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FAO: Mr E Mayhew

**Test Report:** LE390009 **Project No.** 390

**Title:** Emission Monitoring

**Introduction**
Monitoring of emissions was carried out at the above site on 20th and 22nd August 2013, in accordance with the Pollution Prevention & Control Act 1999 and Pollution Prevention & Control (England & Wales) Regulations 2000, Permit Ref Number 6.4/LK/9/07.

**1. Process description**
The process comprises two similar Komori System 38S heat set web offset printing presses. In each case, emissions from the Megtec Dual Dry TNV9.1 driers are vented through an integrated recuperative thermal oxidiser to remove VOC's (volatile organic compounds) from the emissions. These exhaust through a short stack, fitted with an ejector cowl, directly above the oven. The afterburner is set to run at a chamber temperature of 775°c on press 1 and 760°c on press 2.

The emissions were tested for the following parameters specified in the Permit, against the following concentration limits:

| Emission | Test | Limit |
|---|---|---|
| Web press | Total particulate matter | 100 mg/m3 |
| | Carbon monoxide | 100 mg/m3 |
| | Oxides of nitrogen | 100 mg/m3 as NO2 |
| | VOC | 20 mg C/m3 (from 2013) |

All concentrations are 30 minute means, expressed at reference conditions of 273K and 101.3kPa without correction for water vapour or oxygen content, i.e. as mg/Nm3.

**2. Sampling details**
Emission sampling was carried out using the following industry standard techniques. The Testing Protocols are appended.

**Press 1**
Sampling for particulates was carried out between 10:00 and 11:00hrs on 22nd August 2013, when the press was running continuously for the test period.

Sampling for VOC and CO/NO was carried out between 08:30 and 13:30hrs, when the press was running continuously throughout the test period, printing a medium ink coverage at a rate of 29,000 impressions per hour.

**Press 2**
Sampling for particulates was carried out between 09:00 and 10:00hrs on 21st August 2013, when the press was running continuously for the test period.

Sampling for VOC and CO/NO was carried out between 08:30 and 13:30hrs, when the press was running for approximately 80% of the test period, printing a medium ink coverage at a rate of 36,000 impressions per hour.

The samples were taken from one of the 2 x 2" test points in the stack at platform level, directly on top of the oven on each press.

**2.1 Volatile Organic Compounds (VOCs)**
**2.1.1 Extractive Sample**
Monitoring for VOCs was carried out using BS EN 13649:2002; Determination of the mass concentration of individual gaseous organic compounds. Activated carbon and solvent desorption method.

The test equipment was connected to the 2" sample point in the exhaust stack. Samples gases were drawn through an exhaust gas sampling probe, a glass fibre filter to remove particulate matter and an activated carbon sample adsorption tube at a rate of 100ml/min. for 5 hours. The sample tube was analysed in a UKAS laboratory for total hydrocarbons by solvent desorption and GCMS analysis, with the results expressed as mg/m3 of carbon. This was then converted to reference conditions of 273K and 101.3kPa without correction for water vapour, i.e. mgC/Nm3.

**2.2 Carbon Monoxide and Oxides of Nitrogen**
Monitoring for carbon monoxide and oxides of nitrogen, along with carbon dioxide, oxygen and temperature, was carried out using a Kane Quintox 9106 flue gas analyser. Measurements were taken every 15 minutes. The instrument was calibrated by the supplier using reference gases of known and gave a read out directly in ppm carbon monoxide, nitric oxide & nitrogen dioxide, and % carbon dioxide. Results were subsequently converted from ppm to mg/m3 and expressed at reference conditions of 273K and 101.3kPa, i.e. mg/Nm3, without correction for water vapour or oxygen.

On each press, the samples were taken from one of the 2 x 2" test points in the stack at platform level, directly on top of each oven.

**2.3 Total Particulate Matter**
The sampling and analysis procedure is based on the main procedural requirements of British Standard BS ISO9096:2003. On each press, the samples were taken from one of the 2 x 2" test points in the stack at platform level, directly on top of each oven.

Stack gas velocities were measured at the test points using an Airflow Developments PVM100 Pitot probe and meter.

