

Technical Evaluation Report

On

**Laboratory Simulation for Performance Evaluation
of MAXI-FILTRA's Activated Carbon.**

Requested by:

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Laboratory Simulation for Performance Evaluation of MAXI-FILTRA's Activated Carbon.

1 Introduction

Watertec (M) Sdn. Bhd. has approached SIRIM Berhad (SIRIM) to conduct a performance evaluation test on its filter product marketed under the brand name 'MAXI-FILTRA'. The objective of the assignment is to have a report from SIRIM, validating the performance of the product, which supposedly filter out malodorous gases from toilet vent pipe.

The evaluation experiment designed by SIRIM is aimed at obtaining laboratory data that will infer the effect of different weights of activated carbon in the 'MAXI_FILTRA' on the efficiency of filtration of malodorous gases from toilet vent pipe. The scope of service provided by SIRIM is listed herewith:

1. To perform a sampling exercise of emission from a toilet vent pipe on the rooftop of a 13-storey building located at SIRIM Berhad.
2. To develop a suitable experimental method and simulation apparatus for the performance evaluation of the filter system.
3. To determine product effectiveness in the filtration of malodorous gases.

2 Experimental Procedure

The performance evaluation test was carried out at SIRIM Environment & Bioprocess Technology Centre, using a 'simulation chamber' that was designed and fabricated specifically for the project. The experimental procedure is briefly described as follows:

1. Three liters (3L) of hydrogen sulphide (0.01M) and ammonium chloride (0.1M) solutions were prepared separately to act as sources of hydrogen sulphide and ammonia gas, respectively in the simulation chamber. Household LPG gas was also used to provide the hydrocarbon composition, typically propane and butane as it was easily available compared to methane.
2. The simulation chamber as shown in Appendix A was set up. The solutions of H_2S and NH_4Cl were agitated continuously to generate the malodorous gases that were introduced into the chamber through the respective inlet valves for 20 minutes. The two outlet valves, where one was the control (without filter) and the other, the "test



valve" with activated carbon filters were connected to a sampling train. Airflow was created by an air pump and the flow rate was set to ensure a slight positive pressure inside the chamber. Too high with pressure have caused the acrylic chamber wall to "explode" in the earlier runs.

3. The gaseous emissions were trapped using impingers filled with 75 ml boric acid and sodium hydroxide solutions for hydrogen sulphide and ammonia gases, respectively, and tedlar bag to trapped the hydrocarbons. Sampling of gases commenced 10 minutes after the gases were introduced into the chamber.
4. A total of 3 different weights of activated carbon (40g, 25g and 15g) were used in the simulation.
5. A confirmation experiment where 40g of activated carbon was put into a 0.5L tedlar bag and methane gas was introduced directly from the cylinder. The carbon was exposed to the gas for 20 minutes. The gas was then syringed out for methane analysis. The aim of this experiment was to investigate the absorption of methane by activated carbon.

3 Results and Discussion

Table 1 list the gas volume measured from each of the valves after 20 minutes while Table 2 summarizes the findings inferred from the analytical data of Result summary R 024/05 appended as Annex A.

Table 1: Air Volume Through Outlet Valve.

Outlet valve	40 g	25 g	15 g
With Filter (L)	36.6	23.7	17.9
Without Filter (L)	29.6	27	24.2

Table 2: Findings on Performance Evaluation of Activated Carbon Filter.

Parameter	Ammonia			H ₂ S		
	40g	25g	15g	40g	25g	15g
With Filter (mg/m ³)	0.05	0.07	0.00	0.2	0.06	32.3
Without Filter (mg/m ³)	0.2	0.12	0.17	13.43	63.9	71.3
Removal Efficiency (%)	75	41.7	100	98	99.9	54.7

Note : Removal efficiency was calculated as : $\frac{(\text{Conc.}) \text{ without filter} - (\text{Conc.}) \text{ with filter}}{(\text{Conc.}) \text{ without filter}} \times 100\%$



Two conspicuous observations were noted from Table 2:

- (a) Ammonia was filtered by the activated carbon with removal efficiency ranging from 40% to 100%. However, the removal efficiency could not be correlated with the ammonia of carbon.
- (b) Hydrogen sulphide was filtered by the activated carbon with removal efficiency ranging from 55% to 99%. There was also no clear-cut correlation between removal efficiency and carbon amount used.

