TABLE OF CONTENTS

1. EXECUTIVE SUMMARY

Tests showed a significant reduction in diesel particulates, carbon monoxide gas, sulphur dioxide gas, formaldehyde vapour and oxides of nitrogen gases after the installation of the U.D.F. unit.

2. PURPOSE

The purpose of this evaluation is to monitor the carbon monoxide gas, carbon dioxide gas, oxides of nitrogen gases, sulphur dioxide gas, formaldehyde vapour and diesel particulate concentrations being emitted by two diesel trucks in order to quantify the extent of gas and fume reduction (if any) provided by the installation of a U.D.F. unit.

3. METHODOLOGY

3.1 The first series of chemical emission tests were conducted before and after the U.D.F. unit was installed.

The before and after tests were conducted for engine revolution speeds of:

- Idle
- "Green Band" - under load (1500 - 2000 rpm)

Load tests were undertaken prior to chemical testing so as to facilitate maximum purging on the fuel & exhaust pathways thus reducing potential interference bias.

3.2 The tests were conducted at the exhaust outlet using a specifically designed Motor Vehicle Exhaust Gas Probe in combination with Drager Detector Tubes as recommended by Drager South Africa (see Table 1 below) and a PVC 37mm filter membrane and backing with cassette (particulate matter).

3.2 The exhaust emission probe was attached to the exhaust tail pipe as per the manufacturer’s instructions, i.e. static monitoring methods. See Fig. 1 below.

Table 1: Drager detector tubes utilised in the sampling of exhaust emissions.

Contaminant	Tube Description	Part Number
Carbon Monoxide	Carbon Monoxide 10/b	CH20601
Carbon Dioxide	Carbon Dioxide 0.1%/a	CH23501
Nitric Oxide	Nitrous Fumes 0.5/a	CH29401
Formaldehyde	Formaldehyde 0.2/a	6733081
Sulphur Dioxide	Sulphur Dioxide 1/a	CH31701

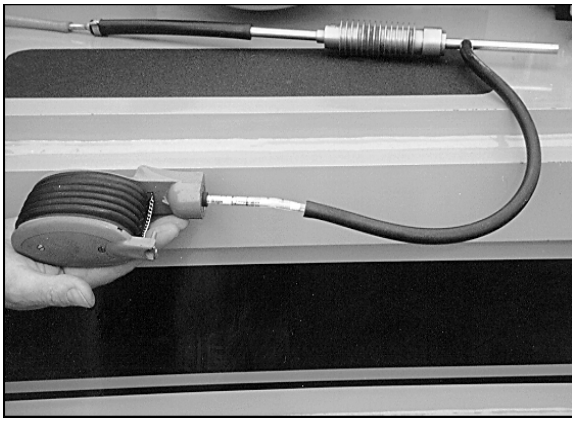


Fig. 2: The Exhaust Probe is fixed to the exhaust manifold by a threaded attachment fitting onto a piece of flexible tubing.

4. TEST RESULTS

TABLE 2: Mercedes Actros V6 295 HP (Reg. AS 092) (Odometer: 65176 Km)

SUBSTANCE MONITORED	ENGINE STATUS	MEASURED CONCENTRATION WITHOUT U.D.F. UNIT	MEASURED CONCENTRATION WITH U.D.F. UNIT	% DIFFERENCE
Carbon Monoxide	**Idle**	80 ppm	50 ppm	37.5
Carbon Dioxide		1.3 Vol %	1.25 Vol %	3.85
Oxides of Nitrogen		50 ppm	45 ppm	10
Formaldehyde		5 ppm	BDL (< 2ppm)	> 60
Sulphur Dioxide		1.5 ppm	BDL (< 0.5 ppm)	> 66.7
Particulates		25 mg/m^3	21.3 mg/m^3	14.8
Carbon Monoxide	**Green Band (1500 rpm)**	200 ppm	190 ppm	5
Carbon Dioxide		3.0 % Vol	3.2 % Vol	6.25
Oxides of Nitrogen		700 ppm	400 ppm	42.9
Formaldehyde		20 ppm	15 ppm	25
Sulphur Dioxide		2.5 ppm	1 ppm	60
Particulates		15 mg/m^3	13.4 mg/m^3	10.7

TABLE 3: Mercedes Actros V6 (Reg. NXB 406 GP) (Odometer: 3063 Km)

