



# Environmental Report

## Air Emission Survey



Client: Boreas Air  
Study Location: Co Monaghan and Co Louth  
Our Reference: H18TC93-BA  
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## Contents

1. Instruction.....	3
2. Background.....	3
3. Health and Safety .....	4
4. Hypothesis .....	4
5. Products Tested .....	4
6. Location of Test.....	5
6.1. Site Conditions .....	5
7. Ad Blue .....	5
8. Test Method.....	6
9. Data and Results .....	7
10. Analysis .....	19
10.1. Limitations to data .....	21
10.2. Recommendations .....	21
11. Conclusions based on findings.....	22
12. Further analysis.....	22
Appendix 1: .....	23

## List of Figures

Figure 1: Air Emission Survey.....	9
Figure 2: Air Emission Survey.....	10
Figure 3: Air Emission Survey.....	11
Figure 4: Air Emission Survey.....	12
Figure 5: Air Emission Survey.....	13
Figure 6: Air Emission Survey Notes .....	14
Figure 7: Air Emission Survey Laverty Motors .....	15
Figure 8: Air Emission Survey Laverty Motors .....	16
Figure 9: VOC Graph comparison different vehicles and filters .....	17
Figure 10: Table Showing VOC changes with different filters in different Vehicles.....	18



## **1. Instruction**

Our Client Boreas Air have instructed Bellew Environmental as Specialist Environmental Consultants to assist with the testing of Volatile Organic Compound (VOC) emissions on Diesel vehicles. We have been instructed to assess emissions using a range of filters and determine if there is a change in VOC levels emitted in addition to this we will assess which filter if any allows for the least VOC's thus which filter reduces emissions from Diesel Vehicles.

## **2. Background**

Boreas Air is a material developed to protect all types of air intake filters. The idea is innovative and versatile in design. The idea for the product came about as the result of an Ash Vacuum, used to clean out fireplaces, was 'clogging' within seconds of having begun the vacuum process thus having to attempt to clean the actual waste several times whilst continuously emptying the Vacuum collector and clear the filter. The patented material will help prevent dust and debris impeding the airflow through any type of air filter, as the protected filter now has a smooth static neutral surface. The Boreas Range has been independently tested for ability to maintain Air flow in Machines in which it is used. It has subsequently been approved by Dundalk Institute of Technology, CREDIT and Dr. Thomas Dooley DkIT School of Engineering.

The design of the product means the existing and original air filters, when retrofitted with the Boreas Air wrap, would have a smooth static neutral surface, unique to this filter, this means that the material including dust and debris which is sucked into the filter chamber is mostly expelled due to turbulence within the chamber. As the Boreas Air material is treated to remain static neutral, dust is not attracted, as an unprotected air filter will become statically charged and therefore attract dust / debris, restricting the airflow through the unprotected air filter. The turbulence is present in the filter chamber, even if the air filter is not protected, but the dust / debris will lodge in the crevices of an unprotected air filter and hence restrict / block the airflow through the unprotected air filter. Restricted / blocked air intake filter cause increased maintenance, downtime, increased wear and energy costs.



There are several current industrial users who have recommended the product and have shown that it provides significant improvements in their businesses or personnel lives.

### **3. Health and Safety**

Health and safety is paramount during any investigation, particularly on site:

- During the investigation precautions were taken to ensure the test area remained well ventilated and background air was regularly tested.
- There were several pieces of heavy machinery on site, care was always taken, when vehicles were moving, to check in the vicinity if there was anyone inspecting the machinery at low levels.
- Care was also taken to not spend extensive periods at low levels where emissions were at their highest concentration.
- HI Viz clothing was worn by all personnel on site during the investigation this ensured all people were clearly visible.
- Earmuffs were a consideration and available however the noise was not persistently loud that these were deemed unnecessary.
- Care was taken during all investigations and inspections to ensure there was no damage to vehicles or equipment on site.

It should be noted that normal business activities were being carried out on site during this site investigation.

### **4. Hypothesis**

The hypothesis being considered is that;

The use of BoreasAir as a retrofit add on to traditional filters can significantly reduce the Volatile Organic Compound levels being emitted from the combustion of fuel in diesel engines, it is also hypothesised that BoreasAir can reduce Carbon Monoxide levels.

### **5. Products Tested**

The vehicles tested in this sample were Diesel Buses, Lorries, Diesel cars and Petrol Cars. The reason for testing these vehicles was to determine if the initial findings on the forklift machines were similar to those found on other types of vehicle. The age of the vehicles



ranged significantly as did the miles or kilometers on each. In addition to this the engine types and sizes also varied. Parameters recorded included

- Make and Model
- Engines Size and Type
- Age
- Mile/ Kilometers
- Temperature
- Filters

## **6. Location of Test**

The location of the test was carried out at several different locations across Co Monaghan and CO Louth.

