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ASSESSMENT OF ENVIRONMENTAL EMISSIONS

DURING

INK MANUFACTURE

at

LINX PRINTING TECHNOLOGIES LIMITED
BURREL ROAD
ST IVES
HUNTINGDON
CAMBRIDGESHIRE
PE17 4LE

REPORT NO:	OEH16829/STAK/SL.27	**CLIENT REF:**	Purchase Order No: Mr M Gilby
DATE OF VISIT:	2 November 2000	**CONTACT ON SITE:**	Mr M Gilby
DATE OF REPORT:	20 November 2000	**DISK REFERENCE:**	C:\AMIPRO\DOCS-TES\OEH16829.SAM 20/11/2000 - 16:12
DATA PROTECTION ACT REGISTRATION NO: B0479 03 4			

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1 EXECUTIVE SUMMARY

The main processs stack from Unit 4 was tested for emission of volatile organic compounds during normal and typical workloads. Emission data indicated that emissions of volatile organic compounds in Unit 4 average at 95 $mg.m^{-3}$, demonstrating compliance with the 150 $mg.m^{-3}$ limit and the Environmental Protection Act 1990.

2 INTRODUCTION

The survey described in this report was carried out on 2 November 2000 by Mr Nigel Mandley at the request of Mr M Gilby at Linx Printing Technologies Limited, Burrell Road, St Ives, Huntingdon, Cambridgeshire. In accordance with our work specifications outlined in quotation reference AL-8220, dated 20 October 2000, emphasis was placed mainly on the assessment of atmospheric emissions of volatile organic compounds which are potentially generated during ink manufacture.

Production schedules on the date of the survey were described as normal. Thus, the data reported herein must be considered typical and representative of the environmental levels experienced during normal daily workloads on this site.

3 DESCRIPTION OF PROCESS

Linx Printing Technologies Plc manufactures and markets a range of inkjet printers and inks. As part of their activities, the Company also services, calibrates and tests printers and printing heads pre and post sales.

The Company occupies four units on the St Ives Industrial Estate. Unit 4 in Edison Road houses the ink manufacture and solvent bottling plant. Resins, dyes and solvents (methyl ethyl ketone, ethanol and acetone) are weighed on electronic and industrial scales into drums or mixing tanks. Depending on the vessel, the ingredient may either be mixed or else blended with paddle mixers. The finished inks are pumped to a bottling station, the bottles are sealed and packed ready for dispatch.

The manufacturing area is kept under negative pressure by a combination of localised exhaust ventilation (LEV) hoods that are situated at various stages of manufacture and at floor level. Fresh make up air is fed into the area from two handling units. The LEV units discharge through a single duct projecting one metre above roof height without abatement.

One the day of testing, the following work schedule was undertaken

Time	Operation	Product
11:25 - 11:40	Apping Only	1009
11:50 - 12:05	Bottling And Capping	1555
12:25 - 12:45	Bottling And Capping	1540
13:50 - 14:05	Bottling And Capping	1590
12:40 - 13:10	Mixing Ink-Extraction Closed	1240
12:40 - 12:55	Filling Vessel - Extraction Closed	1240
12:55 - 13:01	Powder Addition - Extraction Open	1240
13:05 - 13:10	Powder Addition - Extraction Open	1240
13:10 - 13:40	Mixing Ink - Extraction Closed	1240

4 ENVIRONMENTAL CONSIDERATIONS

The process as described in Section 3 is prescribed for Local Authority Air Pollution Control under Section 6.2 of Schedule 1 to the Environmental Protection (Prescribed Processes and Substances) Regulations 1991, SI 472. The process employs a range of solvents and powders. These give rise to emissions of volatile organic compounds from all of the discharge points described earlier. A review of the environmental impact criteria for volatile organic compounds is given below.

4.1 Volatile Organic Compounds (VOC)

Volatile organic compounds or VOCs, are an important class of carbon containing gaseous pollutants found in the atmosphere at ground levels (in the troposphere), particularly in urban and industrial centres. Formally, these are defined as: 'all organic compounds of anthropogenic nature, other than methane, that are capable of producing photochemical oxidants by reaction with nitrogen oxides in the presence of sunlight'.