SUBSTANCE MONITORED	ENGINE STATUS	MEASURED CONCENTRATION WITHOUT U.D.F. UNIT	MEASURED CONCENTRATION WITH U.D.F. UNIT	% DIFFERENCE
Carbon Monoxide	**Idle**	55 ppm	50 ppm	9.1
Carbon Dioxide		1.5 Vol %	1.3 Vol %	13.3
Oxides of Nitrogen		80 ppm	50 ppm	37.5
Formaldehyde		5 ppm	BDL (< 2 ppm)	> 60
Sulphur Dioxide		BDL (< 0.5 ppm)	BDL (< 0.5 ppm)	-
Particulates		2.17 mg/m^3	2.11 mg/m^3	2.7
Carbon Monoxide	**Green Band (2000 rpm)**	130 ppm	100 ppm	23.1
Carbon Dioxide		1.9 % Vol	1.8 % Vol	5.3
Oxides of Nitrogen		300 ppm	210 ppm	30
Formaldehyde		2 ppm	BDL (< 2 ppm)	-
Sulphur Dioxide		2	0.5 ppm	75
Particulates		13.6 mg/m^3	4.6 mg/m^3	66.17

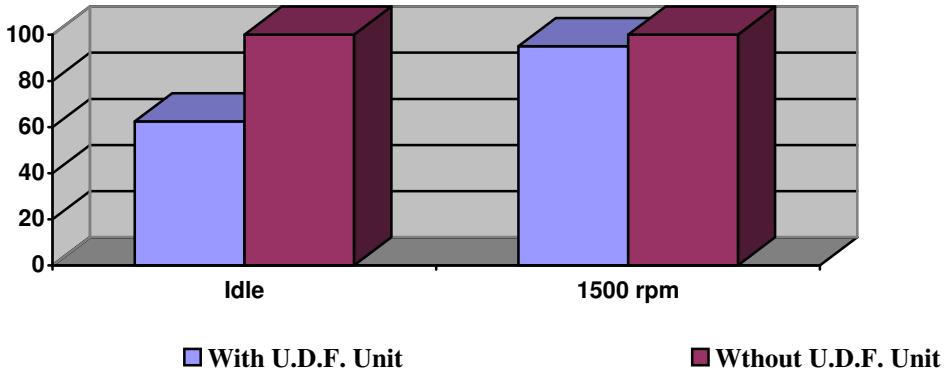
5. EVALUATION OF RESULTS

5.1 Due to the inherent 5 to 30 % Standard Deviation (SD) that exists in Drager Tube Sampling, results within this range of reduction or increase should be discounted. The SD specific to the particular test is provided in each section below.

5.1 **Graphical representation of vehicle 1 results**

5.1.1 In Figure 2 below, the results indicate a significant reduction in Carbon Monoxide Gas levels during Idling after the Filter 2000 was installed. (SD = ± 10 to 15 %).

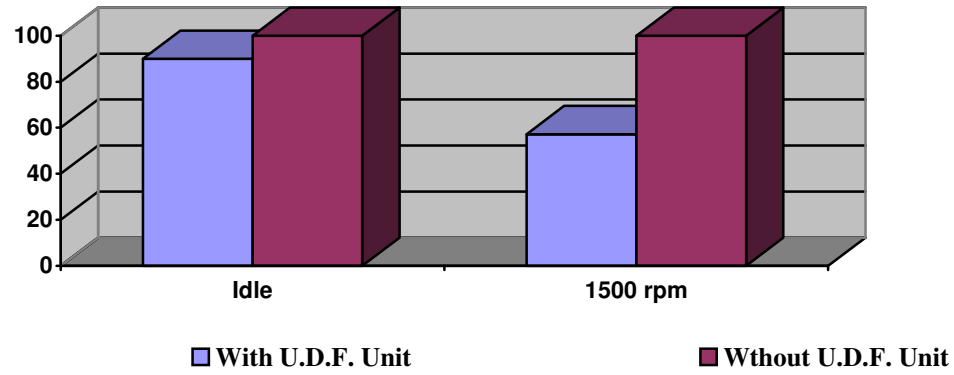
Figure 2: Carbon Monoxide Concentrations (%)



5.1.2 The results obtained for Carbon Dioxide indicate an insignificant increase or reduction in measured Gas levels during Idling and at 1500 rpm. (SD = ± 5 to 10 %).

