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Project Summary

Assessment of Pollution Prevention Opportunities for Five Industries

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This project, funded by the South Coast Air Quality Management District (SCAQMD) and U.S. Environmental Protection Agency (U.S. EPA), evaluated pollution prevention options. SCAQMD and U.S. EPA have determined that there exist a number of consumer and commercial operations that can be identified as volatile organic compound (VOC) and/or organic air toxic emission sources. The purpose of this effort is to assess products and processes involved in printing, coatings, and adhesives that are significant contributors of VOCs.

The primary objectives of this project are to identify pollution prevention research, development, and demonstration opportunities which will reduce VOC and/or organic air toxic emissions from stationary sources such as: flexographic printing, rotogravure printing, graphic arts activities, architectural and industrial maintenance (AIM) coatings, and consumer and industrial adhesives.

The report summarizes the emissions inventory, market survey, product categorization, product characteristics, potential product reformulation, new product research, and alternative application methods for processes involved in printing, graphic arts, AIM coatings, and consumer/industrial adhesives. It also assesses key areas that might lead to reduced VOCs from five categories.

This Project Summary was developed by EPA's Air and Energy Engineering Research Laboratory, Research Triangle Park, NC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

The failure of nearly 100 metropolitan areas in the U.S. to attain the National Ambient Air Quality Standard for ozone is one of the major environmental issues currently faced by the U.S. EPA and local regulatory agencies. The formation of ground level ozone results from complex atmospheric reactions between VOCs and nitrogen oxides (NO_x) in the presence of sunlight. Thus, the control of VOC and NO_x emissions, which are precursors of ozone, is essential in order to meet the ozone standard. While most of the large stationery sources of VOC and/or organic air toxic emissions are covered by existing regulations, small dispersed sources of these pollutants generally are not and may contribute significantly to ozone nonattainment. The use of a wide range of consumer/commercial products has been identified as a substantial source of VOC emissions that is predominantly uncontrolled and unregulated. Control of these emissions can best be addressed by product reformulation, improved application efficiency, or enhanced product efficiency.

A number of consumer and commercial operations have been identified as VOC and/or organic air toxic emission sources. These include, but are not limited to, auto body refinishing, primary furniture finishing, printing, graphic arts, AIM coatings, and consumer and industrial adhesives. This study assessed products and processes involved in printing, graphic arts,

AIM coatings, and consumer/industrial adhesives that are significant contributors of VOC emissions.

Five tasks were completed during this project.

1. Quantification of the emissions of VOC and air toxics presently regulated by the SCAQMD for the five categories identified above.
2. Identification of commonly used products that have significant use for each category above.
3. Identification of existing and potential product reformulation opportunities or substitute compounds which could result in reduced VOC emissions for each category.
4. Identification of emerging technologies for new or modified materials and/or processes that are expected to have reduced VOC emissions.
5. Identification of key areas that might lead to reduced VOC emissions from the five categories listed.

The report summarized the emissions inventory, product categorization, potential product reformulation, new product research, and alternative application methods for processes involved in printing, graphic arts, AIM coatings, and adhesives.

Objectives

The primary objectives of this project are to identify pollution prevention research, development, and demonstration opportunities which will reduce VOC and/or organic air toxic emissions from the following small stationary area sources (hereinafter referred to collectively as the five specified product categories): flexographic printing, rotogravure printing, graphic arts activities, AIM coatings, and consumer and industrial adhesives.

Technologies without sufficient research to allow their implementation will be identified, as well as those promising technologies that are sufficiently mature for field demonstration.

Summary

Printing

The pollution prevention opportunities in printing include ink/fountain solution reformulation, press maintenance, alcohol substitutes, water-soluble cleaning solvents, refrigeration of fountain solution, covering containers, and good housekeeping.

Waste reduction options in the printing process have been evaluated. The two areas that present the most promising pollution prevention opportunities are ink/fountain solution reformulation and equipment cleaning. Reformulation would involve a change from a solvent-based to a water-based system. Equipment cleaning waste reduction would involve switching to a water-based cleaner.

