



CAMFIL LABORATORIES – TECH CENTER

# Novaerus

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## Contents

Abstracts.....	2
Purpose.....	2
Test object .....	3
Description of test methods.....	4
Equipment List.....	4
Test method Declination test,.....	4
Results .....	9
DEHS Declination test – Chamber .....	9
<b>Test 1 – Speed 1, low concentration</b> .....	9
<b>Test 2 – Speed 1, high concentration</b> .....	11
<b>Test 3 – Speed 2, low concentration</b> .....	13
<b>Test 4 – Speed 2, high concentration</b> .....	15
Toluene Test – Chamber .....	17
<b>Toluene test, Speed 1</b> .....	17
<b>Toluene test, Speed 2</b> .....	18
Clean Air Delivery Rate Test .....	19
Conclusion .....	22
<b>Test 1, Low Speed Low Concentration DEHS</b> .....	22
<b>Test 2. Low Speed High Concentration DEHS</b> .....	22
<b>Test 3, High Speed Low Concentration DEHS</b> .....	22
<b>Test 4, High Speed High Concentration DEHS</b> .....	22
<b>Test 5, Low Speed Toluene</b> .....	22
<b>Test 6, High Speed Toluene</b> .....	22
<b>Test 7, Clean air delivery rate</b> .....	22

## **Novaerus Air cleaner – Chamber test**

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### **Abstracts**

The Novaerus air cleaner was placed in a chamber fed with a constant rate of impurities (DEHS first tests, then Toluene) at a constant ventilation rate. Once stable conditions are reached the air cleaner is turned on to measure the efficiency. The air cleaner reaches a minimum efficiency of 55 % on the low speed and a maximum efficiency of 89% is reached on the high speed. In the toluene declination test, where Toluene was injected into the room with a concentration of approximately 1200 ppb, the injection was then turned off and the cleaner was turned on. The Novaerus air cleaner removed 90 % of the toluene within 6 minutes on the high speed and 90% after 17 min on the low speed.

### **Purpose**

Evaluate the particulate and molecular efficiency of the Novaerus air cleaner in a test chamber using DEHS and Toluene.

**Test object**



*Figure 1, Test object*

## Description of test methods

### Equipment List

Particle counter	TSI 3330
Photoionization detector (PID)	RAE Systems ppbRAE 3000(PGM-7340)
Aerosol	DEHS, Toluene
Aerosol Injection	Laskin-Nozzle

### Test method Declination test,

A 19,72 m<sup>3</sup> test chamber is supplied with an air flow equivalent of ca 1 air changes per hour. Incoming air is first passed through a HEPA filter and then a F9 filter to heavily reduce the impact of particle concentration in ambient air. After the filter DEHS and Toluene is supplied at the inlet to the room by using a Laskin nozzle bottle. The air in the room is then mixed with a fan. Particles are measured both inside the room and in the outlet duct while toluene only inside room.

Four tests were made with DEHS and two with Toluene.

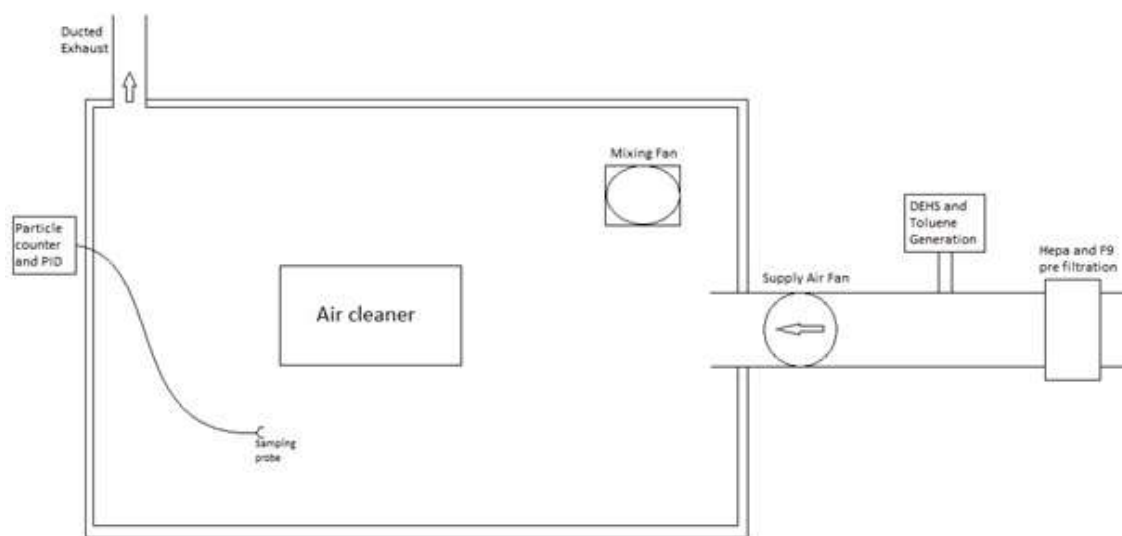


Figure 2 Test chamber sketch

### Test method CADR

The aerosol and toluene were generated in the laskin nozzle and injected into a room until a pre set concentration was achieved then the air cleaner was turned on. The results were then compared to the normal reduction of particles over time in the test chamber.

According Standard ANSI / AHAM AC-1-2015

### 8.4 Performance Calculation.

The performance of an air cleaner is represented by a clean air delivery rate (CADR).

The method for calculating the clean air delivery rate is:

$$CADR = V(k_e - k_n)$$

where:

CADR = clean air delivery rate (cu. ft/min)

V= volume of test chamber, cu. ft.

$k_e$ = total decay rate, min<sup>-1</sup>

$k_n$ = natural decay rate, min<sup>-1</sup>



Figure 3 measuring station outside chamber



*Figure 4 DEHS and Toluene laskin nozzle bottles injecting into the duct*





*Figure 5 Intake air*





*Figure 6, Tested object and mixing fan.*

## Results

### DEHS Declination test – Chamber

“Speed 1” and “Speed 2” is referring to the speed setting of the air cleaners max and minimum fan speed.

