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Project Summary

Evaluation of Innovative Volatile Organic Compound and Hazardous Air Pollutant Control Technologies for U.S. Air Force Paint Spray Booths

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This report gives results of an evaluation of carbon paper adsorption catalytic incineration (CPACI) and fluidized-bed catalytic incineration (FBCI) as control technologies to reduce volatile organic compound (VOC) emissions from paint spray booths. Pilot-scale units were tested simultaneously to evaluate the technical performance of both technologies. Results showed that each technology maintained >99% destruction and removal efficiencies. Particulate emissions from both pilot-scale units were <0.08 gr/dscf. Emissions of the criteria pollutants—SO_x, NO_x, and CO—were also below general regulatory standards for incinerators. Economic evaluations were based on a compilation of manufacturer-supplied data and energy consumption data gathered during the pilot-scale tests. CPACI and FBCI are less expensive than standard VOC controls when net present costs for a 15-year equipment life are compared.

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 objective of this project was to identify and evaluate innovative emission control technologies capable of effectively and economically reducing or eliminating volatile organic compound (VOC) and hazardous air pollutant (HAP) emissions from a typical U.S. Air Force (USAF) paint spray booth.

Significant quantities of VOCs and HAPs are released into the atmosphere during USAF maintenance operations. Painting operations conducted in paint spray booths are major sources of these pollutants. Solvent-based epoxy primers and solvent-based polyurethane coatings are typically used by the Air Force for painting aircraft and associated equipment. Solvents used in these paints include: methyl ethyl ketone (MEK), toluene, lacquer thinner, and other solvents involved in painting and component cleaning.

USAF maintenance facilities have been identified as VOC and HAP emissions sources; as such, they are regulated by the Clean Air Act (CAA) and related state and local regulations. Because many USAF bases are located in areas that have not yet attained pollution control goals established by the CAA, local air pollution control agencies are requesting that the USAF decrease its VOC and HAP emissions. In response to these regulations, the USAF Engineering Services Center (AFESC), in cooperation with the U.S. EPA, initiated technology evaluation programs to minimize VOC and HAP emissions through the application of source control reductions and system modifications to existing paint spray booth operations.

Scope

Technical and economic evaluations, in conjunction with a vendor survey, were performed for 11 innovative emission control technologies. Based upon the results of these tasks, two technologies were selected for field-testing: carbon paper adsorption catalytic incineration (CPACI), and fluidized-bed catalytic incineration (FBCI). In these evaluations, CPACI and FBCI were compared with standard VOC emis-

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sion control technologies, such as regenerative thermal incineration (RTI).

During the field-testing, one CPACI pilot-scale unit and one FBCI pilot-scale unit were tested simultaneously, at the "Big Bertha" paint spray booth in Building 655 at McClellan Air Force Base (AFB), California.

Methodology

Field tests of the pilot-scale CPACI and FBCI units were conducted by using Bay Area Air Quality Management District-(BAAQMD-) and EPA-approved source test methods. BAAQMD Method ST-7, and EPA Methods 2, 3A, 4, 5, 10, and 25A were used. Organics in the exhaust gases were characterized using National Institute for Occupational Safety and Health (NIOSH) Method 1300. Economic evaluations were based on manufacturer-supplied data used in conjunction with estimates provided in EPA's *EAB Cost Control Manual.* This manual and the Naval Facilities Engineering Command's *Economic Analysis Handbook* were referenced to develop the net present cost (NPC) and treatment costs for each technology evaluated.

Test Description

The pilot-scale units were tested over a 10-day period during which the technologies were operated under a variety of conditions. The control technologies' operating temperatures and the flow rate of exhaust gas to be treated were controlled to meet desired operating parameters. Operating conditions generally fell into one of three categories: low flow rate and high temperature, high flow rate and low temperature, and high flow rate and high temperature. During the tests, the paint spray booth was operated normally.

Results

Information gathered in the vendor survey indicates that certain innovative VOC control technologies could be applied to paint spray booths. Regenerative thermal oxidation (RTO), RTI, membrane vapor separation/condensation, carbon adsorption/incineration, CPACI, and FBCI might be applied successfully to USAF paint spray booths. Field tests of CPACI and FBCI have demonstrated that each unit can achieve VOC destruction and removal efficiencies (DREs) of 99% during normal operating conditions.

An economic evaluation performed for a CPACI device sized to treat 60,000 scfm for 15 years resulted in an NPC of $2,570,000.

An economic evaluation performed for an FBCI device sized to treat 60,000 scfm for 15 years resulted in an NPC of $2,369,000.

Conclusions

CPACI, FBCI, and RTO appear feasible based on manufacturers' literature and reports used in the automobile and aircraft manufacturing industries. The DRE of 99% achieved in field tests of the CPACI and FBCI pilot-scale units indicates that these systems can effectively control VOC emissions from USAF paint spray booths. This DRE is equivalent to or better than the DREs achievable with standard technologies. RTO has not yet been tested on USAF paint booths, but its performance is expected to be acceptable.

The economic evaluations of CPACI and FBCI found that both compare favorable to standard treatments such as thermal incineration. NPCs and treatment costs for both CPACI and FBCI are lower than those associated with standard VOC emission controls. Implementation of flow reduction techniques can further reduce the costs of VOC emission controls.

Recommendations

Either CPACI or FBCI can be used effectively and economically to control VOC emissions from USAF paint spray booths. Other technologies, such as RTO, may be applicable, but they should first be field-tested at the pilot-scale level in paint spray booths to determine their viability.

Flow reduction technologies need to be incorporated into existing paint spray booths if possible. Reduction of paint spray booth exhaust by as much as 90% is possible with these technologies. Such a flow reduction is beneficial because it can substantially reduce treatment costs.

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The complete report, entitled "Evaluation of Innovative Volatile Organic Compound and Hazardous Air Pollutant Control Technologies for U.S. Air Force Paint Spray Booths," (Order No. ADA-242508/AS; Cost: $26.00, subject to change) will be available only from:

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