

TERMINALS PTY LTD

CORIO, VICTORIA

**COMBUSTOR EMISSION MONITORING PROGRAMME
– 1, 3 BUTADIENE (SHIP UNLOADING)**

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CONSULTING ENVIRONMENTAL ENGINEERS/SCIENTISTS
– POLLUTION MONITORING AND CONTROL





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TABLE OF CONTENTS

1.0 INTRODUCTION	1.1
2.0 TEST METHODS	2.1 - 2.2
2.1 Exhaust Gas Velocity	2.1
2.2 Exhaust Gas Temperature	2.1
2.3 Exhaust Gas Moisture Content	2.1
2.4 1, 3 Butadiene	2.2
3.0 MEASUREMENT UNCERTAINTY	3.1
3.1 Exhaust Gas Velocity	3.1
3.2 Exhaust Gas Moisture Content	3.1
3.3 1, 3 Butadiene	3.1
4.0 RESULTS	4.1 - 4.3
5.0 DISCUSSION	5.1
 TABLES	
Table 1 Gaseous Emission Tests - Combustor	4.2
Table 2 Butadiene Sphere Conditions	4.3
Table 3 Summary - Sampling Plane	5.1

1.0 INTRODUCTION

A.W.N. (Air Water Noise) Consultants was commissioned by Terminals Pty. Ltd., to conduct 1, 3 butadiene emission tests at the Corio bulk chemical storage facility located at 40 Wharf Road, Corio, Victoria.

The monitoring programme scope consisted of monitoring emissions to air from the combustor during the ship to shore transfer of 1,3 butadiene from the DL Begonia to the 1, 3 butadiene storage sphere.

Specifically, the following tests were conducted:

- Exhaust gas velocity, flowrate, temperature and moisture content;
- Mass rate of emission and concentration of 1,3 butadiene

Sampling was conducted on the 24th May 2007 during product transfer operations.

Ship to shore transfer from the DL Begonia commenced at 21:18 hours on 23rd May, 2007. Sphere degassing was conducted throughout the transfer period, with exhaust gas vented to the combustor. The transfer of product from the ship ceased several times during the unloading period due to pressure regulation problems. Sphere degassing was conducted continuously.

Sphere degassing is not usually conducted during ship to shore transfer of 1, 3 butadiene however as the sphere was recently commissioned residual nitrogen was present in the sphere as a result of pre-storage pressure testing.

Sphere temperature and pressure details were obtained from Terminals Pty. Ltd. in order to calculate the combustor inlet 1, 3 butadiene concentration and subsequently the combustor destruction efficiency.

2.0 TEST METHODS

2.1 EXHAUST GAS VELOCITY

Velocity profiles were obtained across the flue utilizing an S-type pitot static tube and a TSI DP-Calc micro manometer.

Positions for velocity pressure measurement were determined to be at the centre of equal areas over the cross section of the sampling plane.

The manometer was calibrated against manometer 7970 (NATA Calibration Report No. 14688AA – 29/06/2005). All manometer readings were corrected in accordance with the test results.

The test method used was in accordance with A.W.N. Consultants Source Test Method V2, "Velocity and Volume Flowrate: For Source Emissions".

2.2 EXHAUST GAS TEMPERATURE

Exhaust gas temperature was determined using an electronic thermometer equipped with a chromel/alumel thermocouple. The thermometer was calibrated against AMA mercury in glass thermometer 0676311 (NATA Calibration Report No. 956/06 – 25/09/2006).

2.3 EXHAUST GAS MOISTURE CONTENT

Moisture content was determined by drawing an exhaust gas sample through two pre-weighed impingers containing distilled water and silica gel respectively.

The weight change of the two impingers and silica gel was determined using a two figure balance. Sample volume was obtained by placing a dry gas meter in the sample train. The gas meter was calibrated against Email gas meter Serial No. VIC300210 (NATA Calibration Report No. 14344 – 2/05/2005).

The test method used was in accordance with A.W.N. Consultants Source Test Method M5, "Moisture Content".

2.4 1,3 BUTADIENE

A calculated volume of dry, contaminant free, dilution air was added to 20 litre Nalophan sampling bags enclosed in airtight plastic containers.

Stack gas was drawn through a stainless steel probe and PTFE hose connected to the Nalophan sampling bag. The sampling pump was connected to the plastic container to provide a sample gas flowrate of approximately 0.5 – 2 L/min. After the required volume had been sampled, the bag was sealed with a stainless steel plug.

After a period of equilibration the diluted sample was then drawn through PTFE hose into a pre-evacuated SUMMA passivated electro-polished stainless steel canister.

