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Health, Safety & Environment Consultant

Emission Monitoring Report for:-

EXEL
Building 94
RAF Alconbury Airfield
(Northgate) Alconbury
HUNTINGDON
Cambridgeshire
PE28 4WY

Work Completed By :- Mr J Lowrence
Date of Monitoring:- 31st October 2003
Date Reported:- 12th November 2003
Report Number:- 679

Introduction

The report covers emission monitoring for emissions to atmosphere for compliance to PG6/34(97), 'Vehicle Re-Spraying Processes'.

The report covers the emissions of Volatile Organic compounds (VOC's) from the one Dalby Spray booth (Top Coat Oven) flue at the Alconbury site.

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Methods

(1) Process Details

Cars are delivered to the site, predominantly from fleet hire companies / insurance companies for repair and paintwork touch-up at the Alconbury site of Exel Limited. Upon completion of any repairs, the car body parts requiring paint application, are then usually sprayed with an compliant coating undercoat and compliant coating top coat of paint, followed by a none compliant coating of a lacquer coat in any of two Dalby, spray booths.

The paint is applied using HVLP spray guns, by usually one paint sprayer per booth, the car body panels themselves, are by design, subject to an amount of overspray, which is extracted by the spray booth, through several particulate filtration plants, then to external atmosphere.

The spray booths have a guarantee from Harry Dalby Engineering Limited that emissions of particulate matter are below the process guidance limit of 10 mg/m3 (Copy of report is enclosed for reference), so testing for total particulate matter was not deemed as being required, hence only VOC monitoring was requested, its understood that Exel, do predominantly use compliant coatings in the primer and colour coat's.

(2) Strategy

The spray booths operator, (one personnel), were requested to spray under normal conditions for a normal time period, required to spray body panels (e.g. car wing, bumper, etc), in all spray booths, for the usual paint application used, in each respective booth, of an area of at least $1m^2$.

Initial velocity temperature measurements were made before spraying commenced, followed by the VOC sampling run and duplicate, when spraying commenced in the booth.

Independent checks were made, to ensure that spraying was continuing, during the period of the testing on site.

(3) Preparation

Initial measurements were taken from each stack, before emission sampling commenced.

The measurements taken, were used for standardisation requirements, temperature within the stack, pressure, mass flow rate of each stack.

Efflux Velocities were taken using a pitot tube and air neotronics electronic manometer.

Temperature readings were taken with ETP 'K type' air probe and digital readout unit, with traceable NPL calibration certificate.

Stack diameter's and mass air flow were also recorded.

(4) Volatile Organic Compounds (VOC's) FID not PID

VOC's were sampled using a Photo Ionisation Detector, which samples for the Carbon present within the VOC's being emitted to atmosphere.

The PID measures all VOC's as ppm carbon, this is then corrected to a mg/m3 reading, corrected to standard temperature and pressure.

Sampling was completed during normal spraying operations, within each respective booth, for a 2 minute period during spraying and a 15 minute period during baking process, for each respective paint type and each stack.

Instrument used:- Minirae 2000 PID. Serial Number: 8168

Standard Calculation Formula:-

$$\text{Mg/m3 Carbon} = \frac{\text{Measured Temp}}{\text{Standard Temp}} \times \frac{\text{Measured Pressure}}{\text{Standard Pressure}} \times \frac{\text{Instrument Reading (ppm)}}{\text{Response factor of solvent}} \times \frac{50}{\text{ppm reading for 50 mg/m3}}$$

Standard temperature = 273 Kelvin
Standard pressure = 101.3 Kpa.

PID Calibration

The PID was factory Calibrated on 7th January 2003.