### **6.1. Site Conditions**

The weather conditions on site on the day were cool and damp in the morning with a slight breeze. In the afternoon, the weather turned to warm and bright. Upon arrival at each site, there was a brief introduction with all parties on site during the investigation, there was some background information surrounding the vehicles and products being tested. There was a verbal programme of events, what was to be tested, where it was located and when it would be tested, testing began around 10.00am and continued to approximately 9.00pm

## **7. Ad Blue**

The theory of AdBlue is that it allows for the reduction of harmful pollutants to non-harmful products to be released to the environment. Diesel engines can be run with a lean burn air to fuel ratio, this air to fuel ratio ensures the full combustion of the fuel leaving only soot this also prevents the diesel vehicle expelling unburnt fuel into the environment. The excess of air necessarily leads to generation of nitrogen oxides (NOX), these gases are usually produced from the reaction of nitrogen in the presence of oxygen during combustion of fuels, such as hydrocarbons, in air; especially at high temperatures. To minimise the release of NOX to the environment a supplement, AdBlue, which is 32.5% Urea and 63.5% de-



ionized water, is added to the exhaust chamber of the vehicle via injection. The addition of this aqueous solution allows for the Urea to vaporize and decompose to form Ammonia and Carbon Dioxide. The Ammonia then acts as a catalyst to reduce the Nitrogen Oxides into Water and Nitrogen, both of which are harmless in the natural environment. Without the improvement of diesel engines to prevent the release of these and other gases there will be the continued contribution of these gases to the formation of smog and acid rain, as well as tropospheric ozone.

## **8. Test Method**

Upon arrival, the calibration of the Minirae 3000 Portable Handheld VOC monitor was checked and verified. A new Air filter was applied to the nozzle, this was primarily for filtering particulate matter and preventing and residual moisture entering the PID.

Temperature was recorded on each machine upon initial start-up and then again, several minutes later when the engine had 'warmed up', the reason for the varied temperature monitoring was to determine if there was a significant difference In VOC's emitted upon start up and compare that with the VOC's Emitted during warmer engine temperatures

Upon identification of all test vehicles, each machine was identified by Make and Model of vehicle, Engine model and size, age of vehicle and Miles or Kilometers recorded on the machine during the test. There was a Van included in the Test and Make and model of the van was recorded, in conjunction with Miles on the odometer and age of vehicle.

The method of VOC monitoring in Diesel vehicles was that the nozzle of the PID was placed at the end of each exhaust. It was placed at the same point for all vehicles to ensure the same conditions were met for each test range on each vehicle. For Petrol vehicles, the Monitor was held approximately 5cm from the end of the exhaust, this is because the petrol vehicles expel significantly more moisture than the diesel vehicles and have the potential to cause moisture damage to the monitoring equipment. The air filter was changed much more regularly when measuring the petrol vehicles to prevent damage. VOC'S were monitored until the figure recorded on the PID stopped or held the same figure for 3 seconds or the



figure on the display began to drop. At this point the highest figure was recorded. This method of recording was applied for all tests.

The Air Filters were changed by Mr Savage, Mr Woods and Mechanics at the Bus Servicing depo. These people are highly experienced who regularly deal with changing of these vehicles. The wrapping of the Boreas Air filter was carried out by both Mr Savage and Mr Woods both are proficient personnel and experienced at fitting the Boreas air wrap onto existing filters to create the retro filter.

The Air Filter on the PID had to be changed at regular intervals due to the degradation of the filter. There was soot and moisture build up within the filter, however as we were not measuring either parameters during this investigation these were not quantified. There were 5 filters used during this investigation.

## **9. Data and Results**

### **Table and Graphed results**





Client: Boreas Air  
Our Ref: H18TC93-BA  
Date: 16.05.2017

Air Emission Survey											
Machine Identification	Date	Vehicle Age	Vehicle Odometer	Filter (Old/ New/Boreas)	Make and Model	Engine Size	Temperature	Temperature Location	VOC ppm	% Improvement from worst VOC to Boreas Air VOC	% Improvement from New standard air Filter VOC to Boreas Air VOC
Lorry and Bus Vehicles											
05 MN 6265	16.05.2017	2005	1712087 Mile	Old Filter (MAN Brand)	SCANIA	12L	62.2	Engine	395.9	44.19%	44.19%
05 MN 6265	16.05.2017	2005	1712087 Mile	No Filter	SCANIA	12L	61.4	Engine	389.6		
05 MN 6265	16.05.2017	2005	1712087 Mile	New Filter (BOSS Brand)	SCANIA	12L	59.4	Engine	586.1		
05 MN 6265	16.05.2017	2005	1712087 Mile	Boreas Air (BOSS Brand)	SCANIA	12L	58.3	Engine	367.7		
05 MN 6265	16.05.2017	2005	1712087 Mile	Boreas Air (MAN Brand)	SCANIA	12L	58.2	Engine	327.1		
06 D 120303	16.05.2017	2006	761697 KM	Old Filter	SCANIA (Ad Blue Retro Fit)	12L	60.0	Engine	383.1	44.19%	44.19%
06 D 120303	16.05.2017	2006	761697 KM	No Filter	SCANIA (Ad Blue Retro Fit)	12L	62.5	Engine	358.3		
06 D 120303	16.05.2017	2006	761697 KM	New Filter	SCANIA (Ad Blue Retro Fit)	12L	62.5	Engine	290.8		