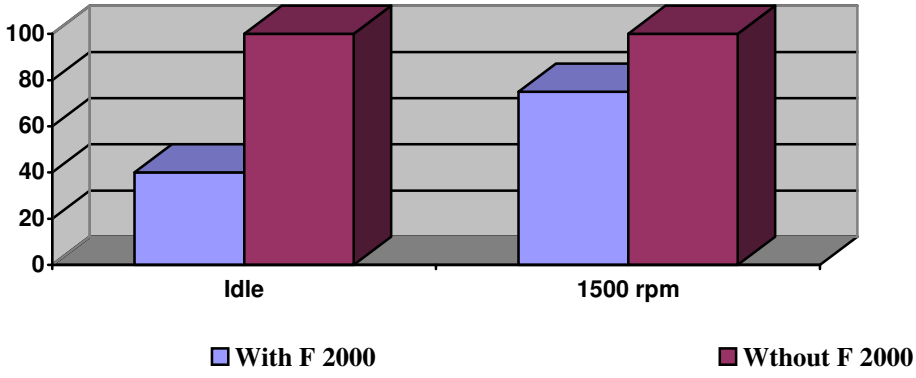
5.1.3 In Figure 3 below, the results indicate a significant reduction in Oxides of Nitrogen (NO_x) at 1500 rpm after the Filter 2000 was installed. (SD = ± 10 to 15 %).

Figure 3: Oxides of Nitrogen Concentrations (%)



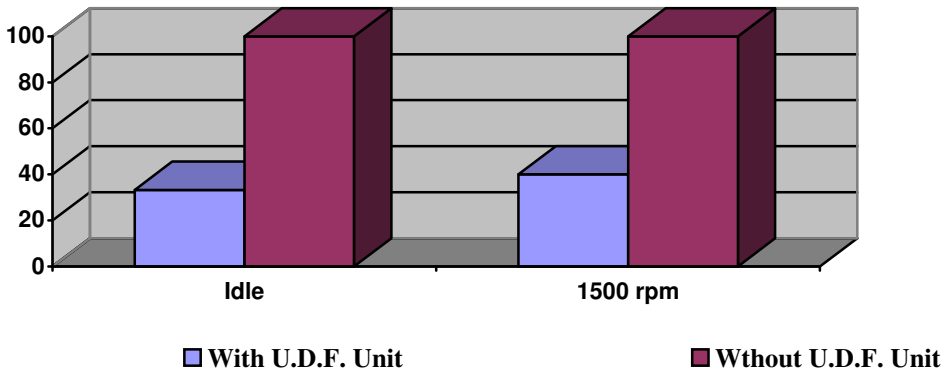
5.1.4 In Figure 4 below, the results indicate a significant reduction in Formaldehyde at Idle after the Filter 2000 was installed. (SD = ± 20 to 30 %).

Figure 4: Formaldehyde Concentrations (%)



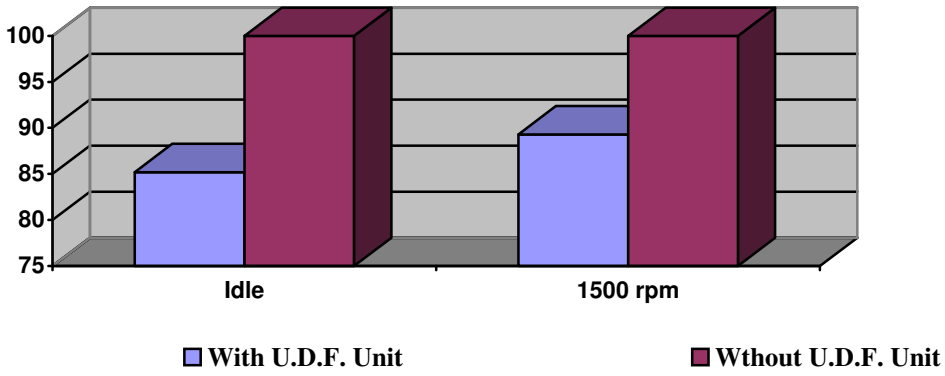
5.1.5 In Figure 5 below, the results indicate a significant reduction in Sulphur Dioxide (SO_2) at Idle and at 1500 rpm after the Filter 2000 was installed. (SD = ± 10 to 15 %).

Figure 5: Sulphur Dioxide Concentrations (%)



5.1.5 In Figure 6 below, the results indicate a significant reduction in Particulates at Idle after the Filter 2000 was installed. (Accuracy = ± 11.4 %).