**3. Results**
The individual results are shown in full and graphically in the Appendix to this report.

**3.1 Press 1**

**3.1.1 Summary of flue gas emission results**

| Press 1 | CO mg/Nm3 | NO2 | Temp C |
|---|---|---|---|
| **Mean** | **41** | **31** | **367** |
| Max | 62 | 41 | 369 |
| Min | 31 | 4 | 364 |
| **EPA Limit** | **100** | **100** | |
| July, 2012 | 113 | 32 | 361 |
| July, 2011 | 9 | 27 | 340 |
| April, 2010 | 81 | 71 | 358 |
| June, 2009 | 17 | 61 | 359 |

**3.1.2 Total Particulate matter**

**TPM**

| Location | Sample | TPM mg/Nm3 |
|---|---|---|
| Stack | P1 | 0.3 |
| **EPA Limit** | | **50** |

### 3.2 Press 2

#### 3.2.1 Summary of flue gas emission results

| Press 2 | CO mg/Nm3 | NO2 | Temp C |
|---|---|---|---|
| **Mean** | **92** | **18** | **357** |
| Max | 128 | 27 | 368 |
| Min | 10 | 4 | 311 |
| **EPA Limit** | **100** | **100** | |
| July, 2012 | 113 | 32 | 361 |
| July, 2011 | 9 | 27 | 340 |
| April, 2010 | 81 | 71 | 358 |
| June, 2009 | 17 | 61 | 359 |

#### 3.2.2 Total Particulate matter

| Location | Sample | TPM mg/Nm3 |
|---|---|---|
| Stack | P2 | 0.5 |
| **EPA Limit** | | **50** |

### 3.3 Presses K1 and K2

#### 3.3.1 Stack gas flow measurements

| Press | Stack dia mm | Area m2 | Temp C | Vel. m/s | Flow m3/hr | Flow Nm3/hr |
|---|---|---|---|---|---|---|
| 1 | 445 | 0.16 | 367 | 17.2 | 9631 | 4109 |
| 2 | 445 | 0.16 | 357 | 16.9 | 9466 | 4102 |

#### 3.3.2 VOC extractive samples

It should be noted that the initial reading outside the factory was slightly higher than those taken inisde, but the results were very similar.

## 4. Discussion

The mean results for the gaseous emissions of VOC, CO and NOx were all below the emission limits on both presses. During the test, the Komori press 1 was running for 85 % of the 5-hour test period, and Komori press 2 was running continuously.

The results for the particulate emissions on both presses were also negligible, and therefore well below the emission limit.

The abatement equipment on both installations are is performing well, and when running emissions were below the prescribed limits.

**5. Recommendations**

The VOC abatement equipment is operating correctly and no remedial action is required.

Emissions should be checked annually to comply with the authorisation.

**Signed:**....P J Darnell.....

P.J.Darnell MRSC

**Date:** 28th Aug 2013

## Appendix 1

### Flue Gas Emission Testing

Express Instruments kit

**Site** Ancient House Press
**Date** 22 August 2013
**Equip.** Kane May Quintox

**Test** Komori press 1
**Point** Stack A1

| Conversion Factors | | Factor @273k | |
|---|---|---|---|
| mgCO/m3 | =COppm x | 1.17 | |
| mgCO2/m3 | =%CO2x10000 x | 1.83 | |
| mgNO/m3 | =NOppm x | 1.25 | |
| mgNO2/m3 | =NOppm x | 1.91 | |
| mg/m3NOx | =NOxppm x | 2.05 | as NO2 |