Figure 1: Air Emission Survey





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## Air Emission Survey

Machine Identification	Date	Vehicle Age	Vehicle Odometer	Filter (Old/ New/Boreas)	Make and Model	Engine Size	Temperature	Temperature Location	VOC ppm	% Improvement from worst VOC to Boreas Air VOC	% Improvement from New standard air Filter VOC to Boreas Air VOC
06 D 120303	16.05.2017	2006	761697 KM	Boreas Air	SCANIA (Ad Blue Retro Fit)	12L	62.5	Engine	217.3	43.28%	25.28%
00 D 75676	16.05.2017	2000	556791 KM	Old Filter	VOLVO D7B/260	7L	57.9	Engine	846.6	99.82%	66.93%
00 D 75676	16.05.2017	2000	556791 KM	No Filter	VOLVO D7B/261	7L	60.7	Engine	871.1		
00 D 75676	16.05.2017	2000	556791 KM	New Filter	VOLVO D7B/262	7L	61.2	Engine	487.1		
00 D 75676	16.05.2017	2000	556791 KM	Boreas Air	VOLVO D7B/263	7L	61.2	Engine	161.1		
01 D 27572	16.05.2017	2001	701000 KM	Old Filter	SCANIA DC9300HP	9L	41.4	Engine	1103	99.82%	66.93%
01 D 27572	16.05.2017	2001	701000 KM	No Filter	SCANIA DC9300HP	9L	41.4	Engine	971.6		
01 D 27572	16.05.2017	2001	701000 KM	New Filter	SCANIA DC9300HP	9L	41.3	Engine	923.1		

Figure 2: Air Emission Survey



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Air Emission Survey											
Machine Identification	Date	Vehicle Age	Vehicle Odometer	Filter (Old/ New/Boreas)	Make and Model	Engine Size	Temperature	Temperature Location	VOC ppm	% Improvement from worst VOC to Boreas Air VOC	% Improvement from New standard air Filter VOC to Boreas Air VOC
01 D 27572	16.05.2017	2001	701000 KM	Boreas Air	SCANIA DC9300HP	9L	41.4	Engine	378	65.73%	59.05%
Diesel Cars											
141 D 31215	16.05.2017	2014	83000 Mile	Old Filter	Volkswagon Passat 2L TDI BLUE Motion	2L	41.4	Engine	268.5	73.44%	51.16%
141 D 31215	16.05.2017	2014	83000 Mile	No Filter	Volkswagon Passat 2L TDI BLUE Motion	2L	41.4	Engine	192.6		
141 D 31215	16.05.2017	2014	83000 Mile	New Filter	Volkswagon Passat 2L TDI BLUE Motion	2L	41.4	Engine	155.8		
141 D 31215	16.05.2017	2014	83000 Mile	Boreas Air	Volkswagon Passat 2L TDI BLUE Motion	2L	41.4	Engine	76.1		
LJZ 72	16.05.2017	2016	12000 Mile	Original uncleaned Million Mile Filter	AUDI Q5 2L TDI (Ad Blue)	2L	46.0	Engine	167.1	73.44%	51.16%
LJZ 72	16.05.2017	2016	12000 Mile	No Filter	AUDI Q5 2L TDI (Ad Blue)	2L	46.0	Engine	126.6		
LJZ 72	16.05.2017	2016	12000 Mile	Cleaned Million Mile Filter	AUDI Q5 2L TDI (Ad Blue)	2L	45.3	Engine	63.3		

Figure 3: Air Emission Survey



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Air Emission Survey											
Machine Identification	Date	Vehicle Age	Vehicle Odometer	Filter (Old/ New/Boreas)	Make and Model	Engine Size	Temperature	Temperature Location	VOC ppm	% Improvement from worst VOC to Boreas Air VOC	% Improvement from New standard air Filter VOC to Boreas Air VOC
LIZ 72	16.05.2017	2016	12000 Mile	Boreas Air	AUDI Q5 2L TDI (Ad Blue)	2L	45.3	Engine	54.1	67.62%	14.53%
08 MN 8203	16.05.2017	2008	163259 KM	Old Filter	Peugeot 207 1.2L Diesel	1.2L	36.6	Engine	31.1		
08 MN 8203	16.05.2017	2008	163259 KM	No Filter	Peugeot 207 1.2L Diesel	1.2L	38.2	Engine	26.6		
08 MN 8203	16.05.2017	2008	163259 KM	Boreas Air	Peugeot 207 1.2L Diesel	1.2L	31.0	Engine	19.9	36.01%	25.19%
Petrol Cars											
00 WW 7405	16.05.2017	2000	98129 Mile	Old Filter	BMW 3L Petrol	3L	39.4	Engine	286.1		
00 WW 7405	16.05.2017	2000	98129 Mile	No Filter	BMW 3L Petrol	3L	39.4	Engine	241.1		
00 WW 7405	16.05.2017	2000	98129 Mile	New Filter	BMW 3L Petrol	3L	43.2	Engine	269.3		
00 WW 7405	16.05.2017	2000	98129 Mile	Boreas Air	BMW 3L Petrol	3L	45.1	Engine	208.35	27.18%	22.63%