The main sources of VOC emissions are industrial processes and miscellaneous industrial usage. In the United Kingdom, in 1988 these accounted for approximately 58% of total emissions. By 1999, it is projected that these will increase to 61%.

The most significant sources of VOC emissions are listed below. Each of the source categories described covers a range of individual sources simply because VOCs occur in almost every industry.

- On road transport vehicles (largest source)
- Solvent usage in industrial processes
- Petroleum industry, including handling of fuels
- Synthesis and handling of organic chemicals
- Domestic heating and industrial boilers
- Food manufacture
- Iron and steel manufacture and processing
- Waste disposal and refining
- Agriculture (excluding methane generation)
- Other sources such as gas leaks and fugitive emissions

There is national and international concern about VOCs for three principal reasons:

- Some contribute to stratospheric ozone depletion;
- Some are toxic and carcinogenic; and
- most of them contribute to the formation of ground level ozone.

The VOCs that cause stratospheric ozone depletion are mostly chlorinated hydrocarbons and chlorofluorcarbons (CFCs). These gradually release chlorine and other halogens into the stratosphere which are extremely effective in destroying ozone even when present in low concentrations. The production of these species has already been restricted under the Montreal Protocol.

The toxic or carcinogenic impact of specific VOCs are principally of concern in the work place. However, there has also been renewed interest in the possible presence of such materials in combustion products from diesel engines.

With the third category of VOCs, their impact on the environment follows a more tortuous route. In unpolluted ground level air, ozone is being formed and destroyed by a complex series of chemical reactions that are triggered by sunlight. The reactions involve naturally occurring oxygen and nitrogen oxides as precursor chemicals and result no net depletion in ozone at ground level. The natural background concentrations of ozone (ca. 10 parts per billion, ppb) result from subventions from the stratosphere ozone layer and occur during certain types of weather in the early summer and especially during the April showers.

There is now sufficient evidence that pollution has trebled the background ozone concentrations, leading to an annual average in the northern hemisphere of around 25-30 ppb. During these ozone episodes, the rise in background concentrations affects human health.

The major route for the uptake of ozone by humans is through inhalation. The principal health effects are changes in lung function, as well as irritations in eyes, nose and throat. Significant changes occur to people taking vigorous outdoor activities during the ozone episodes, and certain sensitive people may experience coughing or discomfort and deep inspiration during exercise. Fortunately, none of these effects are known to cause irreversible lung damage. Plants, crops and forests are also highly sensitive to ozone and may be readily damaged by high concentrations that occur over short periods.

The elevated levels of ozone occur because pollutants interfere with the ozone photostationary state so that the atmospheric chemistry produces a net increase. Emissions (particularly from road transport) increase the atmospheric concentrations of nitric oxide, then VOC are especially efficient at reacting with this gas to drive the atmospheric chemistry towards net ozone production.

5 FIELD SAMPLING AND METHOD OF ANALYSIS

Field sampling and measurement were carried out in accordance with the details given in Appendix I. Methods of analysis employed for quantification of the release analytes are given in Appendix II. Sampling locations have been presented on a schematic diagram in previous reports. Reference should be made to these as necessary.

6 RESULTS

The report lists in tabular form details of the sampling and analytical results for each sample. For ease of interpretation, the data are classified under the following columns (refer to Appendix III).

- Location of sampling and activity monitored.
- Time of sampling.
- Analyte monitored.
- Release limits, in milligrammes per cubic metre.
- Stack release concentrations, in milligrammes per cubic metre. Release data were corrected for standard temperature (273K), and pressure (101.3kPa).
- Stack Parameters; Mean air velocity (Nm/min), mean volume flow rate (Nm^3/hr), mean temperature (°C), cross sectional area (m^2).

7 DISCUSSION

The process undertaken at Unit 4 as described above is covered by the Secretary of States Process Guidance Note *PG6/11(97)* - *Manufacture* of Printing Ink. This document states the following applicable emission limits.