| | Measured data from Quintox | | | | | | | | Calculated results at std conditions | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | Temp °C | O2 % | CO ppm | CO2 % | NO ppm | NO2 ppm | NOx ppm | | CO mg/Nm3 | NOx mg/NO2/Nm3 | | Press |
| 08:20 | 365.5 | 18.4 | 44 | 1.4 | 1 | 1 | 2 | | 51 | 4 | | running |
| 08:30 | 365.8 | 18.2 | 48 | 1.5 | 11 | 0 | 11 | | 56 | 23 | | running |
| 08:45 | 365.3 | 17.9 | 43 | 1.7 | 13 | 0 | 13 | | 50 | 27 | | running |
| 09:00 | 365.1 | 18.1 | 35 | 1.6 | 14 | 0 | 14 | | 41 | 29 | | running |
| 09:15 | 365.3 | 18.2 | 27 | 1.5 | 16 | 1 | 17 | | 31 | 35 | | running |
| 09:30 | 366.5 | 18.4 | 27 | 1.5 | 19 | 1 | 20 | | 31 | 41 | | running |
| 09:45 | 365.8 | 18.4 | 44 | 1.4 | 16 | 0 | 16 | | 51 | 33 | | running |
| 10:00 | 366.8 | 18.7 | 29 | 1.2 | 17 | 0 | 17 | | 34 | 35 | | running |
| 10:15 | 366.6 | 18.8 | 29 | 1.2 | 17 | 0 | 17 | | 34 | 35 | | running |
| 10:30 | 367.4 | 18.9 | 29 | 1.1 | 17 | 0 | 17 | | 34 | 35 | | running |
| 10:45 | 368.8 | 19.0 | 29 | 1.0 | 17 | 0 | 17 | | 34 | 35 | | running |
| 11:00 | 368.6 | 19.0 | 30 | 1.1 | 17 | 0 | 17 | | 35 | 35 | | running |
| 11:15 | 367.1 | 18.9 | 30 | 1.1 | 17 | 0 | 17 | | 35 | 35 | | running |
| 11:30 | 367.4 | 18.9 | 30 | 1.1 | 17 | 0 | 17 | | 35 | 35 | | running |
| 11:45 | 364.4 | 19.0 | 31 | 1.1 | 17 | 0 | 17 | | 36 | 35 | | running |
| 12:00 | 367.5 | 18.9 | 35 | 1.1 | 14 | 0 | 14 | | 41 | 29 | | running |
| 12:15 | 368.3 | 18.9 | 32 | 1.1 | 14 | 0 | 14 | | 37 | 28 | | running |
| 12:30 | 368.7 | 18.9 | 32 | 1.1 | 14 | 0 | 14 | | 37 | 28 | | running |
| 12:45 | 368.7 | 18.9 | 34 | 1.1 | 14 | 0 | 14 | | 40 | 29 | | running |
| 13:00 | 367.8 | 18.9 | 34 | 1.1 | 15 | 0 | 15 | | 40 | 31 | | running |
| 13:15 | 367.8 | 18.9 | 49 | 1.1 | 15 | 0 | 15 | | 57 | 31 | | running |
| 13:30 | 367.8 | 19.0 | 53 | 1.1 | 15 | 0 | 15 | | 62 | 31 | | running |
| **Mean** | **368.9** | **18.7** | **35.2** | **1.2** | **14.9** | **0.1** | **15.0** | | **41.0** | **30.8** | | |
| Max | 368.8 | 19.0 | 53.0 | 1.7 | 19.0 | 1.0 | 20.0 | 0.0 | 61.7 | 41.0 | | |
| Min | 364.4 | 17.9 | 27.0 | 1.0 | 1.0 | 0.0 | 2.0 | 0.0 | 31.5 | 4.1 | | |

Extractive Sample

| Sample Point | Press | Filter | Time on | Time off | Duration | Rate l/min | Vol litres |
|---|---|---|---|---|---|---|---|
| Press 1 | P1 | T2 | 08:30 | 13:30 | 5h | 0.10 | 30.00 |
| Press 2 | P2 | T1 | 08:30 | 13:30 | 5h | 0.10 | 30.00 |

| Sample Point | Press | Time on | Time off | VOC ug | mgC/Nm3 | g/hr |
|---|---|---|---|---|---|---|
| Press 1 | P1 | 08:30 | 13:30 | 3 | 0.1 | 0.41 |
| Press 2 | P2 | 08:30 | 13:30 | 28 | 0.9 | 3.83 |
| | EPA Limit | | | | 30 | |