Figure 4: Air Emission Survey





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## Air Emission Survey

Machine Identification	Date	Vehicle Age	Vehicle Odometer	Filter (Old/ New/Boreas)	Make and Model	Engine Size	Temperature	Temperature Location	VOC ppm	% Improvement from worst VOC to Boreas Air VOC	% Improvement from New standard air Filter VOC to Boreas Air VOC
07 D 29462	16.05.2017	2007	105078 KM	Old Filter	Volkswagon Passat 1.6L Petrol	1.6L	43.0	Engine	13.6	88.93%	72.73%
07 D 29462	16.05.2017	2007	105078 KM	No Filter	Volkswagon Passat 1.6L Petrol	1.6L	43.1	Engine	29.8		
07 D 29462	16.05.2017	2007	105078 KM	New Filter	Volkswagon Passat 1.6L Petrol	1.6L	47.0	Engine	12.1		
07 D 29462	16.05.2017	2007	105078 KM	Boreas Air	Volkswagon Passat 1.6L Petrol	1.6L	39.0	Engine	3.3		
161 Ford Fiesta	16.05.2017	2016	19749 KM	Old Filter	Ford Fiesta 1.2L Petrol	1.2L	52.1	Engine	37.1	91.11%	89.46%
161 Ford Fiesta	16.05.2017	2016	19749 KM	No Filter	Ford Fiesta 1.2L Petrol	1.2L	52.0	Engine	74		
161 Ford Fiesta	16.05.2017	2016	19749 KM	New Filter	Ford Fiesta 1.2L Petrol	1.2L	45.0	Engine	31.3		
161 Ford Fiesta	16.05.2017	2016	19749 KM	Boreas Air	Ford Fiesta 1.2L Petrol	1.2L	44.6	Engine	3.3		

Figure 5: Air Emission Survey



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## Air Emission Survey

Machine Identification	Date	Vehicle Age	Vehicle Odometer	Filter (Old/ New/Boreas)	Make and Model	Engine Size	Temperature	Temperature Location	VOC ppm	% Improvement from worst VOC to Boreas Air VOC	% Improvement from New standard air Filter VOC to Boreas Air VOC
06 MN 1641	16.05.2017	2006	169088 KM	Old Filter	Corsa 1L Petrol	1L	40.1	Engine	85.6	37.38%	10.82%
06 MN 1641	16.05.2017	2006	169088 KM	No Filter	Corsa 1L Petrol	1L	48.0	Engine	75.8		
06 MN 1641	16.05.2017	2006	169088 KM	New Filter	Corsa 1L Petrol	1L	44.6	Engine	60.1		
06 MN 1641	16.05.2017	2006	169088 KM	Boreas Air	Corsa 1L Petrol	1L	46.9	Engine	53.6		
05 MN 2386	16.05.2017	2005	289864 KM	Old Filter	HYUNDAI TRAJET 2L Petrol	2L	71.4	Engine	25.9	59.91%	59.91%
05 MN 2386	16.05.2017	2005	289864 KM	No Filter	HYUNDAI TRAJET 2L Petrol	2L	71.4	Engine	30.8		
05 MN 2386	16.05.2017	2005	289864 KM	New Filter	HYUNDAI TRAJET 2L Petrol	2L	64.0	Engine	65.1		
05 MN 2386	16.05.2017	2005	289864 KM	Boreas Air	HYUNDAI TRAJET 2L Petrol	2L	64.5	Engine	26.1		

Figure 6: Air Emission Survey

Title: Environmental Report

Client: Boreas Air



Client: Boreas Air  
Our Ref: H18TC93-BA  
Date: 16.05.2017

## Air Emission Survey

Machine Identification	Date	Vehicle Age	Vehicle Odometer	Filter (Old/ New/Boreas)	Make and Model	Engine Size	Temperature	Temperature Location	VOC ppm	% Improvement from worst VOC to Boreas Air VOC	% Improvement from New standard air Filter VOC to Boreas Air VOC
Notes:	05 MN 2386 HYUNDAI Vehicle showed worse figures when New filter was installed than with an old dirty filter. It was later detected that there was a faulty Air flow meter in the Vehicle										