The lack of correlation between removal efficiency and amount of carbon could be due to limitation of the experiment. The packing of the carbon into the filter housing was done manually. Hence packaging density varied not only with the amount but possibly the manner in which the filter housing was packed (Note: great care was taken to try to maintain consistency)

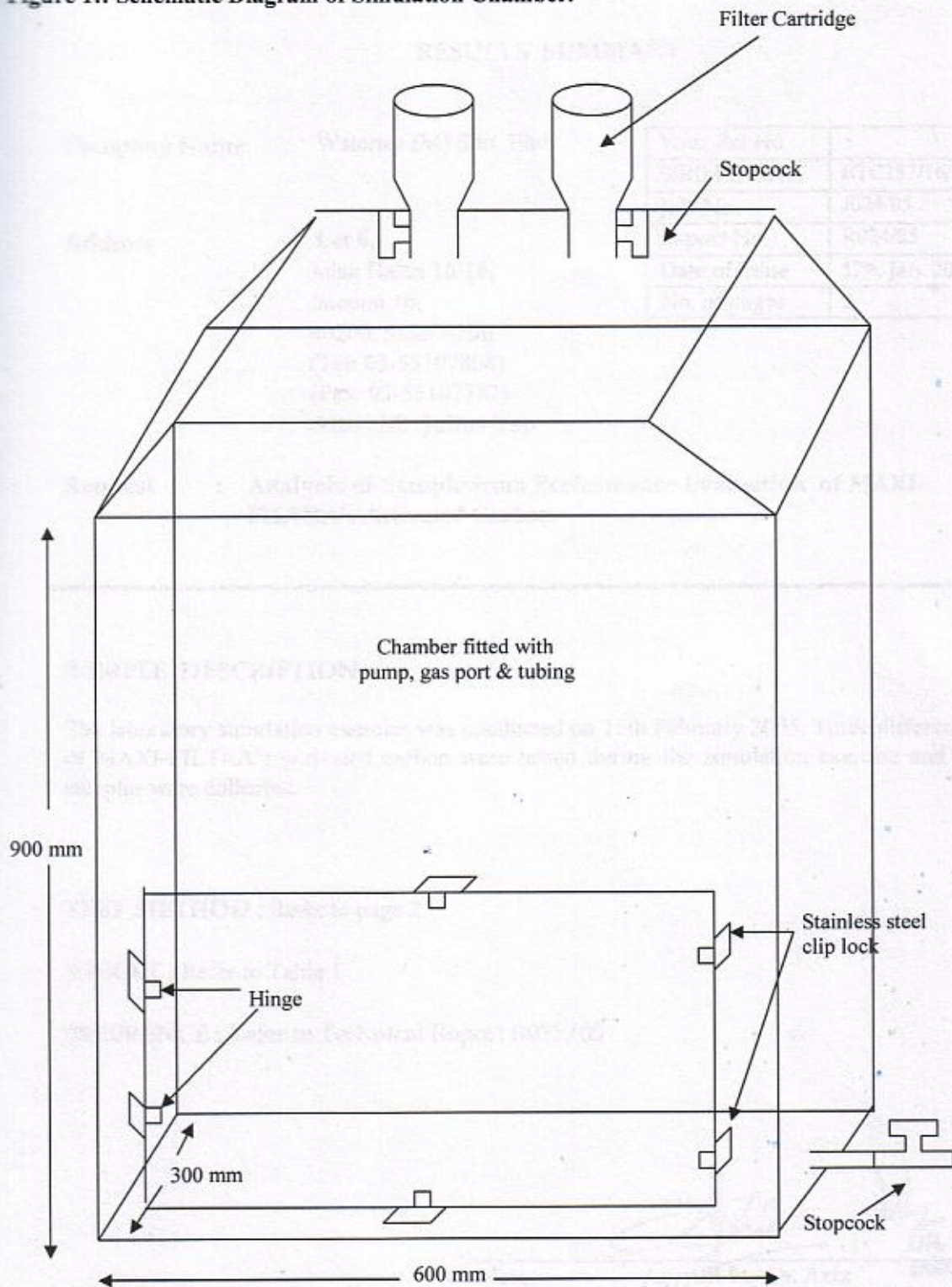
From Table 1 & 2 of Result Summary R024/05, it is noted that the activated carbon filter did not absorb methane, propane or butane. Although the sampling of vent air showed methane to be a major component of the emission, LPG (comprising propane and butane) was used instead because of the cost factor. It is assumed that methane (C1), propane (C3) and butane (C4) are hydrocarbons with similar properties.