Sample analysis was conducted by Queensland Health Scientific Services, NATA Laboratory Accreditation No. 41. Analysis involved water vapour removal and VOC collection using a cryogenically cooled trap. The cryogen was removed and the temperature of the trap raised. The VOCs originally collected in the trap were re-volatilised, separated on a GC column, then detected by one or more detectors for identification and quantification.

The procedure was based on the evacuated canister ambient air monitoring procedure, as described in U.S. Environmental Protection Agency Method TO-15.

The test method used was in accordance with A.W.N. Consultants Source Test Method No. C9, "Canister (Evacuated) Sampling for VOC and Reduced Sulphur Compounds: In Ambient Air and Source Emissions".

3.0 MEASUREMENT UNCERTAINTY

3.1 EXHAUST GAS VELOCITY

When sampling plane conditions comply with the requirements of Australian Standard AS4323.1 – 1995, "Stationary Source Emissions: Method 1: Selection of Sampling Positions", a conservative estimate of the uncertainty of measurement for the determination of exhaust gas average velocity with a pitot tube and micro manometer is $\pm 5\%$ (for velocities greater than 5 m/sec). At lower velocities the uncertainty is substantially increased.

3.2 EXHAUST GAS MOISTURE CONTENT

The estimated uncertainty of measurement for the gravimetric determination of exhaust gas moisture content is $\pm 10\%$.

3.3 1, 3 BUTADIENE

The analytical laboratory measurement uncertainty for the determination of the concentration of 1, 3 butadiene is $\pm 22\%$.



4.0 RESULTS

The results of the 1, 3 butadiene emission monitoring programme are presented in Table 1.

Table 2 details the 1, 3 butadiene sphere temperatures and pressures at the time of sampling.



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TABLE 2 BUTADIENE SPHERE CONDITIONS

COMPANY: Terminals Pty. Ltd.,
 40 Wharf Road,
 Corio, 3214

DATE: 24th May, 2007

TEST CONDITIONS – BUTADIENE SPHERE AND COMBUSTOR						
Sampling Status	Date / Time	Sphere Temperature (°C)			Sphere Pressure (kPag)	Combustor Inlet Pressure (kPag)
		Top	Middle	Bottom		
Butadiene sampling	23/05/07					
	22:00	6.9	7.5	5.9	128	Off
	22:30	8.9	9.6	5.9	144	Off
	23:30	11.0	11.6	6.0	165	Off
	24/05/07					
	00:30	11.8	12.4	6.0	174	Off
	01:30	11.9	12.4	6.0	185	Off
	02:30	11.9	12.5	6.0	195	200
	03:30	12.1	12.2	6.1	208	213
	04:30	12.9	12.9	6.3	224	226
	05:30	13.2	11.9	11.0	243	247
	06:30	13.4	13.5	11.6	257	262
	07:30	12.9	13.5	11.8	268	273
	08:30	11.9	13.3	11.8	264	270
	09:30	11.8	13.1	11.8	268	268
	10:30	11.8	12.9	11.8	263	269
	11:00	12.0	13.0	11.8	264	270
	11:30	11.3	12.9	11.8	259	264
	12:30	11.1	12.6	11.8	253	258

5.0 DISCUSSION

The combustor sampling plane does not meet the requirements of Australian Standard AS 4323.1 – 1995 "Method 1: Selection of Sampling Positions". In terms of the dimensional requirements, the sampling plane has less than the required number of access holes. The number of sampling points was increased in order to improve the accuracy of results from the available sampling plane, however the criterion for a gas velocity of 3 m/s at all sampling points was not met and hence the sampling plane is categorised as non-compliant. Table 3 summarises the sampling plane requirements and the status of the combustor sampling plane.

TABLE 3 SUMMARY - SAMPLING PLANE

REQUIREMENTS	CRITERIA	SAMPLING PLANE	STATUS
Minimum distance from downstream disturbance	2	0 (transition from sampling plane to exit)	✗
Minimum distance from upstream disturbance	6	6.1	✓
The gas flow direction at all sampling points	Same direction	Could not be determined	-
Gas velocity at all sampling points	> 3 m/s	< 3 m/s at all points	✗
Gas profile cyclonic component	< 15°	Could not be determined	-
Temperature difference between sampling points	< 10% absolute temperature	< 10% absolute temperature	✓
Temperature difference between the mean and sampling points	< 10%	<10%	✓
Ratio of highest to lowest pitot pressure at different sampling points	< 9:1	Could not be determined	-
Ratio of highest to lowest gas velocity at different sampling points	< 3:1	Could not be determined	-
Gas temperature	> dew point	> dew point	✓
Overall classification	Non-compliant		