Figure 7: Air Emission Survey Notes



Client: Boreas Air  
Our Ref: H18TC93-BA  
Date: 16.05.2017

Air Emission Survey													
Machine Identification	Date	Vehicle Age	Vehicle Odometer	Filter (Old/ New/Boreas)	Make and Model	Engine Size	CO (g/kg)	CO <sup>2</sup>	Hydrocarbon (ppm)	CO Euro3 (g/kg)	CO Euro4 (g/kg)	CO Euro5 (g/kg)	CO Euro 6 (g/kg)
Carbon Monoxide, Carbon Dioxide and Hydrocarbons Tested by LAVERTY Motors Dundalk													
08 MN 8203	16.05.2017	2008	164839 KM	Filter	Peugeot 207 1.2L Diesel	1.2L	0.66			0.66	0.5	0.50	0.50
08 MN 8203	16.05.2017	2008	164839 KM	No Filter	Peugeot 207 1.2L Diesel	1.2L	0.49			0.66	0.5	0.50	0.50
08 MN 8203	16.05.2017	2008	164839 KM	Boreas Air	Peugeot 207 1.2L Diesel	1.2L	0.47			0.66	0.5	0.50	0.50
05 MN 2386	16.05.2017	2005	290986 KM	Filter	HYUNDAI TRAJET 2L Petrol	2L	0.47	15	16	2.3	1.00	1.00	1.00
05 MN 2386	16.05.2017	2005	290986 KM	No Filter	HYUNDAI TRAJET 2L Petrol	2L	0.52	15	2	2.3	1.00	1.00	1.00
05 MN 2386	16.05.2017	2005	290986 KM	Boreas Air	HYUNDAI TRAJET 2L Petrol	2L	1.75	14	29	2.3	1.00	1.00	1.00
04 MN 1535	16.05.2017	2004	303492 KM	Filter	TOYOTA HIACE Diesel	2L	3.45			0.64	0.5	0.63	0.63
04 MN 1535	16.05.2017	2004	303492 KM	No Filter	TOYOTA HIACE Diesel	2L	3.48			0.64	0.5	0.63	0.63
04 MN 1535	16.05.2017		303492 KM	Boreas Air	TOYOTA HIACE Diesel	2L				0.64	0.5	0.63	0.63
04 MN 1535	16.05.2017	2004	KM		Diesel	2L	6.5						

Figure 8: Air Emission Survey Lavery Motors  
Title: Environmental Report  
Client: Boreas Air





Client: Boreas Air  
Our Ref: H18TC93-BA  
Date: 16.05.2017

Air Emission Survey													
Machine Identification	Date	Vehicle Age	Vehicle Odometer	Filter (Old/ New/Boreas)	Make and Model	Engine Size	CO (g/kg)	CO <sup>2</sup>	Hydrocarbon (ppm)	CO Euro3 (g/kg)	CO Euro4 (g/kg)	CO Euro5 (g/kg)	CO Euro 6 (g/kg)
06 MN 1641	16.05.2017	2006	169088 KM	Old Filter	Corsa 1L Petrol	1L	0.6	15	101	2.3	1	1.00	1.00
06 MN 1641	16.05.2017	2006	169088 KM	No Filter	Corsa 1L Petrol	1L	0.2	15	83	2.3	1	1.00	1.00
06 MN 1641	16.05.2017	2006	169088 KM	Boreas Air	Corsa 1L Petrol	1L	0.12	15	119	2.3	1	1.00	1.00
Notes:	Emissions on HYUNDAI TRAJET 2L Petrol 04 MN 1535 are high due to a faulty Air Flow sensor in the Vehicle. The fault was not detected at the time of the initial survey however, when taken to the NCT centre the car showed very high levels of Carbon Monoxide. The reason for the high levels were unknown however when Lavery motors in Dundalk inspected the vehicle they found a faulty Air flow meter was causing excess fuel to be put into the engine and as a result the fuel was completely not combusting causing the release of Carbon Monoxide.												
	Where figures are in <b>RED</b> these vehicles are Non Compliant with EURO 5 or Euro 6 CO levels. Where figures are <b>Green</b> figures show compliance with Euro 5 and 6. Vehicle 08 MN8203 has successfully reduced Carbon Monoxide from Euro 3 levels of 0.66 g/kg to 0.47 g/kg which are compliant with Euro 6 a significant jump of 3 compliance levels.												