4 Conclusion

Based on the laboratory findings described above, it is evident that the air filter product, "MAXI-FILTRA" can effectively filter malodorous gases such as hydrogen sulphide and ammonia but not volatile hydrocarbons. The study could not establish clear correlation between the amount of activated carbon and removal efficiency of the malodorous gases.



Figure 1:: Schematic Diagram of Simulation Chamber.



Specifications;
 Overall size: Approx. 600 x 300 x 900mm high
 Thickness: 5mm/ 10mm



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Appendix A

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RESULTS SUMMARY

Company Name : Watertec (M) Sdn. Bhd.

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Your Ref No.	
SIRIM Ref.No.	ETC237/16/444
Job No.	J024/05
Report No.	R024/05
Date of Issue	17 th . Jan. 2005
No. of pages	2

Request : Analysis of Sample from Performance Evaluation of MAXI-FILTRA's Activated Carbon.

SAMPLE DESCRIPTION

The laboratory simulation exercise was conducted on 15th February 2005. Three different weight of MAXI-FILTRA's activated carbon were tested during the simulation exercise and 6 set of samples were collected.

TEST METHOD : Refer to page 2

RESULT : Refer to Table 1

INFERENCE : Refer to Technical Report R031/05

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DR. S.S. CHEN
(AMIC, CCTem)

The results contained in this report relate only to samples/ items received and analysed by SIRIM Environmental and Bioprocess Technology Centre. This report shall not be reproduced except in full without the written approval of SIRIM Berhad.

QUALITY
SYSTEMS

SIRIM
MS ISO 9002
Reg. No. AR 2176



ISO/IEC 17025
TESTING
SAMM NO. 195

TEST METHOD

- *Simulation for performance evaluation on MAXI-FILTRA was conducted using three different weights of activated carbon (40g, 25g and 15g). Hydrogen sulphide, ammonium chloride and LPG gas (consisting of propane and butane) were introduced into the chamber for 20 minutes and gaseous emission trapped using :
 - Impingers filled with boric acid and sodium hydroxide.
 - Tedlar bag.

Volume of gas that flowed through the sampling apparatus was measured with a SANAGAWA wet gas meter. Air flow was created by an air pump.

- The impinger solutions were analysed for :
 - Sulphide according to APHA 4500 S²- D (1998) Methylene Blue Method.
 - Ammoniacal Nitrogen analysis according to APHA 4500NH₃ B & C.
- *Methane in the gas sample was determined using GC-TCD (model GC 320 GL Science), with the following conditions :
 - Column : Molecular sieve L3X, Length 7m.
 - Oven temperature : 50°C
 - Mobile phase : Helium gas at 60 psi flow rate.

Quantitation was performed using single point calibration of Mix Gas (1.05% Ethane, 1.06% Propane, 1% Butane and 92.7% Nitrogen) and Methane (99.9%).

Note : *not an accredited method.

RESULT

Table 1: Analysis of Impinger Absorbent Solutions and Gas in Tedlar Bags

Parameter	Result					
	A		B		C	
	With Filter	Without Filter	With Filter	Without Filter	With Filter	Without Filter
Sulphide (mg/L)	0.1	5.3	0.02	23	7.7	23
Ammoniacal Nitrogen (mg/L)	0.02	0.07	0.02	0.04	0	0.05
LPG gases (%)	Propane	28	29	28	28	28
	Butane	72	71	72	72	72

Note : A : MAXI-FILTRA with 40g activated carbon

B : MAXI-FILTRA with 25g activated carbon

C: MAXI-FILTRA with 15g activated carbon

Table 2: Methane analysis result

Exposure Time	Peak Area	Methane Concentration
At '0' minute contact time	775083	99.9
At '10' minute contact time	791650	102

Note: The purity of the methane gas is 99.9%. The peak area was compared between the two samples and considered no significant difference.

