United States
Environmental Protection
Agency

Air and Energy Engineering
Research Laboratory
Research Triangle Park NC 27711

Research and Development

EPA/600/S2-86/068 Nov. 1986

EPA

Project Summary

Microprocessor Control of Rotogravure Airflows

D. R. Rosen and M. R. Wool

This report discusses the technical and economic viability of using microprocessor-based control technology to collect volatile organic compound (VOC) emissions from a paper coating operation. The system evaluated is operating at the James River Corporation rotogravure printing facility in Kalamazoo, Michigan.

The microprocessor-based control system monitors and controls both the airflow rate and vapor concentration level within the printing press dryers. It enables incineration of the VOC emissions in the plant's existing steam boiler and also saves energy by reducing the amount of dryer and room air that must be heated. The general concept, performance levels, and economic parameters for the James River VOC control system demonstrate the potential advantages of the technology for a wide range of applications.

James River looked at three methods to collect and destroy VOC emissions for their rotogravure operation: solvent recovery, thermal destruction in a dedicated incinerator, and thermal destruction in an existing onsite boiler. For James River, the use of their existing boiler is the best option even though they were required to add equipment to collect, transport, and control the rotogravure airflows.

The microprocessor and sensors which are an integral part of the emission control system enable James River to safely reduce the flowrate of air through their presses. The sensors measure the air pressure and VOC concentration in the press dryer exhaust, and the microprocessor adjusts fan speeds to maintain proper flowrates.

Over a 3-day period, operating data were recorded to evaluate the flow systems performance. With the microprocessor in operation, James River expected to see flowrates of less than 30% of the flow prior to conversion. This expectation was confirmed by measurements taken during the test period. Despite the flowrate reduction, concentrations of VOCs remained safely below the lower flammability limit. These tests showed that a microprocessor system, appropriately tied to an incinerator or boiler, is an effective way to address federal and state VOC emission standards for the paper printing industry.

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 microprocessor-based control system monitors and controls both the airflow rate and vapor concentration level within the printing press dryers. The system in this study incinerates VOC emissions in the plant's existing steam boiler and also saves energy by reducing the amount of dryer and room air that must be heated. The general concept, performance levels, and economic parameters for the VOC control strategy demonstrated the potential advantages of microprocessor control technology for a wide range of applications.

This study discusses the technical and economic viability of using microprocessor-based control technology to collect volatile organic compound (VOC) emissions from a paper coating operation. The system evaluated is operating at the James River Corporation rotogravure printing facility in Kalamazoo, Michigan.

System Installation Objective

VOC emissions react in the atmosphere to form ozone and other undesirable constituents of smog. As a result, James River Corporation initiated a program to control atmospheric emission of VOCs from their rotogravure printing operation. The objective of installing the control system was to collect and destroy VOC emissions by the most cost-effective approach.

System Elements

A microprocessor-based system was selected by the James River Corporation to safely lower dryer airflows and permit VOC incineration in an existing process boiler. The microprocessor system automatically controls exhaust fan speeds to minimize airflow rates while maintaining safe VOC concentrations. The net reduction in flow allows the existing process boiler to accept all rotogravure dryer emissions as combustion air.

The major elements of the VOC control and collection system at the James River plant are:

- A microprocessor based computer/controller.
- A continuous analyzer to determine when VOC concentrations approach the lower flammability limit (LFL).
- Variable speed motor drives.
- Pressure transducers.
- Diversion dampers.
- Operator display panel.

Several other modifications and subsystems were also necessary to implement VOC destruction using the existing plant boiler. Ductwork was installed between a transfer fan and the boiler forced draft fan. A new forced draft fan was installed because the existing fan's bearings would be damaged by the VOCs in the press exhaust air. Modifications were also necessary to some press decks in order to provide better sealing, thereby allowing operation at reduced fan speeds.

Performance Data Acquisition

As a part of the VOC control system, process parameters are monitored by permanent instrumentation. However, the existing system has no provisions for data storage. Therefore, process parameters of interest to this study were recorded during the test period by a temporary data acquisition system. The system consisted of a data interface unit and a personal computer. A floppy disk and thermal printer provided for hardcopy data output and storage.

Performance Results

Table 1 shows the effect of the VOC control system on the flowrate of air through the four presses considered in this study and confirms that the system operated as expected during the data acquisition period. Measured airflow rates were close to the expected values, which represented a 71% decrease in airflow when compared to the preconversion values. Despite the decrease in airflow rates, the percentage LFL remained well within acceptable and safe values.