Figure 9: Air Emission Survey Lavery Motors

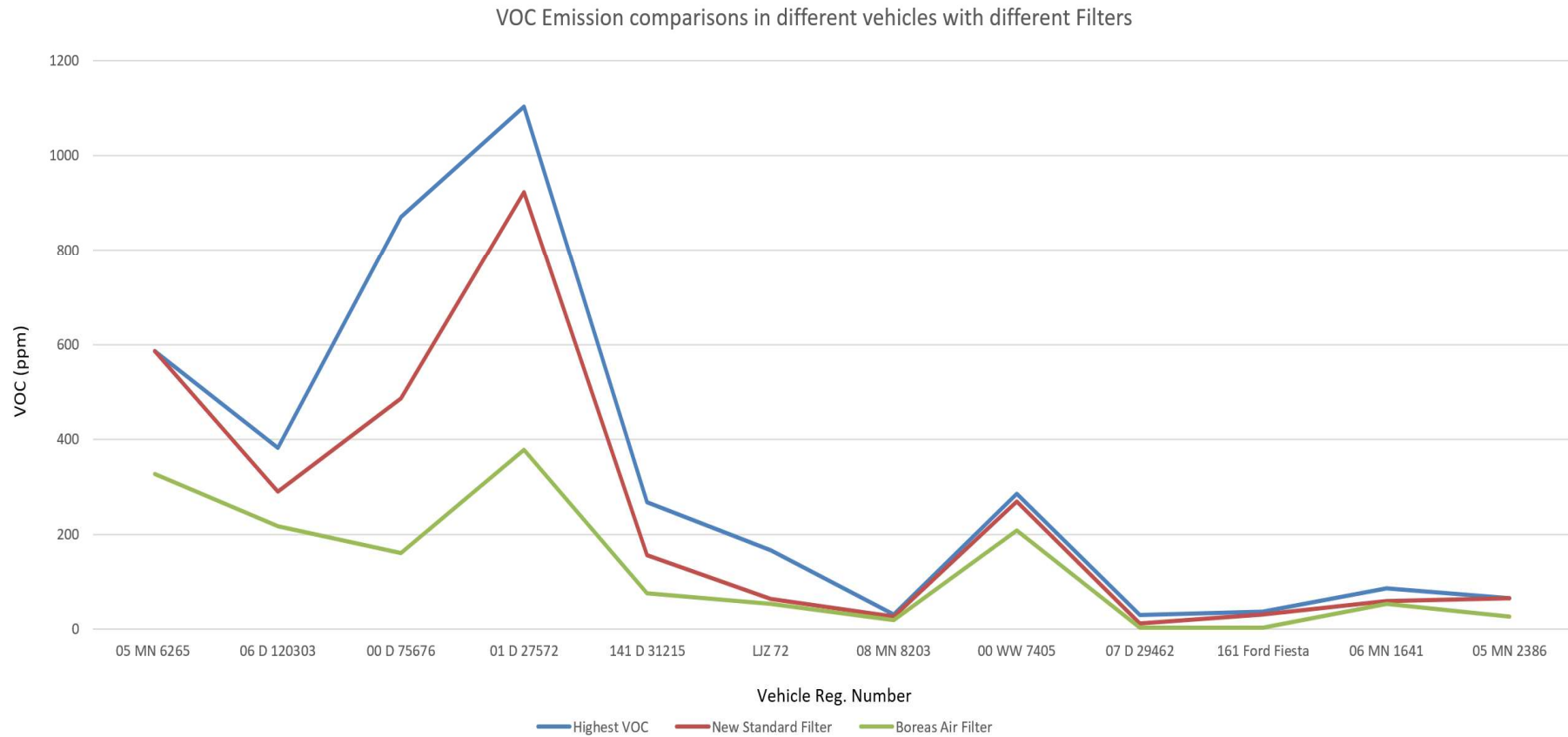


Figure 10: VOC Graph comparison different vehicles and filters

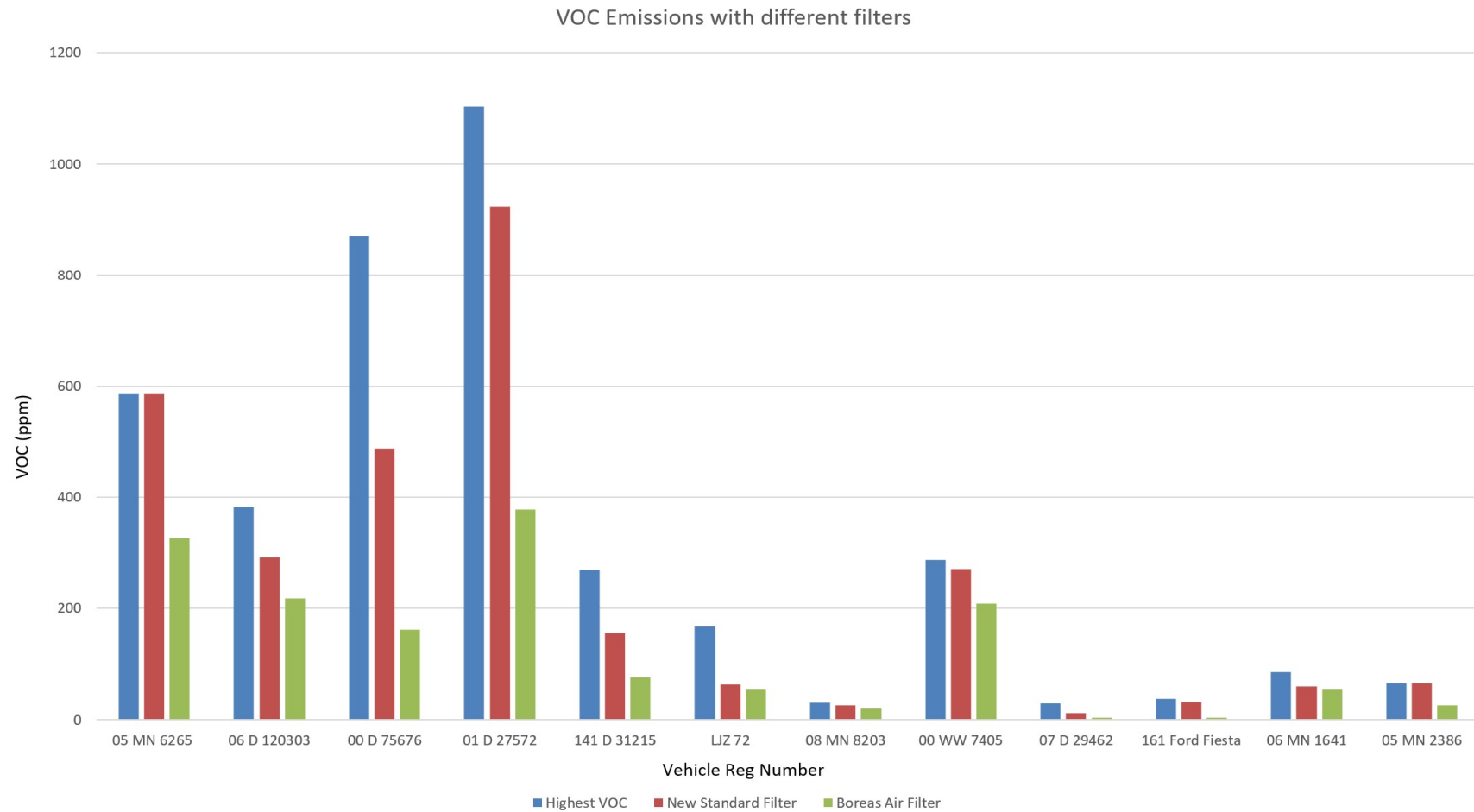


Figure 11: Table Showing VOC changes with different filters in different



## 10. Analysis

The results have shown that the VOC emissions from the vehicles involved in the test vary significantly from machine to machine, all changes in VOC Concentration were measured against the Worst VOC Concentration for the vehicle being measured.

The worst VOC releases came from some of the older vehicles, the 00.D.75676 Volvo 7L recorded a high VOC of 871.1ppm with no filter and the 01.D.27572 Scania 9L recorded a high VOC of 1103ppm with an old dirty filter. These vehicles, although the worst offenders initially, recorded the best percentage change in VOC levels when the VOC's were measured with the Boreas Air wrapped, reputable quality filter. The 00.D.75676 Volvo 7L recorded a 99.82% improvement from the worst recording to the best VOC recording with the Boreas Wrapped filter. The 01.D.27572 Scania 9L recorded a 65.73% improvement from the worst recording to the best VOC recording with the Boreas Wrapped filter.

When comparing the vehicles, it was noted on the 05.MN.6265 Scania 12L engine and 06.D.120303 12L engine that the VOC levels were similar initially. However, the vehicle 06.D.120303 has been retrofitted with an Ad Blue system. This system, is described above, reduced the harmful NOX to non-harmful water and Nitrogen. Although no significant difference in VOC level was found between the vehicle with AdBlue and the Vehicle without AdBlue, both Vehicles showed significant improvements when wrapped with the Boreas Air Filter. It should also be pointed out that during the investigation there were significant improvements in VOC releases with reputable, high quality, filter manufactures

Some of the lowest VOC's came from the Petrol vehicles, with the 07 D 29462 Volkswagen Passat 1.6L recording a high VOC of 29.8ppm with no filter installed. This VOC was further reduced to 3.3ppm upon installation of the Boreas Air wrapped filter, a significant improvement of 88.93% from the high VOC. Similarly, reductions of VOC's were encountered in all petrol vehicles, however the degree of reduction varied from vehicle to vehicle.