## Flue Gas Emission Testing

Express Instruments kit

**Site** Ancient House Press
**Date** 20 August 2013
**Equip.** Kane May Quintox

**Test** Komori press 2
**Point** Stack A2

| Conversion Factors | | Factor @273k | |
|---|---|---|---|
| mgCO/m3 | =COppm x | 1.17 | |
| mgCO2/m3 | =%CO2x10000 x | 1.83 | |
| mgNO/m3 | =NOppm x | 1.25 | |
| mgNO2/m3 | =NOppm x | 1.91 | |
| mg/m3NOx | =NOxppm x | 2.05 | as NO2 |

| | Measured data from Quintox | | | | | | | | Calculated results at std conditions | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | Temp °C | O2 % | CO ppm | CO2 % | NO ppm | NO2 ppm | NOx ppm | | CO mg/Nm3 | NOx mgNO2/Nm3 | | Press |
| 08:35 | 347.8 | 18.3 | 106 | 1.4 | 1 | 1 | 2 | | 123 | 4 | | running |
| 08:55 | 358.1 | 18.5 | 105 | 1.3 | 1 | 1 | 2 | | 122 | 4 | | running |
| 09:06 | 359.4 | 18.5 | 73 | 1.4 | 1 | 1 | 2 | | 85 | 4 | | running |
| 09:15 | 360.2 | 18.5 | 81 | 1.3 | 2 | 1 | 3 | | 94 | 6 | | running |
| 09:30 | 360.9 | 18.6 | 67 | 1.3 | 3 | 1 | 4 | | 78 | 8 | | running |
| 09:45 | 362.1 | 18.8 | 85 | 1.2 | 5 | 1 | 6 | | 99 | 12 | | running |
| 10:00 | 362.2 | 18.9 | 94 | 1.1 | 6 | 0 | 6 | | 110 | 12 | | running |
| 10:15 | 360.9 | 19.0 | 99 | 1.1 | 7 | 0 | 7 | | 115 | 14 | | running |
| 10:30 | 362.0 | 19.0 | 64 | 1.0 | 9 | 0 | 9 | | 75 | 18 | | running |
| 10:45 | 318.9 | 20.0 | 9 | 0.5 | 9 | 1 | 10 | | 10 | 21 | | Shut down |
| 11:00 | 310.9 | 20.0 | 9 | 0.5 | 10 | 1 | 11 | | 10 | 23 | | Shut down |
| 11:15 | 358.1 | 18.5 | 75 | 1.0 | 10 | 1 | 11 | | 87 | 23 | | running |
| 11:30 | 358.9 | 19.1 | 53 | 1.0 | 10 | 0 | 10 | | 62 | 21 | | running |
| 11:45 | 360.9 | 19.2 | 73 | 1.0 | 11 | 0 | 11 | | 85 | 23 | | running |
| 12:00 | 362.5 | 19.3 | 86 | 0.9 | 11 | 0 | 11 | | 100 | 23 | | running |
| 12:15 | 363.2 | 19.2 | 102 | 0.9 | 12 | 0 | 12 | | 119 | 25 | | running |
| 12:30 | 364.3 | 19.2 | 99 | 0.9 | 12 | 0 | 12 | | 115 | 25 | | running |
| 12:45 | 364.1 | 19.2 | 110 | 1.0 | 12 | 1 | 13 | | 128 | 27 | | running |
| 13:00 | 367.7 | 19.3 | 99 | 0.9 | 13 | 0 | 13 | | 115 | 27 | | running |
| 13:15 | 364.5 | 19.3 | 86 | 0.9 | 13 | 0 | 13 | | 100 | 27 | | running |
| 13:30 | 362.5 | 19.5 | 76 | 0.8 | 13 | 0 | 13 | | 89 | 27 | | running |
| **Mean** | **356.7** | **19.0** | **78.6** | **1.0** | **8.1** | **0.5** | **8.6** | | **91.6** | **17.7** | | |
| Max | 367.7 | 20.0 | 110.0 | 1.4 | 13.0 | 1.0 | 13.0 | | 128.2 | 26.7 | | |
| Min | 310.9 | 18.3 | 9.0 | 0.5 | 1.0 | 0.0 | 2.0 | | 10.5 | 4.1 | 0.0 | |

Press 1 stack showing test points

Press 2 stack showing test points

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## Protocol for Emission Testing

**Date**: August 2013 **Site**: Ancient House Press Ltd.

Monitoring of emissions will be carried out at the above site in accordance with the Pollution Prevention & Control Act 1999 and Pollution Prevention & Control (England & Wales) Regulations 2000, Permit Ref Number 6.4/RJD/4.