#### Test 1 – Speed 1, low concentration

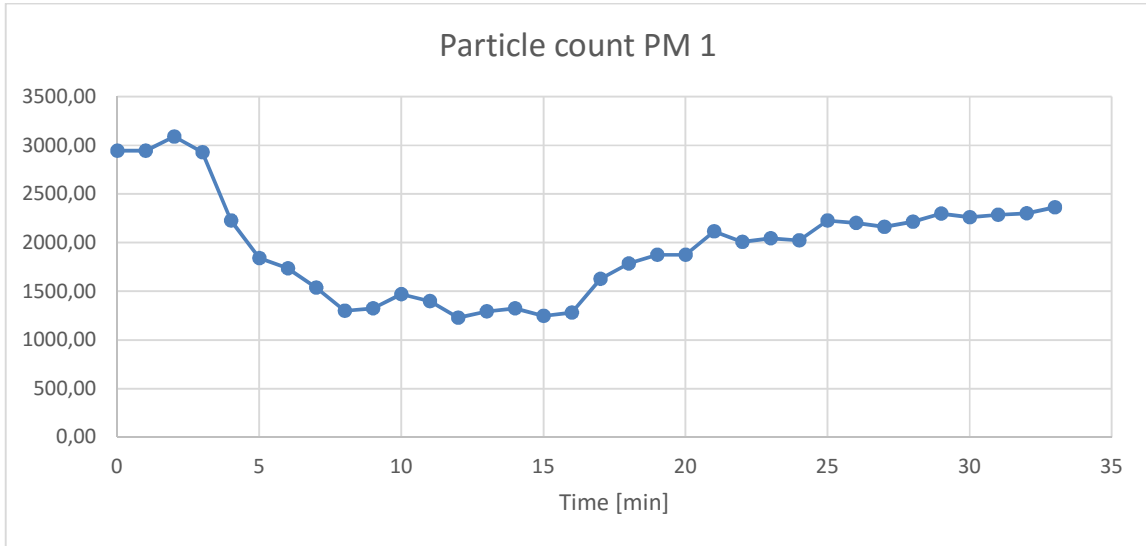


Figure 7, Particle count of PM 1 particles.

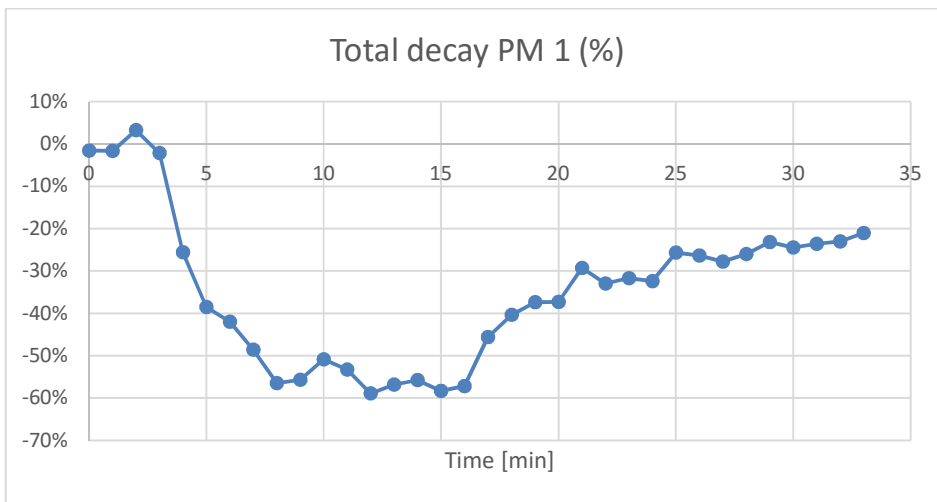


Figure 8, the graph shows the reduction of particles during the test. The air cleaner was on between 4 minutes and 16 minutes which show a reduction down to 55% of the total amount of particles.

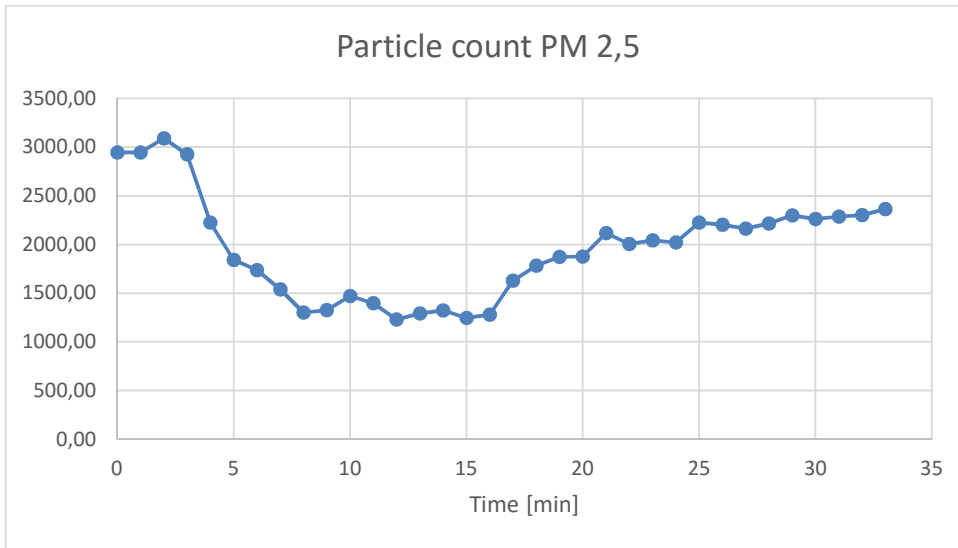


Figure 9, particle count of PM 2,5 particles.