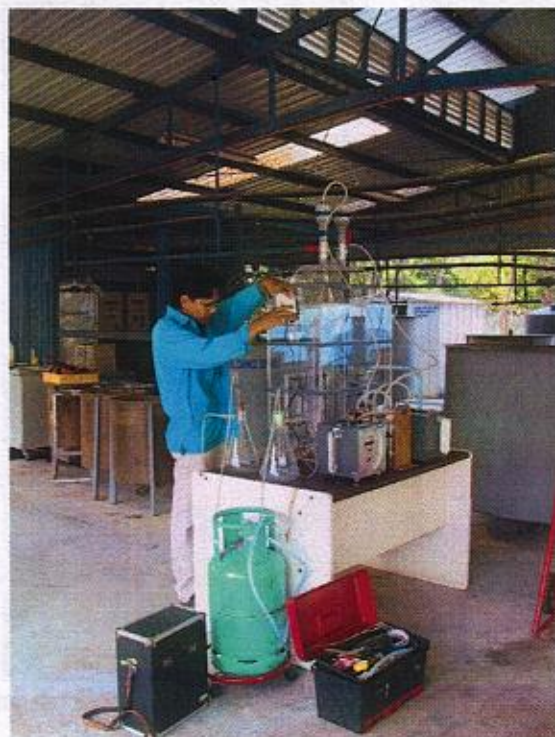
The results contained in this report relate only to the samples/items received and analysed by SIRIM Environmental and Bioprocess Technology Centre. This report shall not be reproduced except in full without the written approval of SIRIM Berhad.

APPENDIX B: Photo plates of Activities During Simulation Experiment.

Picture 1-3 : Setting up various components of the Simulation Experiment.