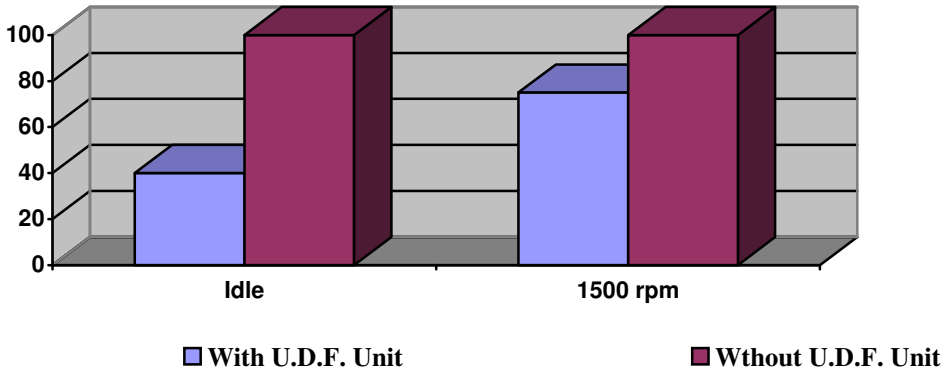
Figure 6: Particulate Concentrations (%)



6.1 Graphical representation of vehicle 2 results

6.1.1 In Figure 7 below, the results indicate a significant reduction in Carbon Monoxide Gas levels at 2000 rpm after the Filter 2000 was installed. (SD = ± 10 to 15 %).

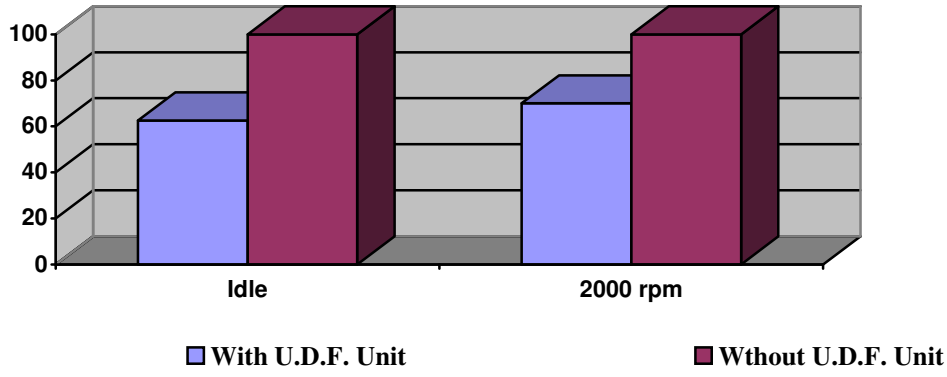
Figure 7: Carbon Monoxide Concentrations (%)



6.1.2 The results obtained for Carbon Dioxide indicate an insignificant increase or reduction in measured Gas levels during Idling and at 2000 rpm. (SD = ± 5 to 10 %).

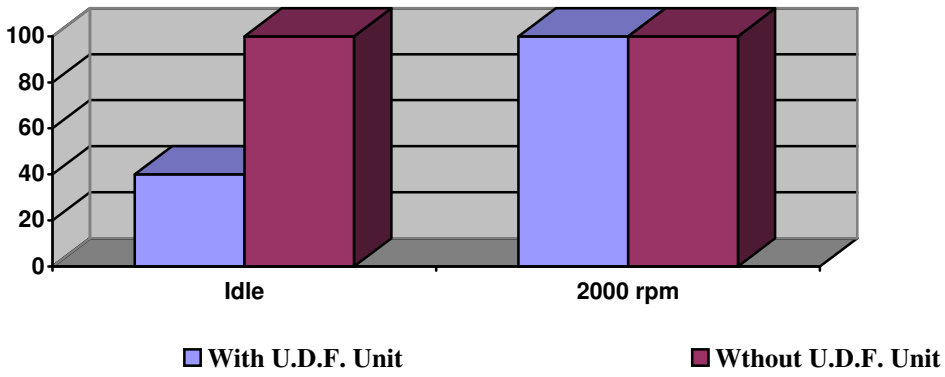
6.1.3 In Figure 8 below, the results indicate a significant reduction in Oxides of Nitrogen (NO_x) at 2000 rpm after the Filter 2000 was installed. (SD = ± 10 to 15 %).