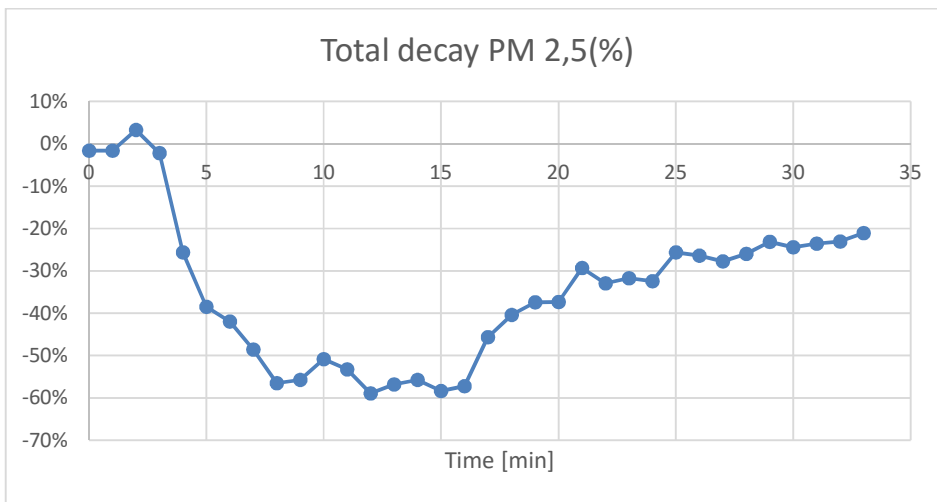


Figure 10, the graph shows the reduction of particles during the test. The air cleaner was on between 4 minutes and 16 minutes which show a reduction of particles with an average of 55% of the total amount of particles.

**Test 2 – Speed 1, high concentration**

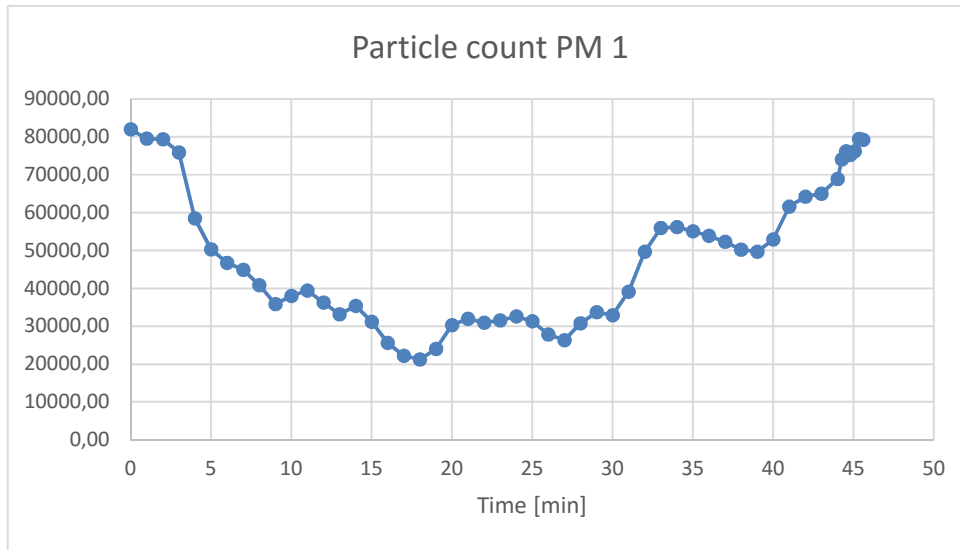


Figure 11, Particle count of PM 1 particles.

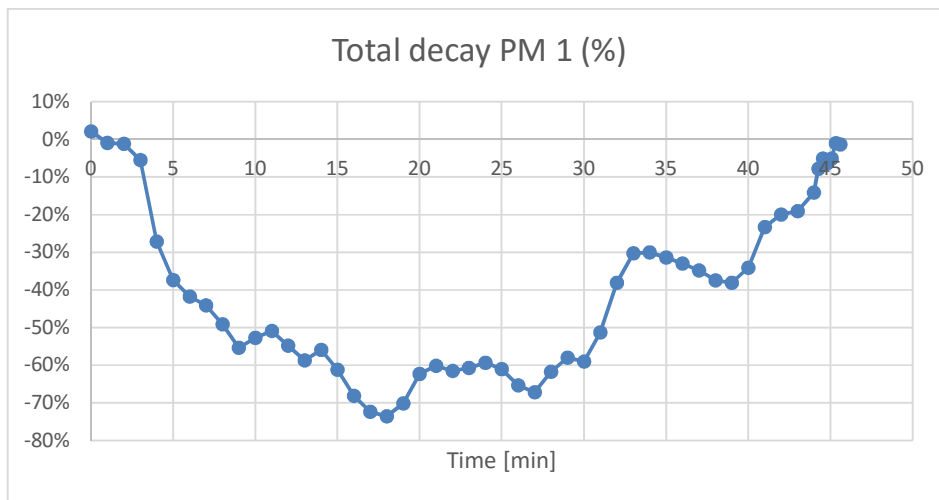


Figure 12, the graph shows the reduction of particles during the test. The air cleaner was on between 4 minutes and 30 minutes which show a reduction of particles down to an average of 60% of the total amount of particles.

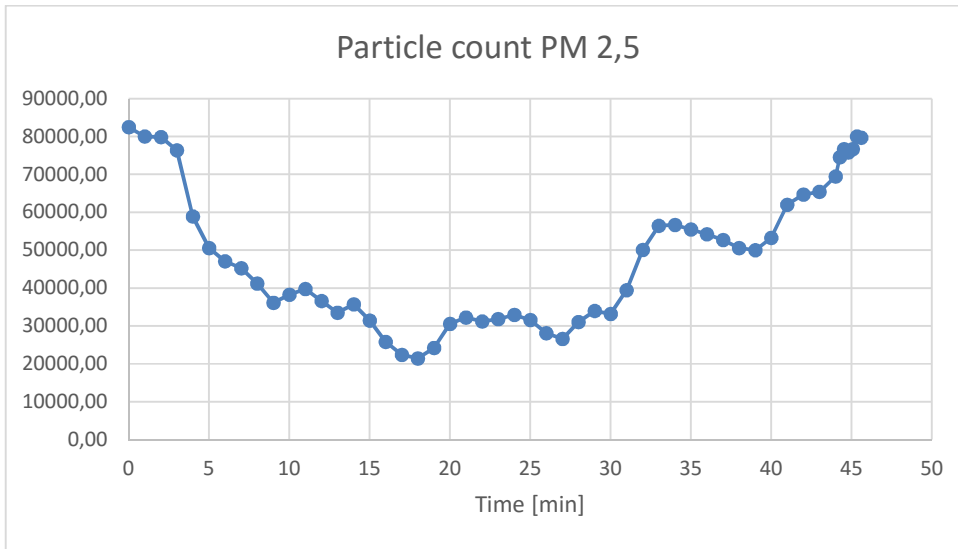


Figure 13, Particle count of PM 2,5 particles.

