two-component solventborne and waterborne, radiation-curable, powder, electrocoat, and autophoretic coatings. Table 1 lists the generic coating chemistries.

Table 1. Generic coating chemistries covered by the Coating Alternatives Information feature of the Coatings Guide™.

SOLVENTBORNE	WATERBORNE	POWDER	MISCELLANEOUS
Air/Force-Dried Alkyd	Air/Force-Dried Alkyd	General Powder Information	100% Solids (Plastisols)
Air/Force-Dried Epoxy Ester	Air/Force-Dried Acrylic Latex	Epoxy	UV Curable Liquids
Air/Force-Dried Two-Component Epoxy	Air/Force-Dried Acrylic Epoxy	Epoxy-Polyester Hybrid	Electron Beam Curable
Air/Force-Dried Two-Component Urethane	Air/Force-Dried Two-Component Epoxy	Polyester	Autophoretic
Air/Force-Dried One-Component Urethane	Air/Force-Dried Urethane Dispersions	Acrylic	Electrocoat
Air/Force-Dried Silicone	Baked Alkyd, Modified Alkyd, Acrylic	Fluorocarbon	
Baked Alkyd	Two-Component Silicone Acrylic	Urethane	
Zinc-Rich Primers		Polyethylene	
		Nylon	
		Polyvinyl Chloride (PVC)	
		UV Curable	

These generic coating chemistry alternatives represent VOC and hazardous air pollutant (HAP) contents of less than 420 g/L (3.5 lb/gal). As shown in Table 2, information is arranged in 13 subcategories for each alternative technology and is summarized from various coatings journals, trade publications, engineering manuals, and expert advice. Each entry is linked to its source in the references for that particular coating listing in the Coating Alternatives Information feature.

Table 2. Subcategories of information for each coating chemistry in the Coating Alternatives Information feature of the Coatings Guide™.

SUBCATEGORIES OF INFORMATION	
Summary	Performance
General Information	Environmental
Substrate	Safety
Surface Preparation	Economics
Application Methods	Case Studies
Process Considerations	References
Curing	

I accessed the Coating Alternatives Information feature for information about high-solids solventborne baked alkyds and waterborne baked alkyd coatings – two of the highest ranked alternatives provided by the Expert System. I found many similarities between the two coating types. They are:

- Both one-component coatings provide excellent physical and chemical properties. Typical uses for either coating include metal furniture.

- Both coatings require phosphate pretreatment as a conversion coating. Since our existing process includes phosphating, this poses no problem for waterborne baked alkyd as a potential drop-in alternative.

- Low-VOC content formulations of 275-360 g/L (2.3-3.0 lb/gal) are available for both coatings[b]. One of the case studies for waterborne baked alkyds (Mackie Designs) used a coating with a VOC content of 96 g/L (0.8 lb/gal).

- Cure temperatures and times are similar. The solventborne alkyds require curing at 350°F (177°C) for 10 minutes, while the waterborne alkyds require 400°F (204°C) for 10 minutes or more. The waterborne alkyds need a slightly higher temperature and/or a slightly longer curing time, which could slow down production. These curing temperatures suggest that only metal be coated with baking alkyds and that heat-sensitive materials be avoided. The high cure temperatures also contribute to increased energy usage. In any case, our existing oven appears to be capable of curing either coating.

[b] A typical regulatory VOC content limit for metal furniture is 350 g/L (2.9 lb/gal).

Possible advantages and disadvantages of either coating are:

- The high-solids solventborne baked alkyd may require heating the coating or special equipment for spray application. A waterborne baked alkyd can use standard equipment. One source recommended an airless spray at 200 psig with a 0.15- to 0.19-in. tip.

- When switching from a solventborne to a waterborne system, careful consideration should be given to choosing equipment due to the effect water has on corrosion of carbon steel. The use of stainless steel paint handling systems for waterborne baked alkyds leads to higher equipment cost. If we decide to use a waterborne coating, we may need to upgrade our paint handling equipment, since we are currently using a solventborne system.