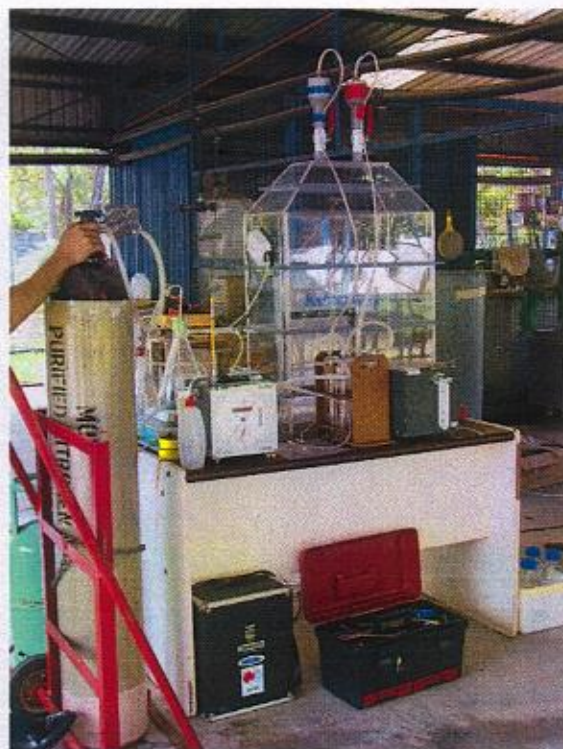
Picture 1



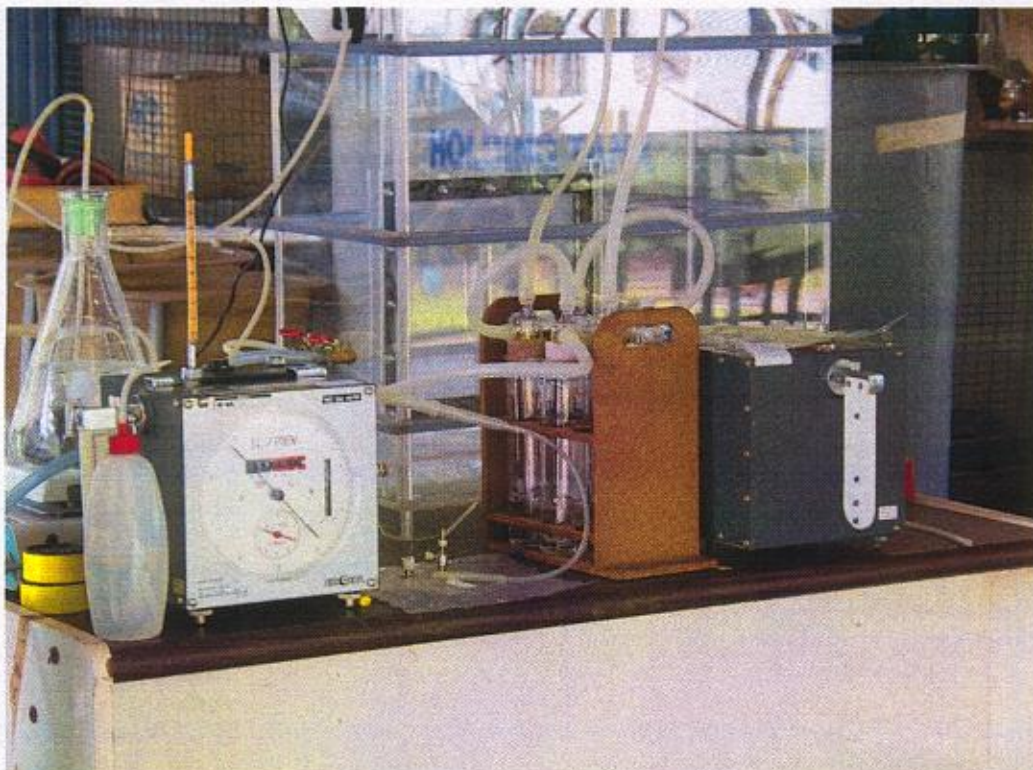
Picture 2



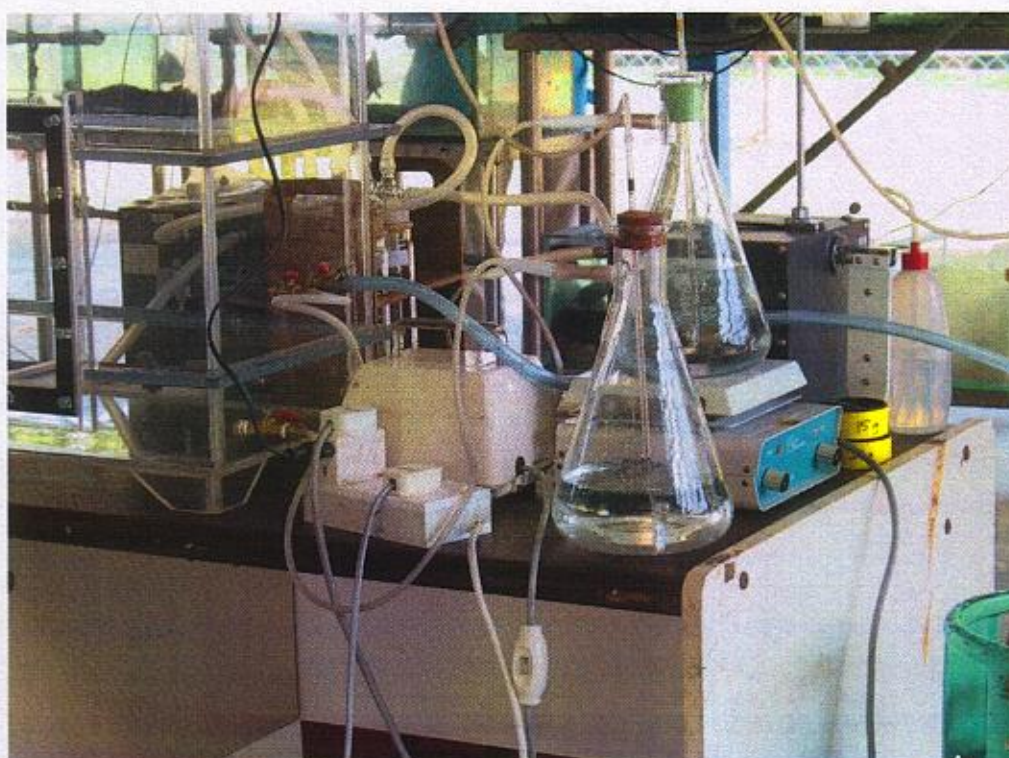
Picture 3



Picture 4 : Completed set-up of Simulation Experiment



Picture 5: Sampling train.



Picture 6: Hydrogen sulphide and ammoniacal-nitrogen sources.