



Stephenson

Environmental Management Australia

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STACK EMISSION SURVEY

PROJECT NO.: 2788/01
DATE: MAY 2001

On Behalf of Kroll Heaters Australia

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1.0 INTRODUCTION

Stephenson Environmental Management Australia was requested by Kroll Heaters Australia and [redacted] to assess the emission from a fired boiler used for heating greenhouses located at [redacted] NSW. The tests were undertaken on 15 May 2001.

The objectives of the tests were to determine compliance of the emission with the Regulations under the New South Wales Clean Air (Plant and Equipment) Regulations, 1997 which are incorporated under the Protection of the Environment (Operations) Act.

[redacted] horticultural business is a Non-scheduled Premise and hence, the Protection of the Environment (Operations) Act Regulation/Limits for Scheduled Premises do not directly refer to these emissions from this operation. However, these Regulation emission concentrations are generally used as the reference base by most local Councils who now administer this part of the Protection of the Environment (Operations) Act.

The emissions were assessed for the following components:

- Particulate Matter (PM)
- Heavy Metals
- Hydrochloric Acid (HCl)
- Sulphur dioxide (SO₂)
- Oxides of Nitrogen (NO_x) (as NO₂)
- Sulphur trioxide/sulphuric acid mist (as H₂SO₄)
- Volatile Organic Compounds (VOC's)
- Odour
- Exhaust Gas Velocity, Volume and Temperature
- Carbon Monoxide, Carbon Dioxide and Oxygen

1.1 LICENCE AND REGULATORY LIMITS

The boiler stack operating at _____ Pty Ltd is on unscheduled premises with the following pollutant emission concentration Regulation limits:

	Regulation Emission Limit (mg/m ³)
■ Particulate Matter	250
■ Heavy Metals	5
■ Hydrochloric Acid	400
■ Sulphur trioxide/sulphuric acid mist (as H ₂ SO ₄)	100
■ Oxides of Nitrogen (as NO ₂)	500
■ Sulphur Dioxide	No specific limit.
■ VOC's	No specific limit.
■ Odour	Increase of 7 OU at boundary max.
■ CO, CO ₂ , O ₂	

Key
mg/m³ = milligrams per cubic metre

The emission tests were undertaken on 15 May 2001.

2.0 RESULTS AND DISCUSSION

2.1 PRODUCTION CONDITIONS

Kroll Heaters Australia and personnel considered the boiler was operating under typical conditions on the day of testing. The fuel was a waste motor vehicle sump oil.

2.2 EMISSION TEST RESULTS

The results of the stack emission tests are presented in detail in Tables A1 to A3 of Appendix A. Appendix B presents a graphical logged record of sulphur dioxide and oxides of nitrogen continuous emissions analysis. Analysis for heavy metals, hydrochloric acid and sulphur trioxide/sulphuric acid mist was performed by the NATA registered Australian Environmental Laboratories. The volatile organic compounds analysis was performed by the NATA registered laboratories of WorkCover NSW. The odour analysis was performed by the Olfactometric Laboratories of AWT. The certificates of analysis are presented in Appendix C of this report.

2.2.1 PARTICULATE MATTER

Particulate matter emission concentrations measured were 181 milligrams per cubic metre (mg/m^3) and $176 \text{ mg}/\text{m}^3$ for the first sampling traverse and second sampling traverse respectively. The average particulate matter concentration of $179 \text{ mg}/\text{m}^3$ was *in compliance with* the NSW EPA limit of $250 \text{ mg}/\text{m}^3$. Refer Table 2.1 and Appendix Table A1.

2.2.2 HEAVY METALS

Total heavy metal emission concentrations measured were $0.93 \text{ mg}/\text{m}^3$ and $0.61 \text{ mg}/\text{m}^3$ during first and second sampling traverses respectively. The average total heavy metal emission concentration of $0.77 \text{ mg}/\text{m}^3$ was *in compliance with* the NSW EPA limit of $5 \text{ mg}/\text{m}^3$. Refer Table 2.1 and Appendix Table A2.