- The Coating Alternatives Information feature of the Coatings Guide™ states that waterborne coatings have lower toxicity, lower odor, and lower flammability than solventborne coatings. On the other hand, it also states that waterborne coatings generally have higher concentrations of HAPs.

- High-solids solventborne baked alkyds have a potential problem with an 'orange peel' appearance. We would have to test such an alternative carefully. The Coating Alternatives Information feature states that waterborne alkyds usually meet or exceed the finish properties of their solventborne counterparts. On the other hand, effective surface cleaning and pretreatment are more critical to these finish properties than for solventborne alkyds, potentially leading to more time-intensive or expensive processing. Waterborne coatings meet industry standards for many top-of-the-line applications for many substrates that are not heat sensitive.

The Coating Alternatives Information feature also provides several insightful case studies. Two that are applicable to Henry's Furniture Company are:

- The Mackie Designs case study indicates that using a waterborne alkyd with a VOC content of 96 g/L (0.8 lb/gal) resulted in a 50 percent reduction of paint costs with a return on investment (ROI) of 18 months. It replaced a high-VOC solventborne system that used a catalyzed two-component urethane.

- In another case study, Eagle Corporation installed a fully automated, self-sufficient paint line for applying solventborne baked alkyds to premium aluminum windows and doors. This reduced painting cost and provided higher quality, more durable finishes. The new paint line allows Eagle to finish more than 3,000 parts in 10 to 20 colors during a single shift.

The Coatings Guide™ Cost Tool

Next, I used the Cost Tool to determine costs that might be involved in applying a new coating type, a waterborne baked alkyd, at our facility. I selected this coating after exploring its use with the Coating Alternatives Information feature of the Coatings Guide™. For users who want to evaluate the pros and cons of changing to a new coating type, the Coatings Guide™ Cost Tool is a way to identify the costs involved. A user selects the current coating system and a new system from 22 of the 31 generic coating chemistries listed in the Coating Alternatives Information feature. Categories of costs include applied material, equipment, energy, labor and maintenance, and non-traditional costs such as testing, training, health, and safety. A simple tab system leads the user through the tool to a final page, which calculates total annual cost per square foot for comparison of current and new coating systems.

After selecting solventborne alkyd as the existing system and waterborne alkyd as the new system, I proceeded to the applied materials screen. On this screen, I provided the cost per gallon for solventborne and the waterborne coatings, as well as the correct DFT, production rate, and application system. For other inputs, including transfer efficiency, I accepted the default values provided by the Tool.

I went through the same process for each Cost Tool cost category, at times accepting default values and at times changing the numbers. For instance, I accepted most of the defaults for the equipment costs, since we were not considering changing or upgrading our equipment. For energy costs, the bake temperature was increased to accommodate the waterborne coating, but all other defaults were accepted

After moving through each Cost Tool screen, I came to the cost comparison summary. The Cost Tool calculated that the waterborne coating was slightly more expensive per square foot to apply. The total annual cost per square foot was 1-2 cents more for waterborne alkyd than solventborne alkyd. To understand the difference, I looked at the itemized cost categories. While equipment, energy, labor and maintenance, and other costs remained nearly equal between solventborne and waterborne coatings, applied material costs and waste costs were slightly higher for waterborne coatings. The fact that the cost comparison summary showed differences only in applied materials and waste costs makes sense when considering that we were prepared to change only the coating type, and did not plan to make any changes in equipment or energy usage. In our case, the raw material cost per gallon of waterborne coating was slightly higher than the solventborne. That may not be the case for many other scenarios. On the whole, the waterborne coating could be less expensive depending on its performance properties, maintenance schedule, and other properties.

The Cost Tool helps companies like Henry's Furniture evaluate the relative differences between current and new coating systems. Built-in flexibility lets users personalize their input by selecting from 22 coating types. Input is also personalized when users replace the default values with numbers they know are correct. The accuracy of the Cost Tool largely depends on the accuracy of the inputs, but in either case can be used to identify relative differences between coating systems.