Equipment Cost and Energy Savings

This installation of a microprocessor control system enables the plant's existing boiler to be used for VOC destruction. James River determined that use of the existing boiler was the most cost-effective method of addressing their VOC emission control requirements. In addition, significant cost savings result from operation of the system because the quantity of collected air was significantly reduced. These savings include:

- Reduction in energy demand for dryer air heating due to reduced air exhaust rates.
- Recovery of thermal energy in press exhaust by using the exhaust as air for boiler combustion (pres: exhaust averages 23°C above ambi ent air temperatures annually).
- Recovery of calorific value of VOC: incinerated in the boiler.

Table 2 summarizes installed cost: for the conversion project at the Jame: River plant. Annual energy savings ar summarized in Table 3.

Safety

The control system incorporates sev eral safety features and interlocks, in cluding:

- LFL analyzer failure (flameout) de tection.
- High LFL level alarm and pres: shutdown.
- Loss of deck exhaust flow.

No LFL analyzer failures occurred dur ing the data collection period, nor wer acceptable percentage LFL levels ex ceeded. Based on the review of the sys tem design and operating data, thes safety features operated as intended.

Conclusions

This study shows that rotogravur printing operations can benefit from th microprocessor-based control techno ogy discussed in this report. Economi benefit accrues due to the reduction i process air exhaust volumes whic must be processed by a collection sy: tem or an incinerator or heated by process dryer. The techniques used t monitor and control VOC concentr tions and to allow lower air volumes ar broadly applicable to processes whic

Table 1. *VOC Collection System Performance Summary*

Press No.	Prior to conversion: Exhaust flowrate scfm (l/s)	After conversion: Expected exhaust flowrate scfm (l/s)	After conversion: Measured exhaus flowrate scfm (l/s)
3047	20,000 (9,378)	6,000 (2,813)	6,105 (2,863)
3049	25,000 (11,723)	4,000 (1,876)	3,839 (1,800)
3051	7,000 (3,282)	4,200 (1,969)	4,245 (1,990)
3052	25,000 (11,723)	8,000 (3,751)	7,900 (3,704)
	77,000 (36,106)[a]	22,200 (10,409)[a]	22,089 (10,357)[a]

[a]*Totals have been rounded off for consistency.*

Table 2. *Conversion Cost Summary—1985 Dollars*

Category	Total ($1000s)
Control System	
1. Microprocessor control system[a]	295
2. LFL Analyzers[b]	145
Subtotal	440
Engineering	
3. Preinstallation analysis and system design	100
Collection and Transport System[c]	
4. Ducting and press modifications	720
5. Boiler modifications	300
Subtotal	1020
Total	1560

[a]Includes computer, pressure transducers, and drives.
[b]Includes two FID analyzers, eight-channel manifold, and sample pump.
[c]Items 4 and 5 are unique costs, required only because James River was ducting to a boiler. If the plant had an existing incinerator, then these costs would not be applicable.

Table 3. *Annual Fuel Energy Savings*

Units	Air reduction savings	Air preheat savings	Calorific value	Total
Btu $\times 10^6$	34,250	12,670	24,930	71,850
Joules $\times 10^9$	36,127	13,364	26,296	75,787

use heated air in the presence of solvents or other materials. The system reduces plant operating and pollution control costs by reducing fuel required to heat the facility air or the air used in the process.

The application of microprocessor technology studied at James River is an extension of the technology from metal coating (i.e., painting) application. This study proved that the technology is applicable to the paper coating industry and can provide economic benefits through the reduction in energy requirements for a printing process. Although the amount of energy savings and the cost of plant modifications will be different for each application, energy savings, in most cases should offset the capital cost of the plant modifications within a short time. Additional reductions in operating costs will also be realized due to the reduced airflows.

A potential user of a microprocessor control system should review the results of this study to assess if similar energy and emission control benefits are possible in other applications of interest. In general, any application where airflows are used to carry away VOCs could be improved through active control of both airflow rates and VOC concentrations. Depending on the application, the best cleanup approach may be:

- Combustion in a dedicated incinerator.
- Combustion in an available plant boiler.
- Collection in a VOC recovery facility.

The best choice in a given situation will depend on the VOC quantities, airflow rates, plant layout, other plant equipment, energy costs, and permitting requirements.

D. Rosen and M. Wool are with Acurex Corporation, Mountain View, CA 94039.
***Charles H. Darvin** is the EPA Project Officer (see below).*
The complete report, entitled "Microprocessor Control of Rotogravure Airflows," (Order No. PB 86-230 075/AS; Cost: $11.95, subject to change) will be available only from:
National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
Telephone: 703-487-4650
The EPA Project Officer can be contacted at:
Air and Energy Engineering Research Laboratory
U.S. Environmental Protection Agency
Research Triangle Park, NC 27711

15

United States
Environmental Protection
Agency

Center for Environmental Research
Information
Cincinnati OH 45268

Official Business
Penalty for Private Use $300

EPA/600/S2-86/068