### 1. Process

The process comprises two similar Komori System 38S heat set web offset printing presses. In each case, emissions from the Megtec Dual Dry TNV9.1 driers are vented through an integrated recuperative thermal oxidiser to remove VOC's (volatile organic compounds) from the emissions. These exhaust through a short stack, fitted with an ejector cowl, directly above the oven. The afterburner is set to run at a chamber temperature of 775°c on press 1 and 760°c on press 2.

The thermal oxidiser system is designed to combust solvents (VOC's) from the heat set web offset printing inks, which contain 30 - 35% high boiling aliphatic hydrocarbons (C12 - C18) with a low aromatic content. Emission form the afterburner will be combustion products of natural gas - carbon dioxide and water vapour. Trace levels of unburned solvent, carbon monoxide and oxides of nitrogen may also be present.

The test will be carried out under normal running conditions, whilst printing under high load, with typically 50 - 80% ink coverage. During the run there may be periods when temporary stoppages occur due to web breakages and for blanket washing. Testing will be continued to include these situations.

The emissions from the stack will be tested for the following parameters specified in the authorisation, against the following concentration limits:

| | |
|---|---|
| volatile organic compounds (as total carbon excluding particulate matter) | 20mg/Nm3 |
| carbon monoxide | 100mg/Nm3 |
| nitrogen oxides expressed as nitrogen dioxide | 100mg/Nm3 |

### 2. Test Procedure

Emission sampling will be carried out using the following industry standard techniques.

1. Monitoring for VOC will be carried out using BS EN 13649:2002; Determination of the mass concentration of individual gaseous organic compounds. (Activated carbon and solvent desorption method.)

2. Monitoring for flue gases will be carried out using a Kane KM9106 flue gas analyser and datalogger.

3. Stack gas velocity will be measured using an Airflow Developments PVM100 micro-anemometer and Pitot probe, and corrected for temperature.

The test will be carried out under normal operating conditions.

## 3. Sampling

3.1 Sampling for VOC will be carried out at the 2 x 2" test points at the base of the stack, 2m above the unit. Gases will be drawn through a particle filter then into an activated charcoal adsorption tube, using a controlled flow pump at 100ml/min. Subsequent analysis will be carried out by GC/Fid in a UKAS accredited laboratory.

3.2 Instrumental sampling for flue gas parameters will be carried out at the second 2" sample point adjacent to 3.1.

3.3 Results will be recorded directly by the datalogger facility on the instrument.

3.4 Results will be corrected to normal temperature and pressure (273K & 101.3kPa) and expressed as mg/Nm3.

3.5 Sampling will be carried out over a 5 hour period during a typical days printing. (Press operation may not be constant)

## 4. Site Requirements

4.1 Plant operating conditions are not within our scope of work, but samples will be taken under 'normal operating conditions' according to plant management. Any stoppages will be recorded.

4.2 Sampling will only be carried out provided safe access is provided to a working platform with handrails adjacent to the sample points. Protective equipment will be worn as required.

## 5. Quality Control

5.1 Flow measurement equipment is calibrated by the manufacturer, and checked against laboratory reference sets.

5.2 Gas sampling and analysis instruments are supplied with calibration certificates.

## 6. Reporting

6.1 Measurement data will be logged on site onto form FG1, and then transferred onto a PC spreadsheet to enable the calculations to be carried out.

6.2 Test reports are produced in a standard format, with a unique reference number. A summary of the test procedure and analytical results will be included in the report.

6.3 Results of the emission tests will be reported graphically.

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**Protocol for Particulate Emission Testing**

**Date**: August 2013 **Site**: Ancient House Press Ltd.

Monitoring of emissions will carried out at the above site in accordance with the Pollution Prevention & Control Act 1999 and Pollution Prevention & Control (England & Wales) Regulations 2000, Permit Ref Number 6.4/RJD/4.