RESULTS

Dalby Spray Booth Serial Number SB4133 (Top Coat Oven)

Mass Flowrates

Efflux Velocity; 13.2 m/s
Stack Diameter; 0.40 x 0.40 m
Cross Sectional Area; 0.16 m2
Mass Emission Rate; 7603 m3/hour
Normal Operation Conditions
Temperature within the stack; 307.4 K
Pressure; 101.3 Kpa
Spray area; Ford Focus – Rear Bumper.
Paint application type; Standox MS Xtra Klarlack Lacquer Coat
Main constituents of Solvents in product; Naptha, Butyl Acetate, Trimethyl Benzene
Minirae Reading at 50 mg/m3 Carbon = 48.2
Mean Response Factor = 2.1

Volatile Organic Compounds, (VOC's)

	Spraying (ppm Carbon)	Baking Cycle (ppm Carbon)
Time		
1 minute	45	10
2 minutes	50	8
3 "	28	7
4 "	12	5
5 "	Finish	0
6 "		0
7 "		0
8 "		0
9 "		0
10 "		0
11 "		0
12 "		0
13 "		0
14 "		0
15 "		0
Highest 2 minute mean;	47.5 ppm Carbon	2.0 ppm Carbon (9 ppm Carbon) ???

Results;

Spraying Lacquer = 24.6 mg/m3 **Baking Cycle = 1.0 mg/m3**

Note:- During baking cycle, extraction does not go to atmosphere, but is recycled into booth, hence readings only show, VOC residues left in ducting

CONCLUSIONS

Conclusions

On the day of testing, 31st October 2003, it can be shown that Emissions to atmosphere of Volatile Organic Compounds (VOC's), were measured at being well below the PG6/34(97) guidance note limit, of 50 mg/m3, during the use of Standox medium solids lacquer coating.

Volatile Organic Compounds (VOC) Emissions

Dalby Spraybooths	RESULT		PG6/34(97) Limit
	Spraying (2 Mins)	Baking (15 Mins)	
Dalby Top Coat Oven (S/N SB4133)	**38 mg/m3**	**1.0 mg/m3**	**50 mg/m3**

Note:-

All results are corrected to standard temperature and pressure (273 Kelvin, 101.3 KPA)

APPENDIX

- Intended use : Professional painting of vehicles only
- Company : STANDOX GmbH
- Street/box : Christbusch 65
- Postal code/City : D-42285 Wuppertal
- Telephone of company: 0049-202-2530-0
- Information by : Division LV Phone:0049-202-2530-2385
- Emergency phone no. : 0049-202-2530-6655

2. COMPOSITION/INFORMATION ON INGREDIENTS

- Substances presenting a health hazard within the meaning of the Dangerous Substances Directive 67/548/EEC (incl. 26. ATP):

CAS-No.	Names	Conc. range	Symbol	R-phrases
000123-86-4	n-butyl acetate	25.0- < 50.0 %		66-67
XXXXXX-XX-X	solvent naphtha (petroleum), light arom.	15.0- < 20.0 %	Xn	
064742-95-6	solvent naphtha (petroleum), light arom.	7.0- < 10.0 %	Xn	66-67
000095-63-6	1,2,4-trimethylbenzene	5.0- < 7.0 %	Xn	20-36/37/38
001330-20-7	xylene	3.0- < 5.0 %	Xn	20/21-36
000100-41-4	ethylbenzene	1.0- < 2.0 %	Xn	20
000108-67-8	mesitylene	1.0- < 2.0 %	Xi	37
000526-73-8	1,2,3-trimethylbenzene	1.0- < 2.0 %	Xi	37

See full text of R(isk) phrases in chapter 16.
Do not total for the above mentioned percentages for risk assessment.

3. HAZARDS IDENTIFICATION OF THE PREPARATION

- Human health hazards: n.a.

Flammable. Repeated exposure may cause skin dryness or cracking. Vapours may cause drowsiness and dizziness.

4. FIRST AID MEASURES

- General:

In all cases of doubt, or when symptoms persist, seek medical attention. Never give anything by mouth to an unconscious person.

- Inhalation:

Remove to fresh air, keep patient warm and at rest. If breathing is irregular or stopped, administer artificial respiration. Give nothing by mouth. If unconscious place in recovery position and seek medical advice.