2.2.3 HYDROCHLORIC ACID

The measured hydrochloric acid (HCl) emission concentration ranged from $3.14 \text{ mg}/\text{m}^3$ and $3.43 \text{ mg}/\text{m}^3$ respectively. The average HCl emission concentration of $3.29 \text{ mg}/\text{m}^3$ was in compliance with the NSW EPA limit of $400 \text{ mg}/\text{m}^3$. Refer Table 2.1 and appendix Table A3.

2.2.4 SULPHUR DIOXIDE

The measured sulphur dioxide (SO_2) emission concentration ranged from 201 to 290 parts per million (ppm), (574 to $829 \text{ mg}/\text{m}^3$) and averaged 262 ppm ($749 \text{ mg}/\text{m}^3$) during the sampling period. There are no specific limits set for sulphur dioxide emission concentrations in NSW. Refer Table 2.1 and Appendix B.

2.2.5 SULPHUR TRIOXIDE/SULPHURIC ACID MIST

The measured sulphur trioxide (SO_3)/sulphuric acid mist was $33.7 \text{ mg}/\text{m}^3$ and $80.6 \text{ mg}/\text{m}^3$ during first and second traverses respectively. The average emission concentration was $57.2 \text{ mg}/\text{m}^3$, this was *in compliance with* the NSW EPA limit of $100 \text{ mg}/\text{m}^3$. Refer summary Table 2.3 and Table A4 of Appendix A.

2.2.6 OXIDES OF NITROGEN

The oxides of nitrogen (NO_x) (expressed as NO_2) emission concentration ranged from 2 to 31 ppm (4 - $64 \text{ mg}/\text{m}^3$) averaging 12 ppm ($25 \text{ mg}/\text{m}^3$) during the sampling period. These emission concentrations *were significantly lower* than the current NSW CAA Regulation Limit of $500 \text{ mg}/\text{m}^3$ for any premises that becomes **scheduled** on or after 1 August 1997, that operates a boiler on a fuel other than gas and is not in connection with an electricity generator that forms part of an electricity generating system. Refer Summary Table 2.1 and Appendix B.

2.2.7 VOLATILE ORGANIC COMPOUNDS (VOCs)

The measured VOCs emission concentrations were below the level of detection of the analytical method employed. Appendix C presents a laboratory Certificate of Analysis from the Work Cover Laboratories.

2.2.8 ODOUR

The measured odour emission concentrations were 390 OU/m³ and 480 OU/m³ respectively.

2.2.9 CARBON MONOXIDE (CO), CARBON DIOXIDE (CO₂) AND OXYGEN (O₂)

The measured CO emission concentrations averaged 18 parts per million (ppm).

The measured CO₂ emission concentrations averaged 10.5%.

The measured O₂ emission concentrations averaged 6.8%.

TABLE 2.1 STACK EMISSION CONCENTRATIONS**15 MAY 2001**

POLLUTANT	AVERAGE EMISSION CONCENTRATION (mg/m ³)	EMISSION CONCENTRATION LIMIT (mg/m ³)
TSP		
Total Heavy Metals	0.77	5 (in aggregate)
Arsenic	< 0.028	
Antimony	< 0.028	
Beryllium	< 0.028	
Cadmium	0.0061	1
Chromium	0.048	
Cobalt	< 0.028	
Lead	0.649	
Mercury	< 0.007	1
Manganese	0.025	
Nickel	0.033	
Selenium	< 0.053	
Tin	< 0.028	
Vanadium	< 0.019	
HCl	3.29	400
SO ₃ /H ₂ SO ₄	749	NA
NO _x	25	500
VOC	ND	NA

Key :

TSP = total solid particulate matter

HCl = hydrochloric acid

SO₂ = sulphuric acid

SO₃/H₂SO₄ = sulphuric acid mist

NO_x = oxides of nitrogen

VOC = volatile organic compounds

ND = not detected

NA = not applicable

3.0 CONCLUSIONS

From the data presented and the emission test work conducted during typical production cycles, the following conclusions can be drawn:

