

VALIDATION TESTS: SORBITE HUMIDITY ADSORPTION PANELS

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SECTION

1 INTRODUCTION

Vizon SciTec Inc. (Vizon SciTec) was contracted by Mr. Stuart Ducote, Chief Financial Officer, at Humitech, to conduct a series of tests to evaluate claims that their product “Sorbite” removes acetic acid and ethylene gas from the air when installed in refrigeration units. In addition, tests to determine the amount of airborne dust generated during the installation of new Sorbite panels were also requested.

The work for this project was conducted in January 2006 at Vizon SciTec’s facility in Vancouver, British Columbia. The tests protocols were developed by Dr. Robert Lockhart, Ph.D, CIH, ROH, Director, Environment, Health and Safety Division. The tests were conducted by Ms. Valerie Comeau, Environmental Technologist and by Mr. James Lees, OHST, CSO, Occupational Hygiene and Safety Technologist. This report was prepared by Robert Lockhart.

1.1 Objectives

Vizon SciTec’s objectives for this project were as follows:

- 1) to validate claims that the product “Sorbite” manufactured by Humitech absorbs acetic acid vapours from the air;
- 2) to validate claims that the product “Sorbite” manufactured by Humitech absorbs ethylene gas from the air; and
- 3) to determine the amount of dust that is generated during the installation of Sorbite panels in refrigerator units.

1.2 Background Information

Sorbite Panels:

Sorbite panels contain an absorbent composed of naturally occurring silicate that has been mined, processed, and packaged for use as a humidity control agent in the food and floral industries. Sorbite panels used in commercial operations are comprised of a cloth bag containing approximately 1.8 kg (4.0 lbs) of absorbent material. The cloth bag is contained in a plastic holder (approximately 40 cm x 30 cm x 2.2 cm) designed to allow free airflow through the bag of absorbent. The product is normally installed at ceiling level in the refrigeration unit. The manufacturer states that normally one panel is used for every 200 ft³ to 250 ft³ of refrigeration space.

Acetic Acid:

Acetic acid (vinegar) is used in dilute form for cleaning in refrigeration units used for storage of vegetable foods and flowers. There is some chance that odour of the cleaning agent can be absorbed by the food and flower products.

Ethylene Gas:

Ethylene is a colourless gas with a faint sweetish smell. It is produced naturally by a variety of fruits, vegetables, and flowering plants, and plays a role in regulating their growth and development. Ethylene gas is commonly used to trigger ripening in some crops after they have been picked. When ethylene gas is applied to select fruits and vegetables at a controlled rate, ripening times can be controlled so that the produce is “ready to eat” when it sold to consumers. Similarly, decreasing ethylene gas concentrations (naturally released by produce and from sources such as combustion engine exhaust) can prolong shelf life by slowing the aging process (e.g., ripening time, bloom life).

Dust Generation:

In addition to the above validation tests, Humitech was interested in determining if hazardous levels of dust are generated during the installation of Sorbite panels in refrigeration units. The Sorbite product is comprised primarily of crystalline quartz which has been associated with certain health outcomes following long-term chronic exposures of workers handling this type of product. The Occupational Exposure Standard or Threshold Limit Value (TLV) for quartz dust in air is 0.05 milligrams per cubic metre (mg/m³) when measured as respirable dust (less than 10 micron particle size). As background, it should be noted that the panels are installed and removed by sales/ service agents who represent Humitech, rather than by the owner of the refrigeration unit.

SECTION

2 TEST PROTOCOLS

2.1 Ethylene Gas Absorption

Test Equipment:

Miran 1B:	The Miran 1B (Foxboro, MA) is an infrared spectrophotometer that can be used to monitor airborne concentrations of a variety of chemical compounds. For this test procedure, the Miran 1B was set up to analyze for ethylene gas in accordance with the operation manual for the instrument. The instrument was zeroed before the beginning of each test. The sampling probe for the Miran 1B was placed in the middle of the glove box through the sampling port. To minimize the volume of air extracted from the chamber into the Miran analyser, air was passed into the analyser only during those periods when samples were being collected.
Glove box:	The glove box used for this procedure is 17 ft ³ in size. The glove box is equipped with a sliding, sealable door that leads to a small (1 ft ³) access chamber. The smaller access chamber contained a second, sealable door that lead to the outside environment. The glove box was also equipped with an external sampling port to which the Miran analyser was attached by tubing.
Lab Stand and Clamp	Used to hold the end of Miran 1B sampling probe in position in the middle of the main chamber of the glove box.
Fan:	Used to generate continuous air mixing inside the glove box.
Plastic Tray:	Used to hold the absorbent.
Sorbite Absorbent:	130 g of fresh absorbent was used for each of the three tests conducted. One Sorbite panel is normally used for every 200 ft ³ to 250 ft ³ of refrigerator space. Each panel contains approximately 4 lbs of absorbent (1814 g). The equivalent amount of absorbent for a 17ft ³ area is 123 g to 154 g.