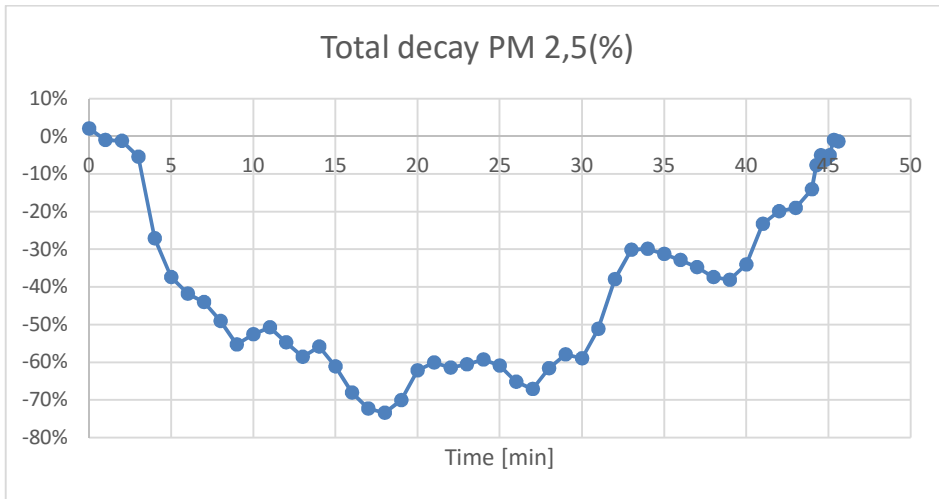


Figure 14, the graph shows the reduction of particles during the test. The air cleaner was on between 4 minutes and 30 minutes which show a reduction of particles down to an average of 60% of the total amount of particles.

**Test 3 – Speed 2, low concentration**

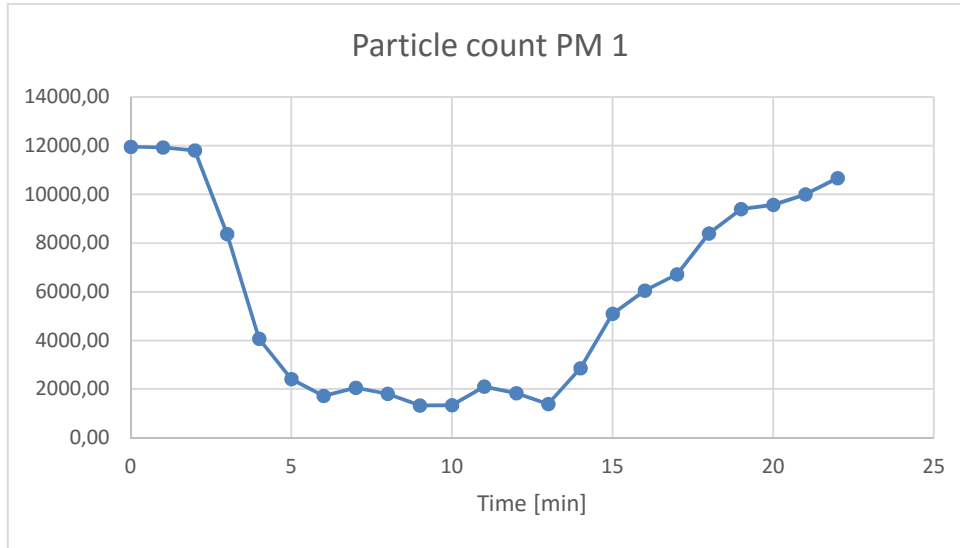


Figure 15, Particle count of PM 1 particles.

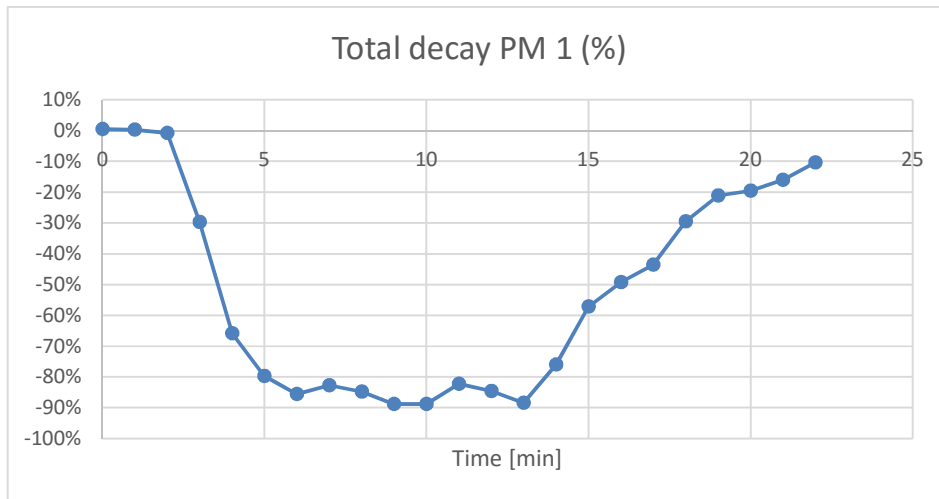


Figure 16, the graph shows the reduction of particles during the test. The air cleaner was on between 3 minutes and 13 minutes which show a reduction of particles down to an average of 85% of the total amount of particles.

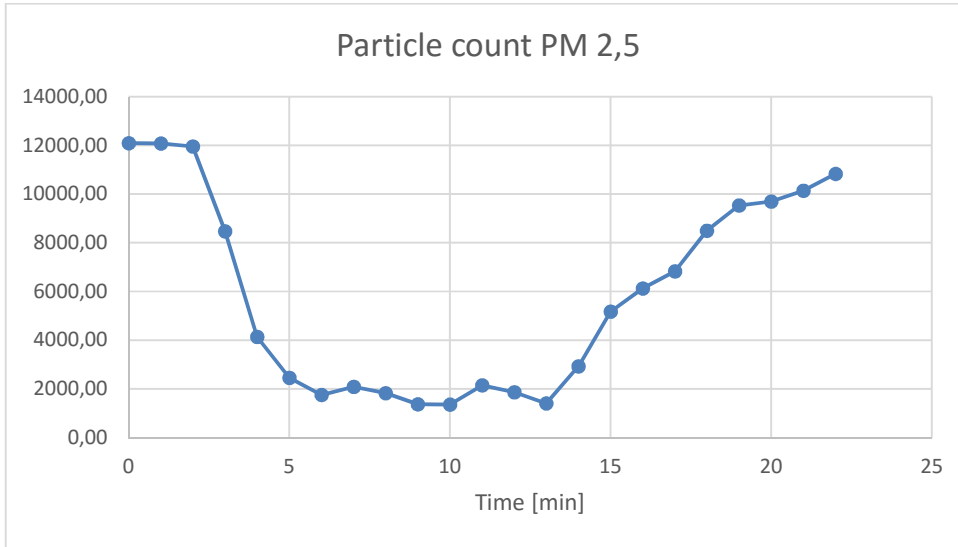


Figure 17, Particle count of PM 2,5 particles.