**1. Process description**

The process comprises two similar Komori System 38S heat set web offset printing presses. In each case, emissions from the Megtec Dual Dry TNV9.1 driers are vented through an integrated recuperative thermal oxidiser to remove VOC's (volatile organic compounds) from the emissions. These exhaust through a short stack, fitted with an ejector cowl, directly above the oven. The afterburner is set to run at a chamber temperature of 775°c on press 1 and 760°c on press 2.

The thermal oxidiser system is designed to combust solvents (VOC's) from the heat set web offset printing inks, which contain 30 - 35% high boiling aliphatic hydrocarbons (C12 - C18) with a low aromatic content. Emission form the afterburner will be combustion products of natural gas - carbon dioxide and water vapour. Trace levels of unburned solvent, carbon monoxide and oxides of nitrogen may also be present.

The test will be carried out under normal running conditions, whilst printing under high load, with typically 50 - 80% ink coverage. During the run there may be periods when temporary stoppages occur due to web breakages and for blanket washing. Testing will be continued to include these situations.

The emissions from the stack will be tested for the following parameters specified in the authorisation, against the following concentration limits:

total particulate matter shall not exceed 50 mg/m3.

**2. Test Procedure**

Particulate sampling will be in accordance with the main procedural requirements of British Standard BS ISO9096:2003.

Air flows within the stack will be measured at each test point, to establish a velocity profile. Samples will then be taken isokinetically, by taking incremental samples at 2 locations within the stack. Particulates will be collected onto dried pre-weighed glass fibre filters, which will be subsequently dried and re-weighed to determine total dust concentrations. Two 1-hour samples will be taken to ensure representative results are obtained.

**3. Sampling**

3.1 Sampling and analysis will be carried out following Levington Laboratories method EA/5.

3.2 The sample train consists of a stainless steel exhaust sampling probe with an appropriate nozzle, between 3 & 12.7mm dia. fitted with a Whatman 25mm GF/A filter in a two part cassette. This is connected via flexible tubing to a cooled Dreschel bottle as a water condenser, a rotameter, a dry gas meter and finally a suction pump.

3.3 Leak testing is carried out in the lab by pressurising the assembled apparatus with compressed air and using soap solution to test the joints. On site, the nozzle is blocked to check there is no flow due to leaks.

3.4 Typical sampling flow rates are from 5 to15 litres/min, dependent on stack flows, and duplicate samples are taken over two 1 hour periods.

3.5 A four point sampling regime will be employed if the duct area is less than 2.5sqm (0.15d & 0.85d), otherwise an eight point regime will be used.

3.6 Dust from the sample probe is knocked from the probe into the filter after sampling with the pump still running. If necessary it is washed using a acetone.

3.7 The filters are pre-weighed after desiccation and loaded into the cassettes. After exposure they are dried, desiccated and re-weighed on an analytical balance with a resolution of 0.01mg.

3.8 The volume of the condensate collected in the first Dreschel bottle will be combined with the weight gain in the second bottle to calculate the moisture content, if required.

3.9 Results are expressed at reference conditions 273K, 101.3kPa without correction for water vapour content.

**4. Site Requirements**

4.1 Plant operating conditions are not within our scope of work, but samples are taken under 'normal operating conditions' according to plant management.

4.2 Sampling will only be carried out provided safe access is provided to a working platform with handrails adjacent to the sample points. Protective equipment will be worn as required.

**5. Quality Control**

5.1 Flow measurement equipment is calibrated by the manufacturer, and checked against laboratory reference sets.

5.2 The analytical balance is calibrated daily and maintained under a service contract.

5.3 A 'travelling blank' filter is weighed alongside the exposed filters.

5.4 During chemical analysis 'check samples' of known analysis are tested alongside samples.

**6. Reporting**

6.1 Data is logged on site onto form EA/5f, and then transferred onto a PC spreadsheet to enable the calculations to be carried out. A copy of this spreadsheet is appended to the Test Report.

6.2 Samples filter holders are numbered, and the details transferred to the site form. On receipt in the laboratory, all samples are given a unique laboratory reference number and logged into the laboratory 'Analytical Record' system.

6.3 Test reports are produced in a standard format, with a unique reference number. A summary of the test procedure and analytical results are included in the report.