Dalby

HARRY DALBY ENGINEERING LTD

ENVIRONMENTAL PROTECTION ACT 1990

SECRETARY OF STATE'S PROCESS GUIDANCE NOTES:

PG6/20 – PAINT APPLICATION IN VEHICLE MANUFACTURING
PG6/23 – COATING OF METAL AND PLASTIC
PG6/34 – RESPRAYING OF ROAD VEHICLES
PG6/40 – COATING AND RECOATING OF AIRCRAFT AND AIRCRAFT COMPONENTS
PG6/41 – COATING AND RECOATING OF RAIL VEHICLES

TECHNICAL DATA AND INFORMATION BOOKLET

Issue No: 6 Issue Date: 25 Mar 03
Manager Responsible:
Engineering Manager

Approval Certificate No: 912451

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SECTION 2

ENVIRONMENTAL PROTECTION ACT 1990
PAINT PARTICULATE EMISSION RATES FROM DALBY SPRAY BOOTH EQUIPMENT
RESEARCH PROGRAMME AND COMPILATION OF TEST DATA

INTRODUCTION

Following the introduction of the Environmental Protection Act 1990 and the consequent requirements for controls on Paint Particulate Emissions from Spray Booth plants, Harry Dalby Engineering Ltd initiated a research and development programme. This programme's aim was to establish emission rates and to be able to give test data support to guarantees of conformity with all Spray Booth plant offered by the company.

OBJECTIVES

The objective of the programme was to develop a filtered extraction system for the company's range of Spray Booth/Oven plants which would achieve known rates of emissions together with the development of a filter bed design giving easy and economic maintenance. The whole programme was based on development work in connection with a dry filter media system, and was later applied to the design of the waterwash extraction chests.
Note: The results of the test data are based on using Dalby Filter Media of a known quality when fitted to our Local Exhaust Ventilation (LEV) plant/machinery, filter media supplied from sources other than Dalby may not meet the required particulate arrestment standard.

THE TEST APPARATUS

It was found that there was no well-established test apparatus or procedures available for the testing of fine particles, sticky paint particulate emissions. The BS 3405 test method suggested in the Process Guidance Notes is simply impractical with this type of emission due to the very small quantities of air sampled, the minute weight of material collected and the tendency of material to adhere to the pitot tube etc. Opto-electronic aerosol monitors were considered but their sensitivity to particle size, complex parameters of settings together with uncertainties over calibrations and readouts render their performance inconclusive for this test.

It was decided to develop an apparatus for emission testing based on the abstraction of relatively large quantities of contaminated air and collecting a significant quantity of emission particles by absolute filtration to enable easy weighing. By measuring relatively large quantities of air the proportion of material arrested in sampling tubes becomes much less significant and more easily assessed. The Dalby apparatus takes measurement quantities of approximately 1 cubic metre. The apparatus has proved to be very consistent in use and is easily operated.

THE TEST PROGRAMME

The initial dry filter bed testing programme was carried out from October 1991 to May 1992. The test programme comprised running a series of tests on standard Dalby Spray Booth/Oven models. A further programme of testing was undertaken on varying types of filter bed/extract air ratios to establish predictable performance for different kinds of filter bed against different airflow rates against different paint particulate materials.

Further tests were carried out in April 1997, comprised running a series of tests on standard Dalby open fronted dry filter booths.

The prototype waterwash extraction chest was tested in Aug 1998 during the design development of a new range. The testing procedure used in the earlier particulate test was repeated.

PAINT MATERIAL AND SPRAY GUN EQUIPMENT USED FOR TESTS

Our test programme showed that the type of spray gun profoundly affected the efficiency of any filter bed used, the viscosity of the paint material and the rate of application. Additionally, the transfer efficiency of the work being carried out was important i.e. when painting a flat panel where maximum transfer efficiency of the paint spray process was being achieved, the amount of over-spray material and therefore particulate emission was reduced. Our testing showed that with high-pressure spray guns of the Devilbiss JG type using two-pack Isocyanates based paint material produced the finest particle size of all the processes tested.

It was therefore decided to base our testing programmes using this type of spray gun and ICI 2K auto colour paint material with the colour of black and generally releasing the paint spray gun into the free area of the extraction system without any transfer efficiency at all. The spray gun was set to deliver the maximum possible amount of paint using an air pressure of approximately 55 psi. This basic parameter of equipment and material coupled with totally free release provided the worst scenario for testing filter efficiencies.