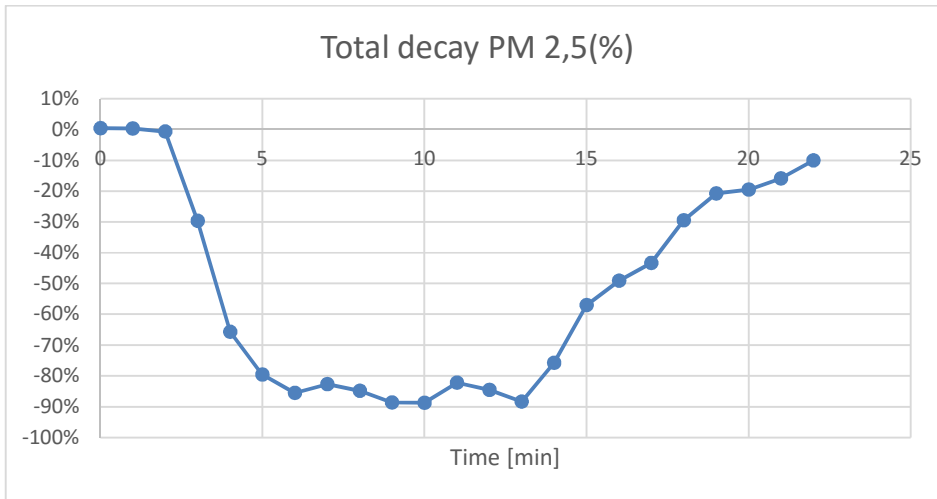


Figure 18, the graph shows the reduction of particles during the test. The air cleaner was on between 3 minutes and 13 minutes which show a reduction of particles down to an average of 85% of the total amount of particles.



**Test 4 – Speed 2, high concentration**

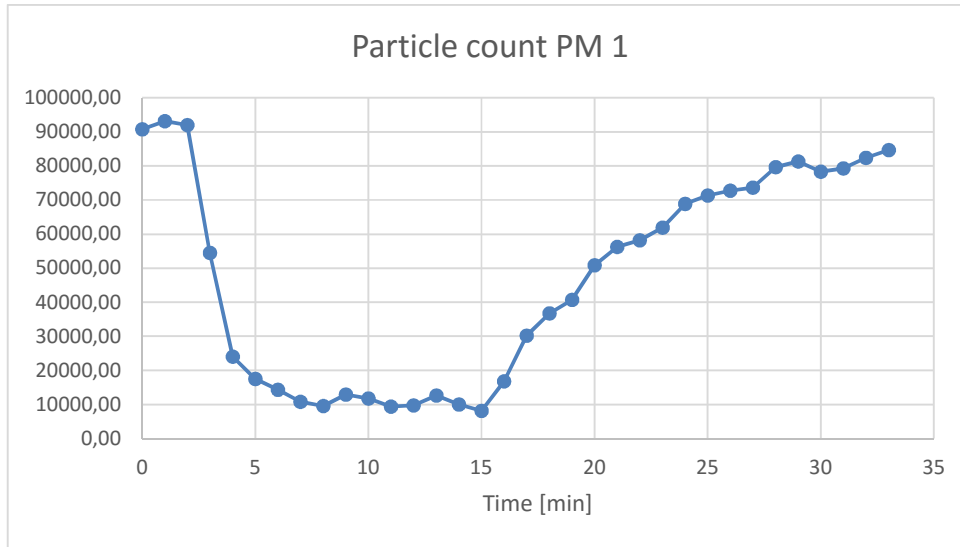


Figure 19, Particle count of PM 1 particles.

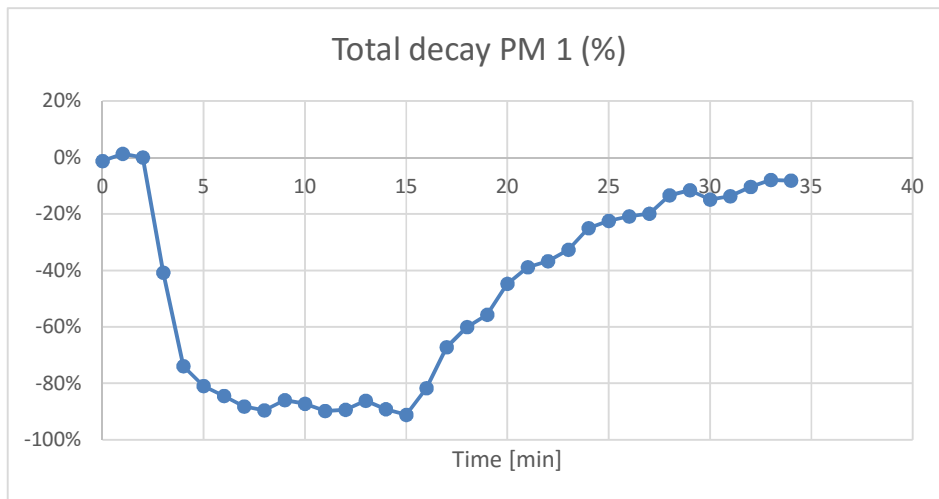


Figure 20, the graph shows the reduction of particles during the test. The air cleaner was on between 3 minutes and 15 minutes which show a reduction of particles down to an average of 89% of the total amount of particles.