One potential pollution prevention option is to use a low-VOC fountain solution. Many new water-based inks are available, but only limited research and product development are focused on low-VOC fountain solution. A new biodegradable fountain solution which can reduce VOC emissions from traditional sheet printing processes has been identified. However, certain chemicals in many ink formulations can interfere with the chemistry of this fountain solution. This is an area with great emissions reduction potential.

The merits of this low-VOC fountain solution are:

- The hydrophobic/hydrophilic nature of the product produces a very high resolution (sharp) image;
- The superconcentrated nature of the product permits minimum storage space;
- The chemical nature of the product allows use of lower quality water;
- Product use results in 30% less ink use; and
- Current testing shows compatibility with most available inks.

Disadvantages are:

- The necessary strength of this fountain solution depends on the ink formulation;
- Test projects showed trace benzene in standing water solution, perhaps due to sulfate-reducing bacteria indigenous to the South Coast Basin; and
- The impact of potentially increased wastewater volume.

An alternative cleaning technique for rotogravure printing cylinders involves the use of aqueous solutions and ultrasonication. Ultrasonication enhances the cleaning efficiency of aqueous detergent solutions. The cylinders are immersed and rotated for only a few minutes (the immersion time may be extended or repeated for difficult cleaning jobs).

The cylinders are then rinsed with clean water and dried using either compressed air or towels. Use of hot rinse water hastens the drying. Applicability of this technique depends on:

- The potential for damage to the cylinders from the water immersion, and
- Whether the cylinders are difficult to dry (especially if thorough drying is costly).

AIM Coatings

High-solids coatings, inorganic coatings, radiation-curable coatings, and waterborne coatings are conventional products with potential to achieve VOC compliance for AIM coatings. New products (OS Fluids™) from Dow Corning using volatile silicone fluids as solvent replacement were studied. These fluids are considered to be "Ozone Safe" by Dow Corning and are specifically developed to remove industrial soils (machining fluids, fluxes, waxes, fats, oils, greases) from metal and other substrates. They are useful as carriers in a variety of coatings and other formulations. OS Fluids have been used to clean coating materials from equipment.

OS Fluids are pure methyl polysiloxanes of linear structure, contain no additives, and are essentially non-toxic. They decompose chemically in the environment. They have a life expectancy in the atmosphere of less than 30 days, after which they decompose to carbon dioxide, silicic acid, and water. These OS Fluids are recyclable following vacuum distillation and optional filter finishing steps. Product warnings include proper disposal (the materials are classified as ignitable waste) and avoidance of sprays and mists (they may pose a fire problem).

Consumer and Indutrial Adhesives

Available technologies to minimize VOC emissions for adhesives include reactive diluent-based adhesives, exempt solventborne adhesives, waterborne adhesives, and solventless adhesives. Reformulated adhesives that use exempt organic solvents are considered hazardous air pollutants and/or depleters.

Terpenes (mostly simple d-limonene products) have been demonstrated to be safe for use in metal cleaning applications as a replacement for chlorinated solvents such as 1,1,1-trichloroethane. New generation terpenes are currently being developed which have the advantages of low odor, high flash point, low residue, low vapor pressure, minimal waste discharge, low VOC emissions, and superior performance. While identified as a replacement for solvent cleaners, it has not been identified as a substitute for diluent solvents in adhesive formulations due to its expense and reactivity with polymers.

Demonstration Project—Low-VOC Fountain Solution

Based on the assessment of the emission reduction potential for printing industries, AIM coatings, and consumer and industrial adhesives, the new low-VOC fountain solution is a significant opportunity for pollution prevention and could merit further technology evaluation and demonstration.

The applicability of low-VOC fountain solution to the printing industry was evaluated in July 1993. The low-VOC fountain solution selected for evaluation is manufactured by Color Brite, Inc. of Huntington Beach, CA. The demonstration consisted of four projects. Two were held at Color Brite's facility, one for their ASR-red fountain solution concentrate (for Pro-alcohol dampening systems) and the other for their APG-green (for integrated presses). The other two facilities selected have switched to the Color Brite Low-VOC Fountain Solution within the past 3 or 4 months.

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The complete report, entitled "Assessment of Pollution Prevention Opportunities for Five Industries," (Order No. PB95-167367; Cost: $19.50, subject to change) will be available only from:
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