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Industrial Environmental Research
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Research and Development

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Project Summary

Evaluation of Solvent Loss from Vapor Degreaser Systems Phases 2 and 3: Effect of Crosscurrent Air Velocity on Control System Performance

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The U.S. Environmental Protection Agency (EPA) initiated a research program to evaluate the solvent loss reduction capabilities of various degreaser modifications, controls, and operating practices of open-top vapor degreasers. PEDCo Environmental, Inc., was contracted to carry out the research program. The American Society for Testing and Materials (ASTM) was asked to assist EPA in defining and formulating the test program and reviewing its progress. A special ASTM subcommittee of Committee D-26 on degreasers was established for this purpose.

This Project Summary was developed by EPA's Industrial Environmental Research Laboratory, Cincinnati, OH, 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 and Summary

The program began with the writing of a detailed test plan, which was submitted to EPA for technical review. The plan provided details of tests, test location, types of solvents, variables and control modifications to be tested, parameters to be measured, and test procedures. The results of these tests referred to as Phase 1 were presented in the report "Evaluation of Solvent Loss from Vapor Degreaser Systems," November 1980.

Phase 1 quantified the ability of a control device to reduce solvent loss from a job-shop-size degreaser at the ideal operating conditions suggested by the manufacturer and EPA. It also tested the effect of non-ideal operating conditions on solvent loss, but did not quantify the effectiveness of control devices operating at non-ideal conditions. The test data showed, however, that a slight draft across the lip of the degreaser increased solvent loss dramatically. On the basis of this increase, the EPA decided that control devices should be evaluated for the ability to control solvent loss at high crosscurrent air velocities: 0.67 m/s (132 ft/min) and 1.12 m/s (220 ft/min).

Phase 2 comprised the supplemental tests that were performed to supply the previous evaluation. Tests were also conducted to supplement the Phase 1 data about variations in hoist speed.

Some Phase 2 results were unusual. Although the refrigerated freeboard

chiller (RFC) substantially reduced solvent loss when methylene chloride (MC) was used, it substantially increased solvent loss when 1, 1, 1-trichloroethane (TE) was used. Further, Phase 2 results indicated that changing the freeboard ratio (FR) reduced solvent loss only slightly, regardless of solvent. Phase 3 was, therefore, conducted to re-verify the Phase 2 results, further examine the interaction of air velocity, RFC, and FR, and to explain the anomalies experienced in the Phase 2 testing.

A separate set of plant site evaluations were also conducted to characterize the cross-current velocities that typically are found in industrial sites. Seven plants were evaluated which included a broad range of industrial functions from aircraft manufacturers to heavy machinery manufacturing to small and large appliance manufacturing. The typical average cross-current velocity was found to be approximately .445 m/s (87.6 ft/min). Thus, the typical plant's cross-current draft characteristics were found to be within the boundary of this experimental program.

Conclusions

The conclusions that were developed from the program characterizes and quantifies the effectiveness of various control options for vapor degreasers. Those conclusions, when combined with Phase 1 test results, are summarized below.

- An increase in cross-current velocity will increase solvent emission rates from open top vapor degreasers. A 40 percent increase in emissions is predicted at .67 m/sec over calm conditions. The typical plant draft conditions were within the draft conditions of this research program. Thus, the emission rates determined during the program are typical of those which would be experienced in an industrial facility.
- Increased freeboard ratios will reduce emission rates. Increasing freeboard from .50 to .75 will decrease emissions by 40 percent in some cases. Additional incremental reductions are achievable as the freeboard is increased above .75.
- Refrigerated freeboard chillers will reduce emission rates when used either by themselves or in combination with other control options. Control effects of greater than 40 percent are possible under some conditions.
- Automatic lids can assist in the reduction of solvent emission rates. Test indicated that the use of an automatic lid can reduce solvent loss by greater than 50 percent in some instances.

The best emission reduction technique was found to be the minimization of cross-current drafts at the lip of the degreaser. However, some operational constraints may prevent the lowering of air velocity. Other solvent reduction options, as previously indicated, were also found to be effective in reducing solvent loss.

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The complete report, entitled "Evaluation of Solvent Loss from Vapor Degreaser Systems Phases 2 and 3: Effect of Crosscurrent Air Velocity on Control System Performance," (Order No. PB 81-246 308; Cost: $9.50, subject to change) will be available only from:

National Technical Information Service
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