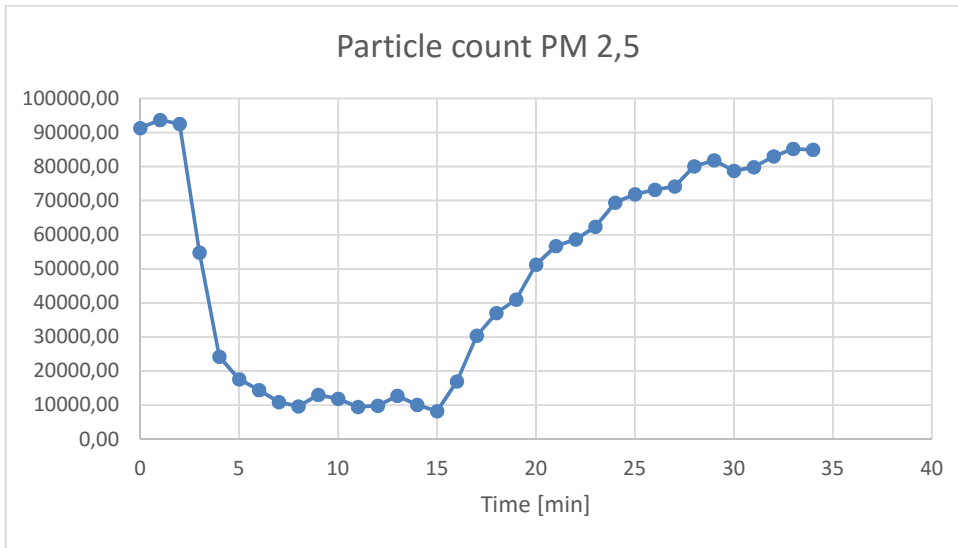


Figure 21, Particle count of PM 2,5 particles.

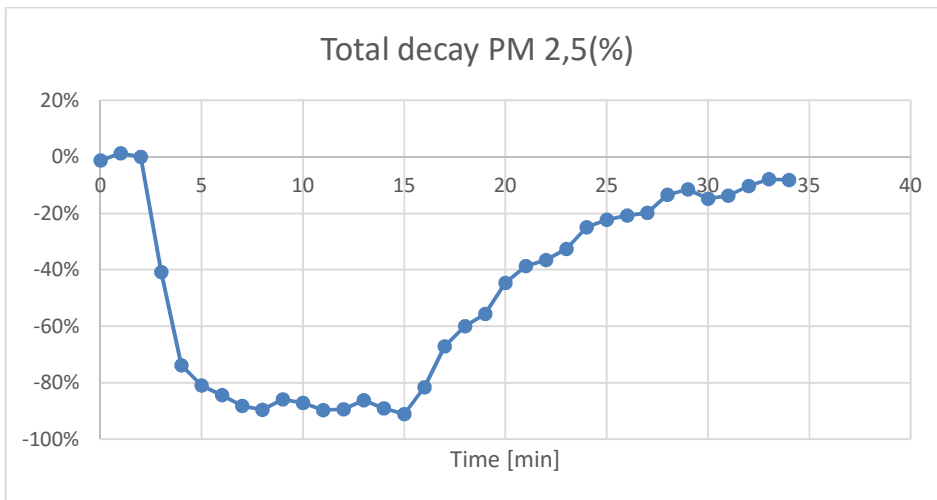


Figure 22, the graph shows the reduction of particles during the test. The air cleaner was on between 3 minutes and 15 minutes which show a reduction of particles down to an average of 89% of the total amount of particles.

## Toluene Test – Chamber

### Toluene test, Speed 1

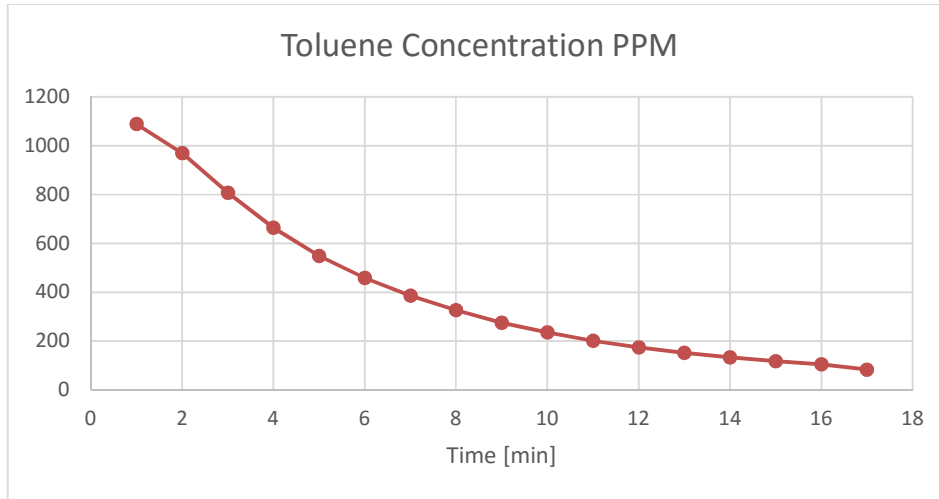


Figure 23, Toluene reduction when air cleaner is activated.

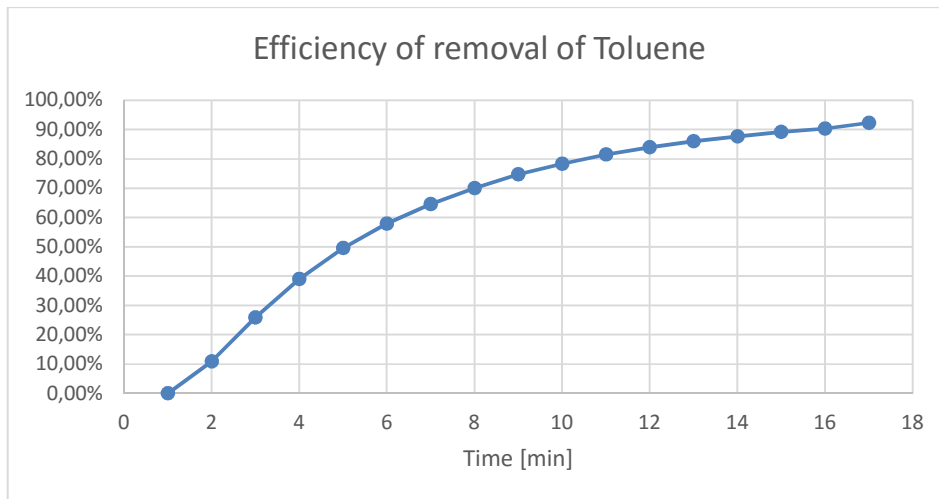


Figure 24, Toluene reduction when air cleaner is activated.