Figure 8: Oxides of Nitrogen Concentrations (%)



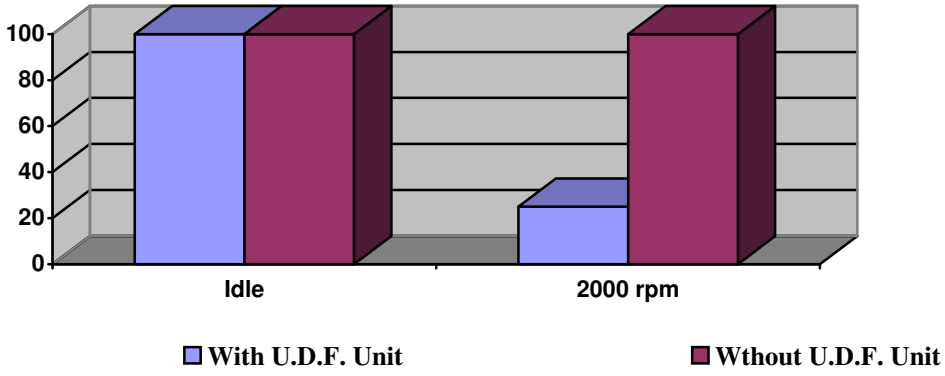
6.1.4 In Figure 9 below, the results indicate a significant reduction in Formaldehyde at Idle after the Filter 2000 was installed. (SD = ± 20 to 30 %).

Figure 9: Formaldehyde Concentrations (%)



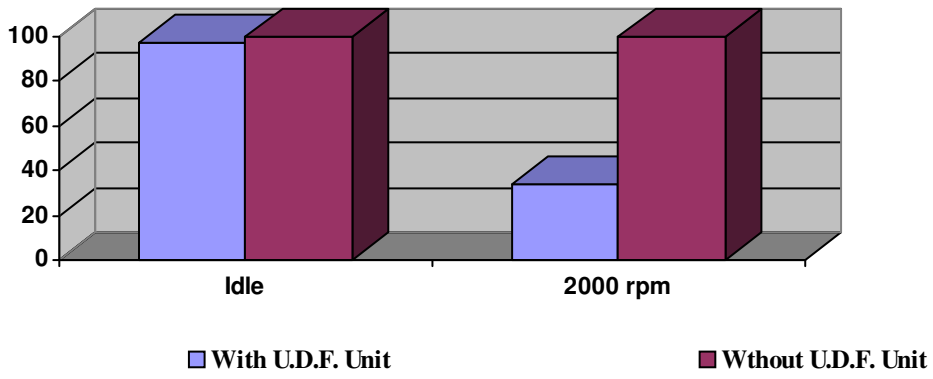
6.1.5 In Figure 10 below, the results indicate a significant reduction in Sulphur Dioxide (SO_2) at 2000 rpm after the Filter 2000 was installed. (SD = ± 10 to 15 %).

Figure 5: Sulphur Dioxide Concentrations (%)



6.1.5 In Figure 11 below, the results indicate a significant reduction in Particulates at 2000 rpm after the Filter 2000 was installed. (Accuracy = ± 11.4 %).

Figure 6: Particulate Concentrations (%)



6. LIMITATIONS

Limitations of the gas monitoring equipment:

a) Gravimetric sampling for particulates has a calculated accuracy of ± 11.4 %.
b) Drager sampling tubes have an inherent standard deviation of between 5 and 30 %.

Results obtained were indicative of the conditions that prevailed during the sampling period.

TECHNICAL DATA

Details of recommended requirements, specifications and conditions which are to be contained in written reports, are issued in terms of the following code:-

SABS Code 0259 - 1990 (ISO/IEC Guide 25:1990) - “General Requirements for competence of Calibration and Testing Laboratories”.

7. CALIBRATION OF EQUIPMENT

All sampling media was used before the prescribed expiry date and the Gillian constant flow sampling pumps were calibrated before and after the tests and found to be within the required limits.

8. TEST OFFICER

S.J. Chester
C.O.H. (SAIOH)
B. Tech. Environmental Health

9. INSTRUMENTATION

9.1 Bellows Hand Pump: Accuro
9.2 Motor Vehicle Exhaust gas Probe for use with Drager Detector Tubes
9.3 Gillian Constant flow sampling pumps

10. CERTIFICATION STATEMENT

This is to certify that the attached report has been compiled and issued under the authority, direction and the responsibility of the Technical Manager, Polycon.

11. REPRODUCTION OF REPORTS

12. DATE OF ISSUE

13 March 2003

13. COMPILED BY

Mr S.J. Chester
C.O.H. (SAIOH)

CHECKED BY

Mr R.W. Randolph
Deputy Technical Manager