I found the Cost Tool easy to use. If I did not understand one of the required inputs, I could access pop-up definitions with a click of the mouse. In addition, I could print each page of calculations, so that I could discuss the results with my staff. While other cost models leave out equipment costs and nontraditional costs, or lump them into general overhead costs, the Cost Tool addressed equipment costs in detail, as well as other costs such as testing, training, and health and safety.

Additional Features of the Coatings Guide™

The Product Guide

I took some time to look at additional features of the Coatings Guide™. The Product Guide[c] provides information on specific low-emission paint products from various manufacturers. I could search for coating chemistries by VOC content, manufacturer's name, and type of coating. For more information on a particular formulation, I could easily find a manufacturer's contact name and number. This minimized the searching that I would need to do to find appropriate coatings and streamlined the process of finding the correct contact. For example, I consulted with the Product Guide to see which particular waterborne alkyd coatings might be available. When searching for waterborne alkyd coatings, the Product Guide identified seven options with varying VOC contents and cure schedules.

The Source Category References Feature

The Source Category References feature identified low-emission coating options that may allow us and other companies to achieve permit objectives. It also cross-referenced industry sectors (source categories) with the Coating Alternatives Information feature. For example, since Henry's is in the Metal Furniture source category, I clicked on that category to see which coating options, or other emissions reduction options, are listed for possible compliance with permit limits. The waterborne baked alkyd coating we are considering is listed under other options, like high-volume, low-pressure (HVLP) paint spray systems or the Laser Touch™ gun. I could also use the Regulatory Matters section to determine state offices that might be able to help us with various compliance or permitting issues.

Other Features

The References section of the Coatings Guide™ offers users a glossary of terms and a bibliography of sources. Another helpful feature is Related Web Sites, which provided a variety of links to coatings associations and manufacturers, pollution prevention sites, and miscellaneous coatings links for further research needs.

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[c] The information in the Product Guide is provided solely as a preliminary source of information from vendors on low-emitting coating alternatives for metal and plastic parts painting. Neither the U.S. EPA nor Research Triangle Institute makes any representations or warranties with respect to the contents or recommendations provided by the Product Guide.

DEVELOPMENTAL HISTORY OF THE COATINGS GUIDE™

After I used the Coatings Guide™, I contacted its developers to find out how and when such a useful and accessible tool was developed. This is what I learned.

The Coatings Guide™ was developed as a cooperative research effort between the U. S. Environmental Protection Agency (EPA)[d] and Research Triangle Institute (RTI). In late 1993, EPA personnel recognized the need for a tool that could be used by small businesses to identify and learn about lower polluting surface coating options. In 1994, the cooperative effort with RTI began. Its initial focus was to develop a software expert system that would act as a surrogate to the process engineer for coating operations. This would be accomplished by:

- Asking questions about the existing process which point to a solution,
- Having the software/expert system qualitatively rank alternatives,
- Providing the user with access to an information base to learn about coating alternatives, and
- Identifying contacts and vendors for coating users to approach for testing and detailed design.

EPA and RTI targeted the Coatings Guide™ by soliciting input from state technical assistance programs about user needs. Among many others, the Massachusetts Office of Technology Assistance and the North Carolina Division of Pollution Prevention and Environmental Assistance were particularly helpful. With this input, EPA and RTI decided on their initial metal and plastic substrates focus.

As the Expert System feature was developed, technical experts helped to fine-tune the recommendations of the Coatings Guide™. Experts included coating vendors and users, state technical assistance programs, and coating consultants.

The initial Coatings Guide™, the Coatings Alternatives Guide (CAGE), was made available in MS DOS™ on diskettes during the summer of 1995 as Version 1.0.[3] The Guide has been available on the Coatings Guide™ website since July 1996 as an evolving web-based tool[1]. At that time, EPA and RTI made a joint decision to stop supporting the diskette version for cost and utility reasons (*e.g.*, it was difficult to modify, update, and distribute the MS DOS™ version). Since the web tool was more easily updated and use of the Internet for accessing information was growing exponentially, we felt that our clients could get the best available information most efficiently through use of the Internet for distribution. Information in the Coating Alternatives Information feature has been updated at least annually, and many improvements to the Expert System and Coating Alternatives Information features have been completed.