**Toluene test, Speed 2**

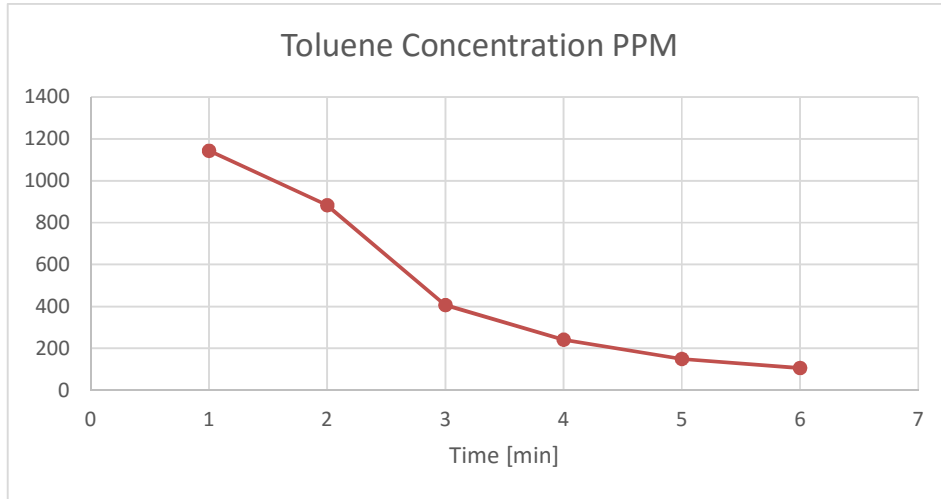


Figure 25, Toluene reduction when air cleaner is activated.

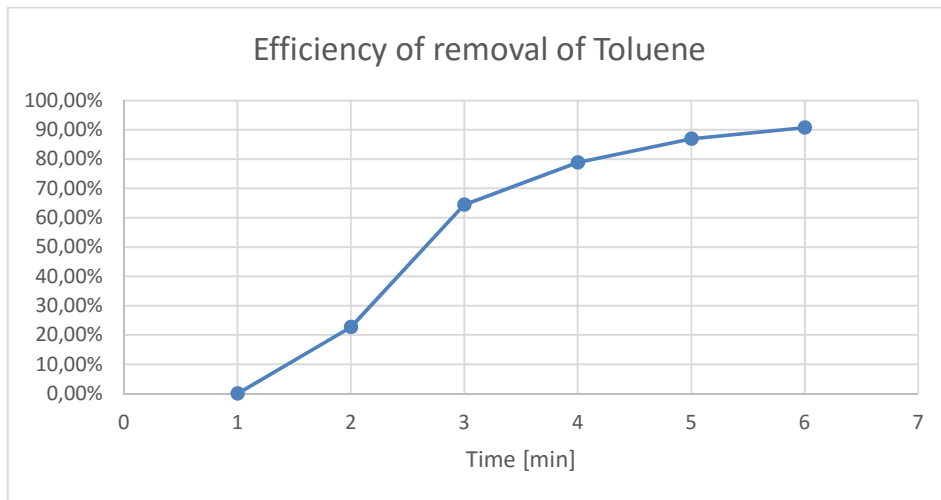


Figure 26, Toluene reduction when air cleaner is activated.

## Clean Air Delivery Rate Test

Clean Air Delivery Rate (CADR) PM1	
Speed I	Speed II
143	507
CFM	CFM

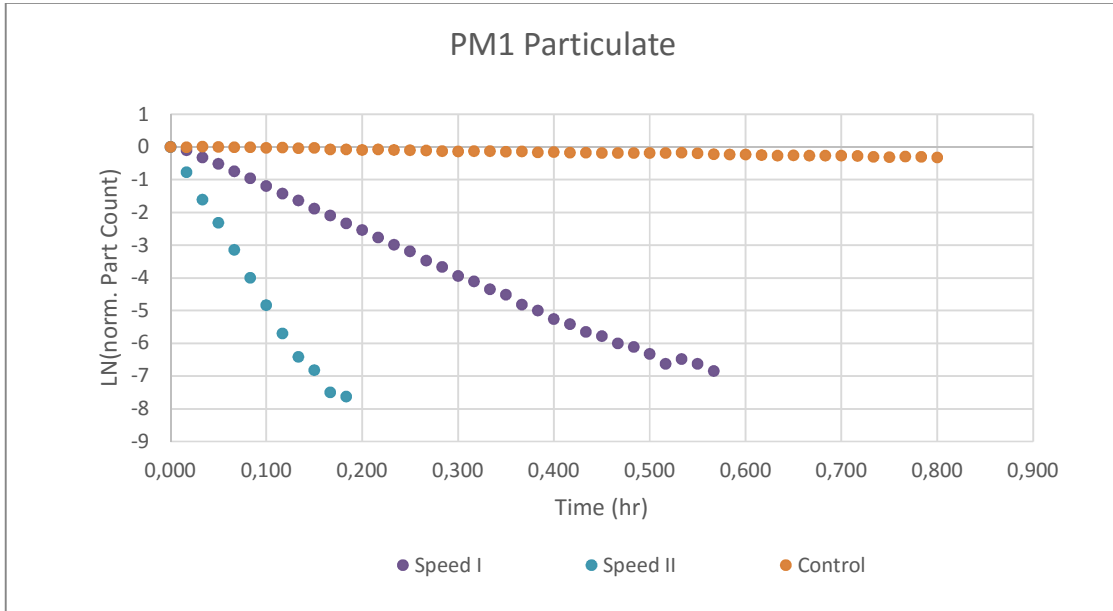


Figure 27, Clean air delivery rate pm 1.