- Particulate matter emission concentration averaged 179 mg/m³ which was *in compliance with* the NSW EPA Regulation limit of 250 mg/m³.
- The total heavy metals emission concentration averaged 0.77 mg/m³ which was *in compliance with* the NSW EPA Regulation limit of 5 mg/m³.
- The hydrochloric acid emission concentrations averaged 3.29 mg/m³ which was *in compliance with* the NSW EPA Regulation limit of 400 mg/m³.
- The sulphur dioxide emission concentration ranged from 574 to 829 mg/m³ with an average of 749 mg/m³ during the test period. Currently there are no specific limits set for sulphur dioxide emission control in NSW.
- Sulphur trioxide emission concentration averaged 57.2 mg/m³ which is *in compliance with* the NSW EPA Regulation Limit of 100 mg/m³.
- The oxides of nitrogen emission concentration ranged from 4 to 64 mg/m³ with an average of 25 mg/m³, expressed as nitrogen dioxide, which was *below* the NSW EPA Regulation emission limit of 500 mg/m³ for any premises that becomes **scheduled** on or after 1 August 1997, that operates a boiler on a fuel other than gas and is not in connection with an electricity generator that forms part of an electricity generating system.
- The VOC emission concentration was below the analytical limit of detection. Currently there are no specific limits for VOC emission in NSW.
- The odour emission concentrations averaged 435 OU/m³. To determine the ground level impact of this odour it would be necessary to use a computer based dispersion model such as AUSPLUME.
- The carbon monoxide emission concentration averaged 18 parts per million. The carbon dioxide emission concentration averaged 10.5%. The oxygen emission concentration averaged 6.8%. These levels indicate a boiler of this type was being operated efficiently.

TABLE NO. A1

EMISSION TEST RESULTS: PARTICULATE MATTER
 PROJECT NO.: 2788/01
 PROJECT NAME:
 TEST LOCATION: BOILER STACK
 DATE: 15 MAY 2001

TEST CONDITIONS	TRAVERSE 1	TRAVERSE 2
Sample Time (hrs)	1115 - 1211	1246 - 1326
Inlet/Exhaust	Exhaust	
Stack Temperature (°C)	132.5	132.5
Stack Cross-sectional area (m ²)	0.16	0.16
Average Stack Gas Velocity (m/sec)	3.9	4.0
Actual Gas Flow Volume (am ³ /min)	38	38
Total Normal Gas Flow Volume (m ³ /min)	24	24
Analysis	Particulate Matter	
Method	Gravimetric	
Mass in Sample (mg)	103	80.8
Air Volume Sampled (am ³)	0.62	0.50
Normal Sample Volume (m ³)	0.57	0.46
Concentration (mg/m ³)	181	176
Mass Emission Rate (g/s)	0.073	0.071
Moisture Content (%)	3.77	5.14
EPA Licence Limit (mg/m ³)	250	
Sample Storage Period	3 months	

NOTE:

Normal Volume (m³) = cubic metre at 0°C and 760 mm pressure (1 atmosphere)
 am³ = cubic metre of gas at actual conditions
 m² = square metre
 m/sec = metre per second
 am³/min = cubic metre of gas at actual conditions per minute
 m³/min = cubic metre per minute
 g/s = grams per second
 mg = milligrams
 mg/ m³ = milligrams per cubic metre at 0°C and 1 atmosphere

Analysis Performed By: SEMA
 Calculations Performed by: JW
 Checked By: PWS

TABLE NO. A2

EMISSION TEST RESULTS: HEAVY METALS
 PROJECT NO.: 2788/01
 PROJECT NAME:
 TEST LOCATION: BOILER STACK
 DATE: 15 MAY 2001

TEST CONDITIONS	TRAVERSE 1	TRAVERSE 2
Sample Time (hrs)	1115 - 1211	1240 - 1320
Inlet/Exhaust	Exhaust	
Stack Temperature (°C)	132.5	132.5
Stack Cross-sectional area (m ²)	0.16	0.16
Average Stack Gas Velocity (m/sec)	3.9	3.9
Actual Gas Flow Volume (am ³ /min)	37	38
Total Normal Gas Flow Volume (m ³ /min)	23	22
Analysis	Metals	
Method	SEM 001	
Metal	0.82	0.39
Mass in sample (mg)	0.97	0.70
Air Volume Sampled (am ³)	0.88	0.64
Normal Sample Volume (m ³)	0.93	0.61
Concentration (mg/m ³)	0.0004	0.0002
Moisture Content (%)	7.17	11.3
Licence Limit (mg/m ³)	5	
Sample Storage Period	Consumed by analysis	