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[d] More specifically, the U. S. Environmental Protection Agency, Office of Research and Development, National Risk Management Research Laboratory, Air Pollution Prevention and Control Division, Emissions Characterization and Prevention Branch.

In 1998, work was initiated to include tools to estimate the cost of converting to lower polluting processes. The initial version of the Cost Tool, designed to provide cost estimates within an order of magnitude, was released to the public during September 1999. After several rounds of feedback from industry and other experts and with subsequent improvements, the Cost Tool is significantly more accurate. The most recent version became available in July 2000.

In 1999, design of a structure for including formulations information was initiated. The resulting feature of the Coatings Guide™ is called the Product Guide and became available in August 2000. The Product Guide currently includes product information from three coating vendors. Active efforts to populate the Product Guide with additional product information have begun.

Presently, EPA and RTI are developing a structure to contain coatings information for architectural applications in the Coating Alternatives Information feature of the Coatings Guide™.

CONCLUSION

The Coatings Guide™ is a unique information resource on the web that covers a variety of coating topics that are useful for coatings businesses like Henry's Furniture Company. Decision tools that tackle surface coating issues include the Expert System, the Coating Alternatives Information feature, the Cost Tool, the Product Guide, and Source Category References. Each tool answers questions relevant to most coating applicators, including: Which coating is best for me? What are the costs involved? How can I find coatings with lower emissions?

ACKNOWLEDGMENTS

Much of the material included in this paper comes from an article that the authors prepared for publication in *Metal Finishing* magazine.[4] The authors would also like to thank Ron Joseph of Ron Joseph & Associates, Inc., San Jose, CA, http://www.ronjoseph.com, for providing the Henry's Furniture Company scenario that was used in this paper.

DISCLAIMER

This paper has undergone U.S. EPA's peer and quality assurance reviews and is approved for publication. The paper does not necessarily reflect the views and policy of the U.S. EPA. Neither the U.S. EPA nor RTI makes any representations or warranties with respect to the contents or recommendations provided by the Coatings Guide™ program. The Coatings Guide™ is provided as an information dissemination service only. The information it contains is provided solely as a preliminary source of information on low-emitting coating alternatives only for metal and plastic parts and products painting. The U.S. EPA and RTI do not recommend the use of any particular coating chemistry. Any mention of trade names or commercial products does not constitute recommendation for use or endorsement.

REFERENCES

1. Coatings Guide™ Home Page. http:/cage.rti.org.

2. Goldberg, T., et al. Pollution Prevention in Painting and Coating Operations: A Manual for Technical Assistance Providers; The Northeast Waste Management Officials' Association (NEWMOA): Boston, MA; April 1998.

3. Coating Alternatives Guide (CAGE), V 1.0. Research Triangle Institute, Research Triangle Park, NC, July 1, 1996.

4. Kosusko, M. and Archibald, C., "The Coatings Guide: An Integrated Tool for Coatings Decisions," *Metal Finishing*. Not yet published, scheduled for the May 2001 issue.

KEY WORDS

Coatings Guide™
Coatings Alternative Guide (CAGE)
Pollution prevention
Coatings
Paint
Economics
Cost-benefit analysis
Environmental decision-making
Total cost accounting
Expert system
Product guide
Internet, web-based tool
Coating alternatives

Information Report

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Use SAVE AS on the FILE menu and rename the file with a .txt or .htm extension. Otherwise you may not be able to get back to it.

Prepared for: KPPC
Part name/number: Widget
Company name: Widgets R Us
Part description: Plastic Box
State information: KENTUCKY

Part / Process Characteristics

- **Metal:** *None*
- **Plastic:** *Polyethylene*
- **Is the part conductive?** *no*
- **How was the part molded?** *compression*
- **Must the coating you apply contain metallic and/or mica flakes?** *no*
- **What type of coating does the part already have on it?** *none*
- **What type of coating does the part already have on it?** *no cleaning*
- **What is the part volume?** *small*
- **What is the longest rigid length of the part?** *small*
- **Does the part have a complex shape?** *5*
- **Which of the following pretreatment operations do you use?** *none*