Clean Air Delivery Rate (CADR) PM2.5	
Speed I	Speed II
<b>144</b>	<b>513</b>
CFM	CFM

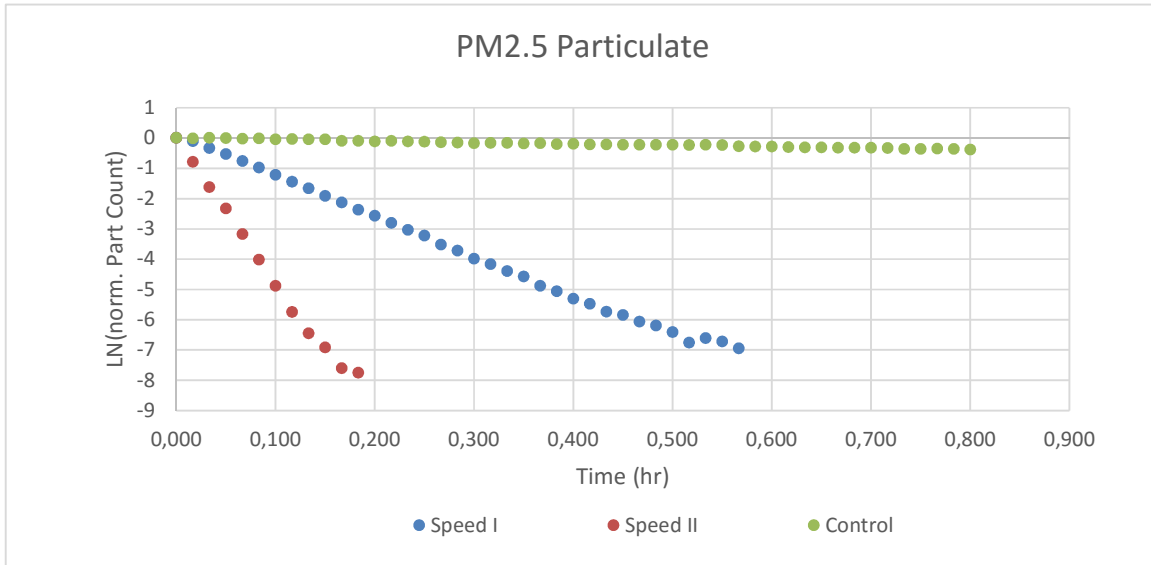


Figure 28, Clean air deliver rate of PM2.

Clean Air Delivery Rate (CADR) Toluene	
Speed I	Speed II
<b>109</b>	<b>351</b>
CFM	CFM

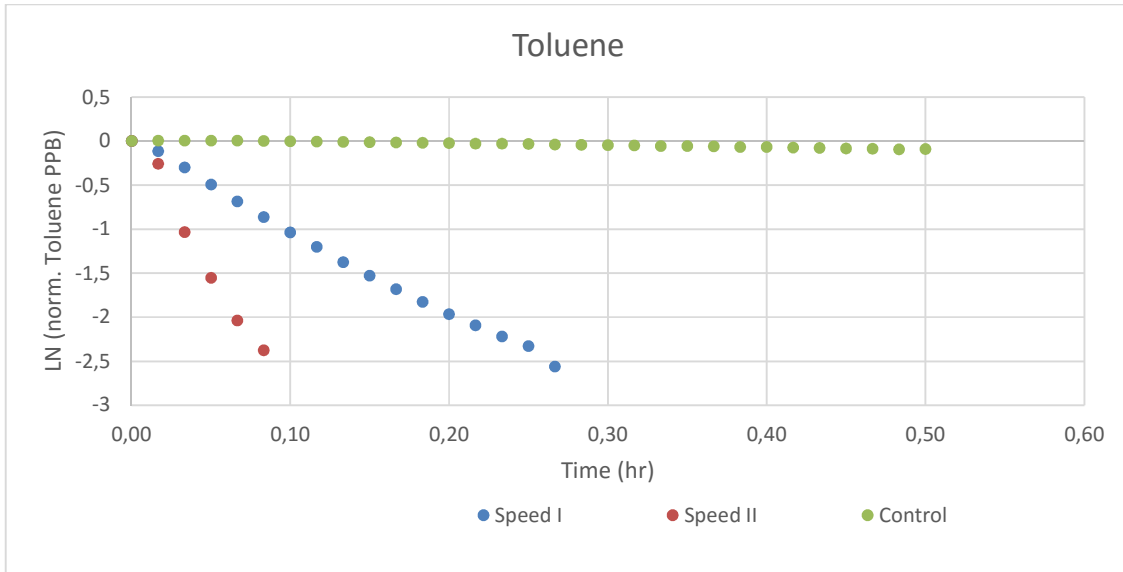


Figure 29, Clean air delivery rate of toluene



## **Conclusion**

### **Test 1, Low Speed Low Concentration DEHS**

With the low speed and low concentration test configuration the cleaner reached an average efficiency of 55%. This was the lowest efficiency reached in all the different test configurations. It took the air cleaner around 7 minutes to reach the steady state inside of the test chamber.

### **Test 2. Low Speed High Concentration DEHS**

The test configuration with low speed and high concentration reached an average efficiency of 60% and the time to reach the steady state was 10 minutes. When compared to test number 1 there is a 10% higher efficiency and the time to reach steady state is a few minutes longer.

### **Test 3, High Speed Low Concentration DEHS**

With the high speed and low concentration of DEHS test was performed it reached an average efficiency of 85%. The steady state was reached after approximately 5 minutes. The steady state was reached 2 minutes faster with the high fan speed when compared to the low speed setting.

### **Test 4, High Speed High Concentration DEHS**

The test configuration high speed and high concentration DEHS achieved an average efficiency of 89% which was the best performance seen in these tests. It took 5 minutes before the air cleaner reached a steady state which is the same result as in test 3.

### **Test 5, Low Speed Toluene**

With the low speed configuration, it took the air cleaner 16 minutes to reduce the toluene with 90% from 1200 to 86 ppm.

### **Test 6, High Speed Toluene**

When the air cleaner was set to high speed it took 6 minutes to remove 90% of the toluene in the test chamber. When compared to test two there is a significant difference in time to reduce the concentration to 90 %, it was 10 minutes faster than with the low speed setting.

### **Test 7, Clean air delivery rate**

The clean air delivery rate was performed on pm 1 and 2.5. It was also performed on the selected VOC Toluene. The result of these measurements can be seen in figures 27, 28 and 29.