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Project Summary

Fugitive Emission Reductions Due to the Use of Enclosed Doctor Blade Systems in the Flexographic and Rotogravure Printing Industries

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This project summary describes the results of an evaluation project to quantify the level of fugitive emission reductions resulting from use of enclosed doctor blade (EDB) systems in place of traditional ink feed systems at flexographic and rotogravure printing operations. An EDB system is an innovative ink feed system that contains an enclosed ink chamber. Such a system has the potential of limiting fugitive emissions from each printing station on a printing press.

Traditional printing ink feed systems employ ink pans; solvents in the exposed pools of ink in these pans create fugitive volatile organic compound (VOC) emissions. EDB systems eliminate these exposed pools of ink, and can therefore reduce VOC emissions. This project involved testing for fugitive emissions at flexographic and rotogravure printing stations, to quantify the potential emission reductions achieved by EDB ink feed systems. Prior to this testing, the magnitude of the emission reduction achieved by EDB systems had not been quantified.

Testing was conducted on single-color stations on flexographic and rotogravure presses. Emission reductions achieved by EDB systems were measured, and printing station operators evaluated the quality of the printing with traditional and EDB systems. Additionally, evaporation rates from ink pools were measured in a laboratory test.

The measured emission reductions on the flexographic press ranged from 0.26 to 1.83 kg/h with the press idle, and 0.84 to 0.89 kg/h with the press running. Measured emission reductions for the rotogravure press ranged from 0.35 to 0.36 kg/h with the press idle, and 0.83 kg/h with the press running. These values were consistent with ink pool evaporation rates measured in the laboratory.

This Project Summary was developed by EPA's National Risk Management 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

Previous cooperative research efforts between Research Triangle Institute (RTI) and the Environmental Protection Agency (EPA) have identified traditional ink feed systems as sources of emissions in flexographic and rotogravure printing operations. These ink feed systems are therefore areas for pollution prevention technology. Enclosed Doctor Blade (EDB) systems, which eliminate several exposed ink surfaces found in traditional ink feed systems, represent one potential pollution prevention technology.

EDB systems can be expected to reduce solvent usage during ink feed system cleaning and reduce leftover ink at the end of a print run. The potential for EDB systems to reduce emissions during printing is less certain. Some printers maintain that these systems reduce exposed ink surfaces such as the ink pan, and therefore must reduce emissions. These printers point to the fact that they do not need to add as much make-up solvent to the ink during print runs. Other printers question this observation, and believe that most fugitive emissions result from the ink exposed on the anilox cylinder. These printers believe that any reduction in fugitive emissions is probably negligible, since EDB systems are similar to traditional systems in that ink on the anilox cylinder is still exposed to air.

The purpose of this testing was to measure volatile organic compound (VOC) emissions from flexographic and rotogravure presses operating with traditional and EDB ink feed systems. Additionally, printing quality was evaluated for the EDB system on a rotogravure press, since EDBs are not commonly used as ink delivery equipment in rotogravure printing.

Methods and Materials

Emission reductions achieved by EDB systems were measured for a single-color station on flexographic and rotogravure presses. Temporary enclosures were constructed around the presses. Emissions were first measured with the traditional ink feed systems operating. Then emissions were measured with EDB systems installed, and the emission reductions were calculated.

Emissions were determined by measuring air flow rates and pollutant concentrations at all inlets to and outlets from the enclosures. Air flow rates were measured by pitot tube (differential pressure) or by hot-wire anemometer, depending on the air velocities being measured. At the flexographic printing facility, total hydrocarbon pollutant concentrations were measured primarily with a portable flame ionization detector (FID). At the rotogravure facility, concentrations were measured primarily with a fixed-path-length infrared spectrophotometer.

In addition to hydrocarbon emission measurements, an attempt was made to determine whether the enclosures that were constructed had any influence on the emissions from the traditional and EDB ink feed systems. This assessment was performed by simultaneously measuring both hydrocarbon emissions and capture efficiency of a tracer gas, at varying rates of enclosure exhaust (at the flexographic facility) or containment (at the rotogravure facility).

The tracer gas that was used to measure enclosure capture efficiency was carbon dioxide (CO_2). Enclosure capture efficiency was evaluated by the ratio of mass measurements of CO_2 injection rate and CO_2 capture, as measured by CO_2 concentration measurements.

After the emissions tests were performed at the two printing facilities, ink evaporation rates were measured in a laboratory, to aid in understanding and evaluating the field testing results. These laboratory ink pan measurements involved pouring press-ready inks from the two facilities into small pans. The pans were located on top of digital electronic scales, underneath a laboratory hood. The mass loss (evaporation) rate was monitored at two levels of air flow over the ink pool surface. The areal evaporation rates determined during this laboratory testing were then compared with the field emissions testing results.

Results and Discussion

The measured emission reductions on the flexographic press ranged from 0.26 to 1.83 kg/h with the press idle, and 0.84 to 0.89 kg/h with the press running. Measured emission reductions for the rotogravure press ranged from 0.35 to 0.36 kg/h with the press idle, and were 0.83 kg/h with the press running.

Laboratory ink pan evaporation tests were performed with the flexographic and rotogravure inks. These laboratory tests can be combined with estimates of the ink pool surface areas at each of the two facilities, to produce predictions of the emission reduction benefits of eliminating the ink pool surface areas at each facility. The predicted emission reductions range from 0.11 to 0.28 kg/h for the flexographic press, and 0.18 to 1.12 kg/h for the rotogravure press. The predictions for the flexographic press are generally lower than the measured results, while all the rotogravure results fell within the predicted range. It appears that laboratory ink pan measurements can be used to provide order-of-magnitude predictions for emission reductions achieved by EDB systems.

Problems were experienced with the CO_2 tracer gas injection and resulting enclosure capture efficiency measurements. These problems prevented definitive conclusions about the effects of the enclosures on emissions from the traditional and EDB ink feed systems. However, the high enclosure exhaust rate used on the flexographic system appeared to artificially increase emissions; future research on evaporative emissions within enclosures should consider this possibility.

The EDB system used on the flexographic press resulted in acceptable printing quality. The EDB system used on the rotogravure press resulted in unacceptable printing quality, even when printing line speed was slowed. However, it may have been possible to improve the printing quality of the rotogravure EDB system, if production requirements had not dictated a return to the original system.

Conclusions

The EDB system is currently commercially available for flexographic printing, and reduces fugitive emissions. The EDB system, as installed during the test for rotogravure printing, also reduced fugitive emissions. However, the EDB system at the rotogravure facility substantially degraded print quality, even at reduced line speeds. The issue of printing quality will need to be addressed before EDB can become a viable option for the rotogravure printing industry.

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The complete report, entitled "Fugitive Emission Reductions Due to the Use of Enclosed Doctor Blade Systems in the Flexographic and Rotogravure Printing Industries," (Order No. PB98-137391; Cost: $36.00, subject to change) will be available only from

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