- **If acid pickling, does the pickling process include at least 5 rinse stages followed by a neutralization bath?** *na*
- **What will be the function of this coating?** *topcoat only*
- **Which application method are you using to apply paint to this part?** *Air-assisted airless spray*
- **How do you currently apply your paint?** *automatically*
- **Are parts moved through your coating area on a conveyor?** *yes*
- **What will be the minimum ambient temperature during application?** *between 0 and 60*
- **Will the relative humidity during application get above 90 percent?** *yes*
- **Do frequent color changes cause a significant problem in your coating process?** *yes*
- **What will be the exposure environment for the coated part?** *below ground*
- **Are there post-coating applications, such as application of decals, glazing, installation of upholstery, installation of electronics, etc.?** *no*
- **What will be the maximum dry temperature to which the coated part will be exposed?** *between 0 and 150*
- **Will this be a highly visible part?** *no*
- **How often do you change color?** *five or less*
- **Do you have dedicated lines and/or equipment for each color?** *no*
- **Is any section of your current coating delivery system made of carbon steel?** *yes*
- **What is your required dry film thickness, in mils (1 mil + 0.001 inch = 0.254 mm)?** *2*
- **How many coats do you apply?** *2*
- **What is your production rate (in parts per hour)?** *between 50 and 100*
- **How do you cure your coating?** *air-dry*
- **What is your required dry-through time?** *between30_60*
- **What is your required dry-through time?** *no*
- **Will the relative humidity during curing get above 90 percent?** *yes*
- **How long will the part air dry before being moved to an outside area?** *2 hours or*

less

- **What is your "time-to-recoat" drying time?** *between30_60*
- **What is your "flash-off" time between coats (in minutes)?** *more than 30*
- **Is touch-up usually required?** *no*
- **Rate the price of the product as seen by the customer.** *5*
- **Will an increase in the price of the product (within a few cents or dollars) influence the customer's decision to buy?** *yes*
- **Adhesion:** *1*
- **Intercoat adhesion:** *1*
- **Salt spray exposure:** *5*
- **Flexibility:** *5*
- **Hardness:** *5*
- **Impact resistance:** *5*
- **Chip resistance:** *5*
- **Gouge resistance:** *5*
- **Abrasion resistance:** *1*
- **UV Light resistance:** *5*
- **Range of color:** *1*
- **Gloss retention:** *5*
- **Hiding power:** *5*
- **Distinctness of image (DOI):** *5*
- **Fire retardency:** *5*
- **Conductivity (EMI/RFI shielding):** *5*
- **Dry film thickness (DFT):** *1*
- **Print resistance:** *5*
- **Type of pollution control systems connected to application line:** *dry*
- **Type of pollution control systems connected to cure line:** *solvent*

- **Type of intermittent chemical resistance needed:** *water*
- **Type of immersion chemical resistance needed:** *water dry*
- **Willing to change the following areas:** *delivery*

Coating Alternative Rankings

Rankings are out of 100 possible points

COATING ALTERNATIVE	RELATIVE SCORE
water-reducible, air/force-dried acrylic epoxy	100
water-reducible, air/force-dried two-component epoxy	86
water-reducible, air/force-dried alkyd	71
water-reducible, baked alkyd, modified alkyd, acrylic	59
solvent-borne, air/force-dried silicone	55
water-reducible, air/force-dried acrylic latex	41
radiation-cured coatings	3

	5
electrocoat	12
autophoretic	12
solvent-borne, air/force-dried epoxy ester	6
solvent-borne, baked alkyd	0
solvent-borne, air/force-dried two-component urethane	0
100% solids (plastisols)	0
solvent-borne, air/force-dried one-component urethane	0
solvent-borne, air/force-dried two-component epoxy	0
solvent-borne, air/force-dried alkyd	0
water-reducible, air/force-dried urethane dispersions	0
powder (epoxy)	0
powder (epoxy-polyester hybrid)	0
powder (polyester)	0
powder (acrylic)	0
powder (fluorocarbon)	0

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Dynamically derived from the CAGE Expert System available at URL: http://cage.rti.org/es/index.htm