THE EFFECT OF AIR FLOW RATE ON PARTICULATE EMISSION

Different specifications of Spray Booth provide different airflow rates according to specification and engineering cost compromise. Our test programme shows that air flow rate has a profound effect on emission rate for a given paint release rate as the particulate is diluted with increasing air capacity. The lowest paint discharge rate to booth air flow rate is experienced on the Dalby 8K and 'X' model Spray Booth/Ovens where the air flow rate is approximately 6,000 cubic feet per minute or 10,000 cubic metres per hour. As the booth's air movement capacity increases so a predictable reduction in emissions take place.

The test result data detailed below is a representative sample of the range of booths supplied by this company, and establishes a relationship between airflow quantity and extraction filter area/type required to provide satisfactory particulate emissions. This enables the company to provide guarantees on the booths specified below, as well as booths not specifically mentioned: 'X', 'Q', & '15K' booths, and many other configurations of bespoke spraybooth installations conforming to the airflow and filter area/type relationship.

The prototype testing of the water wash chests used an air quantity of 4,500 cubic metres per hour and as a result the particulate measured in the discharge air was significantly higher. However the quantity of air flow used in this prototype booth is lower than normal equipment supplied and thus the true particulate emission rate would subject to further dilution by an increased air flow rate.

The average paint release rate of the spray gun equalled 150 grams per minute.

SUMMARY OF TEST RESULT DATA

Dalby 8K Standard Spray Booth/Oven

Measured airflow of Spray Booth equalled 9,500 cubic metres per hour.
Average emission rate over 4 separate tests equalled 8.37 milligrams per cubic metre of air.

Dalby 10K Spray Booth/Oven

Measured airflow of booth 18,700 cubic metres per hour.
Average emission rate of 4 tests - 5.6 milligrams per cubic metre of air.

Dalby 12K Spray Booth/Oven

Measured airflow rate 20,400 cubic metres of air per hour.
Average emission rate over 8 tests - 4.3 milligrams per cubic metre of air.

Dalby Commercial Vehicle Spray Booth/Ovens

From the period January 1992 to April 1996 test programmes have been performed on a range of Dalby Large Plants using dry filter extract systems. Designed with similar parameters of paint release rates/proportionate airflow rate/proportionate filter areas, all of which produced results lower than 5 milligrams per cubic metre of air.

Dalby 2.33m Open Fronted Dry Filter Booth

Measured airflow of dry filter booth equalled 12,300 cubic metres per hour. Average emission rate over 4 separate tests equalled 6.3 milligrams per cubic metre of air.

Dalby Prototype Waterwash Extract Chest

Measured airflow of dry filter booth equalled 4,500 cubic metres per hour. Final emission rate on completion of development work equalled 15.2 milligrams per cubic metre of air.
The quantity of air flow used in this prototype booth is lower than normal equipment supplied and thus the true particulate emission rate would subject to further dilution by an increased air flow rate.

Additional Testing carried out

Apart from the specific Dalby models tested above, a further programme of testing was carried out to evaluate the possibility of predicting Dalby Filter Bed arrestance performance to investigate standard design parameters for special booths, large multi extract system Spray Booth/Ovens and production dry back Spray Booth equipment. This additional programme proved that it was possible using standard Dalby combinations of filter material against specific filter bed areas against specific air rates to predict with very good accuracy the performance of a special filter bed.

ADDITIONAL TEST DATA AVAILABILITY

The Dalby research and development programme including the development of suitable test apparatus has been costly and commercial confidentiality requirements prevent the release of more specific data regarding filter bed areas and types. However, further information will be made available to bona fide third parties who will not benefit commercially by such information.

VALIDITY OF TEST DATA

Harry Dalby Engineering Ltd submit the foregoing test data as ample evidence to support the guarantees of conformity for paint particulate emission rates of its Spray Booth/Oven equipment offered for general sale. Additionally, the data obtained and submitted enables the Company to guarantee any modified existing equipment or individually designed special purpose plant.

OUR CONCLUSIONS

Plants using Dalby developed filter beds can be made to conform with the emission limits defined in the Process Guidance Notes using the worst scenario of paint material/spray gun/air pressure. Our research shows that with the low VOC content paint materials being introduced in the future, coupled with the use of high volume low pressure spray guns, the particle size greatly increases and the consequent filtration efficiency is much improved. This also applies to the use of airless spray guns and air assisted airless guns used in the application of heavier paint materials.