NOTE:

Normal Volume (m³) = cubic metre at 0°C and 760 mm pressure (1 atmosphere)
 am³ = cubic metre of gas at actual conditions
 m² = square metre
 m/sec = metre per second
 am³/min = cubic metre of gas at actual conditions per minute
 m³/min = cubic metre per minute
 g/s = grams per second
 mg = milligrams
 mg/ m³ = milligrams per cubic metre at 0°C and 1 atmosphere

Analysis Performed By: AEL
 Calculations Performed by: JW
 Checked By: PWS

TABLE NO. A3

EMISSION TEST RESULTS: HYDROCHLORIC ACID
 PROJECT NO.: 2788/01
 PROJECT NAME:
 TEST LOCATION: BOILER STACK
 DATE: 15 MAY 2001

TEST CONDITIONS	TRAVERSE 1	TRAVERSE 2
Sample Time (hrs)	1115 - 1211	1240 - 1320
Inlet/Exhaust	Exhaust	
Stack Temperature (°C)	132.5	132.5
Stack Cross-sectional area (m ²)	0.16	0.16
Average Stack Gas Velocity (m/sec)	4.0	4.0
Actual Gas Flow Volume (am ³ /min)	38	38
Total Normal Gas Flow Volume (m ³ /min)	24	23
Analysis	HCl	
Method	SEI - 029	
Mass in Sample (mg)	2.67	2.2
Air Volume Sampled (am ³)	0.93	0.70
Normal Sample Volume (m ³)	0.85	0.64
Concentration (mg/m ³)	3.14	3.43
Mass Emission Rate (g/s)	0.0012	0.0013
Moisture Content (%)	7.68	9.16
Licence Limit (mg/m ³)	400	
Sample Storage Period	Consumed by analysis	

NOTE:

Normal Volume (m³) = cubic metre at 0°C and 760 mm pressure (1 atmosphere)
 am³ = cubic metre of gas at actual conditions
 m² = square metre
 m/sec = metre per second
 am³/min = cubic metre of gas at actual conditions per minute
 m³/min = cubic metre per minute
 mg = milligrams
 mg/ m³ = milligrams per cubic metre at 0°C and 1 atmosphere

Analysis Performed By: AEL
 Calculations Performed by: JW
 Checked By: PWS

TABLE NO. A4

EMISSION TEST RESULTS: SULPHUR TRIOXIDE/SULPHURIC ACID MIST
 PROJECT NO.: 2788/01
 PROJECT NAME:
 TEST LOCATION: BOILER STACK
 DATE: 15 MAY 2001

TEST CONDITIONS	TRAVERSE 1	TRAVERSE 2
Sample Time (hrs)	1115 - 1211	1240 - 1320
Inlet/Exhaust	Exhaust	
Stack Temperature (°C)	132.5	132.5
Stack Cross-sectional area (m ²)	0.16	0.16
Average Stack Gas Velocity (m/sec)	3.9	3.9
Actual Gas Flow Volume (am ³ /min)	37	38
Total Normal Gas Flow Volume (m ³ /min)	25	25
Analysis	H ₂ SO ₄ /SO ₃	
Method	SEI 079	
Mass in Sample (mg)	37	48.3
Air Volume Sampled (am ³)	1.22	0.66
Normal Sample Volume (m ³)	1.11	0.60
Concentration (mg/m ³)	33.70	80.6
Mass Emission Rate (g/s)	0.01	0.03
Moisture Content (%)	1.32	2.43
Licence Limit (mg/m ³)	100	
Sample Storage Period	Consumed by analysis	

NOTE:

Normal Volume (m³) = cubic metre at 0°C and 760 mm pressure (1 atmosphere)
 am³ = cubic metre of gas at actual conditions
 m² = square metre
 m/sec = metre per second
 am³/min = cubic metre of gas at actual conditions per minute
 m³/min = cubic metre per minute
 mg = milligrams
 mg/ m³ = milligrams per cubic metre at 0°C and 1 atmosphere

Analysis Performed By: AEL
 Calculations Performed by: JW
 Checked By: PWS