Emission	Concentration
Volatile Organic Compounds (expressed as total carbon excluding particulate matter)	
i) for emissions from fixed and change pan processes where the mass emission of volatile organic compounds from an individual source exceeds 1kg/8hr.	150 mg/m^{3}
ii) from pan washing processes.	50 mg/m^{3}
iii) from manufacture of exempted inks.	None

7.1 Unit 4

Emission releases for volatile organic compounds ranged from 21 mg.m^{-3} to 211 mg.m^{-3}, and averaging at 95 mg.m^{-3}. The 211 mg.m^{-3} result was achieved during the addition of powder to the mixing vessel containing MEK. It is therefore possible that when powder is introduced with the aid of extraction, VOC is extracted, adding to the VOC emissions from bottling and capping operations. However, the average result of 95 mg.m^{-3} demonstrates compliance with the 150 mg.m^{-3} limit and therefore the Environmental Protection Act 1990.

8 APPENDICES

Appendix I	:	Field Sampling and Measurements
Appendix II	:	Methods of Analysis
Appendix III	:	Release Data

Surveyed and reported by

N Mandley.

Mr Nigel Mandley *BSc (Hons)* CCP
Environmental Scientist
ON BEHALF OF OEH SCIENTIFIC LIMITED

Checked by:

Mr Paul Calland
Environmental Consultant

APPENDIX I : FIELD SAMPLING AND MEASUREMENTS

MEASUREMENT OR ANALYTE	TECHNIQUE AND SAMPLING PROTOCOL	UNITS	PRECISION OF MEASUREMENT (%)	EQUIPMENT SERIAL NOS. AND CALIBRATION LOGS	METHOD REF.
Temperature	Thermocouple connected to a hand held electronic thermometer.	°C	± 5	Stack Kit 2	IEHO + HMIP (M1/M2) and references therein
Pressure	Pitot tubes connected to a calibrated electronic manometer.	Pa	± 5	Stack Kit 2	BS:1042 S2.1 (1983)
Miscellaneous	Duct diameters, cross sectional area, barometric pressure, humidity and prevailing meteorological conditions.	m, m^2, kPa	N/A	N/A	N/A
VOC Extractive	Portable pump connected to absorption tubes.	ppm or mg/m^3	± 10	Rotameter: NM Pump: 145	IEHO + HMIP (M1/M2) and references therein

APPENDIX II : METHODS OF ANALYSIS

ANALYTE	ANALYSIS TECHNIQUE	UKAS STATUS	DETECTION LIMIT	PRECISION OF MEASUREMENT (%)	CALIBRATION LOGS	METHOD REF.
VOC	Solvent Desorption/Gas Chromatography for extractive samples.	×	2 µg on absorption tube	± 2	GC/4535	IEHO + HMIP (M1/M2) and references therein

Opinions and interpretations expressed herein are outside the scope of UKAS Accreditation.

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APPENDIX III

ENVIRONMENTAL RELEASE DATA

ENVIRONMENTAL RELEASE DATA FOR LINX PRINTING TECHNOLOGIES LIMITED

			ENVIRONMENTAL RELEASE LEVELS†				-
	STACK REFERENCE AND ACTIVITY MONITORED		UNIT 4 - MAIN PROCESS STACK				
	TIME OF SAMPLING		11:32 - 12:02	12:02 - 12:32	12:32 -13:02	13:02 - 12:32	13:32 - 14:02
	DATE OF SAMPLING		02 November 00				
ANALYTE(S)	UNITS	RELEASE LEVEL					
Volatile Organic Compounds	mg/m³	150	21.3	36.4	127.4	211.0	79.5
STACK PARAMETERS							
Mean Air Velocity	m/sec		7	7	7	7	7
Mean Air Velocity	m/min		421	421	421	421	421
Mean Volume Flow Rate	m³/hr		4684	4684	4684	4684	4684
Mean Temperature	°C		16	16	16	16	16
Cross Sectional Area	m²		0.20	0.20	0.20	0.20	0.20

† Release data and stack flow parameters have been corrected for standard temperature (273° K) and pressure (101.3kPa), but no correction has been made for water vapour.

<dl = less than detection limit