Vehicle 05 MN 2386 Hyundai Trajet 2L was first monitored on site with the other vehicles in the sample. Although the vehicle did show a reduction in VOC's overall, the results were not consistent with the other vehicles. This vehicle recorded 25.9ppm with an old dirty filter, yet recorded 65.1 ppm with a new reputable branded unwrapped filter. Previous results have shown a decrease in VOC's emitted with a new clean reputable filter due to better air flow and efficiency in fuel combustion. The VOC reduced to 26.1ppm upon installation of the Boreas Air wrapped filter. This vehicle was subsequently taken for NCT testing and the Carbon Monoxide (CO) levels were significantly higher than what would have been expected for a vehicle of this type with similar mileage. The reason for increased CO levels would arise from incomplete combustion of fossil fuels, in this instance the petrol in the vehicle. Initially we were unable to determine the reason for this and had thought that air restriction could have been an issue. This led to the investigation of CO levels by Laverty Motors. Laverty Motors determined that CO levels were significantly high in this vehicle, significantly above what would be expected for a passenger vehicle under Euro 5 and Euro 6 regulations. It was found that a faulty air flow meter was the reason for the increase.

The Vehicle 04 MN 1535 TOYOTA HIACE 2L Diesel vehicle was also monitored for CO levels. The CO levels for this vehicle, again were significantly high with the lowest CO level 3.45 mg/kg recorded with the original filter, this increased to 3.48 mg/kg with no filter and 6.5 mg/kg. the reason for this increase is unknown and could be potentially a faulty Air Flow sensor. This should be investigated further.

Vehicle 08.MN.8203 Peugeot 207 1.2L Diesel when tested for VOC's, showed a 36.01% improvement from the worst VOC recording to recording with the Boreas Air wrapped filter. This vehicle was also inspected by Lavertys motors for Carbon Monoxide, the results showed that it had a carbon monoxide level of 0.66g/kg with the original filter installed, this reduced to 0.49 g/kg with no filter installed and reduced further to 0.47 g/kg with the Boreas Air filter. Early assumptions show that the diesel is combusting better with the use of the Boreas Air wrap. Significantly the reduction in CO level has allowed the vehicle which was only just within the compliance limit for Euro 3 emissions criteria become compliant



with both Euro 5 and Euro 6 standard of 0.5 mg/kg of CO emissions it has moved comfortably within the bracket of compliance.

The LJZ 72 Audi Q5 Diesel Ad Blue Vehicle was measured for VOC concentration, and showed reductions from a high of 167.1 ppm with the dirty filter down to 54.1ppm with the cleaned, million mile filter, wrapped with Boreas Air. This was an improvement of 67.62%; it must be noted that this vehicle is fitted with an Ad Blue system. As stated above this system reduces the NOX levels in any vehicle that has the system.

Similar reductions were found in 06 MN 1641 Vauxhall Corsa 1L Petrol where high CO levels were recorded at 0.6 mg/kg with the standard filter, 0.2 mg/kg for no filter and 0.12 mg/kg with the Boreas Air wrapped filter. This vehicle was within both Euro 5 and Euro 6 regulation levels prior to filter changing, however the decrease is significant. The Boreas air filter has the potential to reduce the CO, NOX and CO<sub>2</sub> levels (pending results of further investigation) of the larger Vehicles where Euro 5 and Euro 6 regulations and criteria are rigidly applied specifically on the intercontinental journeys.

#### **10.1. Limitations to data**

PID has Limitations in that the volatile chemical range is measured using a UV lamp held within the detector, an FID More suited to this type of testing, it measures the range of chemicals with a flame to produce chemicals with the combustion of the flame. The residue metals are collected and measured to quantify the contaminants, however the availability of this product and the qualified personnel available to run the test could not be found within the time and financial budget available.

PID used because of Portability, accessibility, availability of equipment and experienced personnel that had the machine and was able to do site survey. It is suitable in that it provides sufficient data to indicate that hypothesis is confirmed and that further in depth testing of product is fully justified.

#### **10.2. Recommendations**



- Further testing to quantify the decrease in VOC's and ascertain the chemicals responsible for greatest decrease.
- Confirm if particulate matter is reduced any or significantly. This was not measured during the test as it goes beyond the scope of the investigation on the day.
- Further testing of Carbon Monoxide, NOX, and Carbon Dioxide levels on all vehicles, particularly the large Commercial Vehicles. Determine if similar reductions in these chemicals can move a non-compliant vehicle from Euro 4 and before to Euro 5 and Euro 6 regulation and compliance levels.

## **11. Conclusions based on findings**

The conclusions based on the analysis have shown that significant reductions are recorded with the change from old used filter to new filters. These reductions are further increased using the Boreas Air wrap, with the Boreas Filter allowing for the most significantly reduced VOC's in all samples analysed. Some Vehicles have shown greater improvements than others however the reduction in all samples indicated that vehicles should where possible use the Boreas Air Filter wrap on a high quality reputable air filter, to further reduce VOC emissions giving the best possible result.

## **12. Further analysis**

Further analysis is recommended on several parameters:

- Particulate matter before and after Boreas Air filter
- moisture content before and after Boreas Air filter
- Lifecycle analysis on the product
- Quantification of decrease of individual contaminants
- Quantify NOX, CO, and CO<sub>2</sub> and any other chemicals relevant to Air pollution in conjunction with Euro 5 and Euro 6 regulations.





# Appendix 1

## Site Photos





