Test Method:

The Miran 1B was zeroed before each test and the air in the glove box was sampled to ensure that there was no residue from previous tests. Once the Miran 1B was properly warmed up and ready to sample, a sealed bag of absorbent (a small portion of approximately 130g) was placed into the glove box. A Tedlar bag filled with ethylene gas and fitted with a sampling septum and a gas syringe were placed inside the test chamber. The entry ports to the glove box were then sealed shut. Inside the glove box, the syringe was used to remove controlled quantities of

ethylene from the Tedlar bag and then discharged in front of the fan to get an even concentration of gas throughout the space. Tests were conducted with ethylene gas concentrations in the 10 – 20 ppm range. Once the target concentration was reached the supply of ethylene gas and the syringe were removed from the glove box by way of the small chamber through the first sealed door. Once ethylene gas concentrations were stabilized, the bag of absorbent was opened and poured into a plastic tray which was located on the bottom, middle of the glove box. Concentration readings were taken every 15 minutes initially, and then less frequently as ethylene gas concentrations declined slowly. The concentration of ethylene gas was monitored for 24 hours, at which time the test was terminated. In addition to flushing air from the glove box between tests, one test was conducted per day to ensure the glove box was sufficiently vented to remove residual gas from the previous test.

2.2 Acetic Acid Absorption

Test Equipment:

Miran 1B:	The Miran 1B (Foxboro, MA) is an infrared spectrophotometer that can be used to monitor airborne concentrations of a variety of chemical compounds. For this test procedure, the Miran 1B was set up to analyze for acetic acid in accordance with the operation manual for the instrument. The instrument was zeroed before the beginning of each test. The sampling probe for the Miran 1B was placed in the middle of the glove box through the sampling port. To minimize the volume of air extracted from the chamber into the Miran analyser, air was passed into the analyser only during those periods when samples were being collected.
Glove box:	The glove box used for this procedure is 17 ft ³ in size. The glove box is equipped with a sliding, sealable door that leads to a small (1 ft ³) access chamber. The smaller access chamber contained a second, sealable door that lead to the outside environment. The glove box was also equipped with an external sampling port to which the Miran analyser was attached by tubing.
Lab Stand and Clamp	Used to hold the end of Miran 1B sampling probe in position in the middle of the main chamber of the glove box.
Fan:	Used to generate continuous air mixing inside the glove box.
Plastic Tray:	Used to hold the absorbent.
Sorbite Absorbent:	130 g of fresh absorbent was used for each of the three tests conducted. One Sorbite panel is normally used for every 200 ft ³ to 250 ft ³ of refrigerator space. Each panel contains approximately 4 lbs of absorbent (1814 g). The equivalent amount of absorbent for a 17ft ³ area is 123 g to 154 g.

Test Method:

The Miran 1B was zeroed before each test and the air in the glove box was sampled to ensure that there was no residue from previous tests. Once the Miran 1B was properly warmed up and

ready to sample, a sealed bag of absorbent (a small portion of approximately 130g) was placed into the glove box as well as a sealed bottle of concentrated acetic acid and a cloth. The glove box was then sealed shut. Inside the glove box, the bottle of acetic acid was opened and a small amount was poured onto the cloth. The cloth was then placed in front of the fan, resulting in the evaporation of the acetic acid into the air inside the glove box. Once the concentration of acetic acid inside the glove box was between 5 to 10 ppm, the bottle of acetic acid and the cloth were removed from the glove box by way of the small chamber outside the first sealed door. The bag of absorbent was then opened and poured into a plastic tray and placed on the bottom of the chamber, in the middle of the glove box. Concentration readings were taken every minute for the first 15 minutes and approximately every five minutes thereafter until the concentration of airborne acetic acid was not longer detectable. In addition to venting the chamber between tests, one test was conducted per day to ensure the glove box was sufficiently vented to remove residual vapour from the previous test.

2.3 Respirable Dust Generation During Installation and Removal of Sorbite Panels

The amount of dust released during the installation / removal of four Sorbite panels was conducted as follows:

Test Room for Dust Measurements:

A climate controlled room equipped with an internal air conditioning unit at Vizon SciTec was selected for conducting the tests. This room had the following physical characteristics:

- Size: 7.8 ft high x 12.3 ft. wide x 13.2 ft long
- Volume: 1270 ft³
- Relative Humidity: Approximately 50%
- Temperature: Approximately 15°C

Dust Monitoring Equipment:

A datalogging TSI Dust Track monitor, equipped with a cyclone adaptor for respirable dust, was positioned 5 feet, 8 inches above the floor level and directly below the brackets into which panels were to be installed. The position of the TSI Dust Track Datalogger was approximately two feet below the location where the Sorbite panels were being installed (at ceiling level). The TSI Dust Track datalogger was set to record dust concentrations every 10 seconds for the duration of the tests.

Respirable dust, rather than total dust, was selected for dust monitoring in these experiments in order to be able to compare the results to the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value for alpha quartz which is 0.05 mg/m³ (respirable).

Test Protocol:

A total of six tests were conducted:

- 1) Three while installing the Sorbite panels with the fan off.
- 2) Three while installing the Sorbite panels with the fan on.

For each test, a total of four Sorbite panels were installed in the room in accordance with the Sorbite Installation Guide provided by Humitech. The background airborne concentration of respirable dust was monitored for 10 minutes prior to each test being conducted, during the installation process (approximately four minutes) and after each test for approximately 10 minutes. The minimum, mean and average concentrations were recorded before, during and after each test. It should be noted that installation of four Sorbite panels took less than one minute when the box of new panels was available on the floor beside the Technician.

Approximately 30 minutes was allowed between tests to ensure that airborne dust in the room had stabilized at background levels.

SECTION

3 RESULTS AND DISCUSSION

3.1 Ethylene Gas Absorption

Figure A-1 in Appendix A visually presents the results of the three tests showing Sorbite absorption of ethylene gas.

The results of all three ethylene gas absorption tests indicate that the absorbent in Sorbite panels absorb ethylene gas, however, the rate of absorption and total amount absorbed was found to be incomplete and to vary substantially between the three tests. Table 3-1 below summarizes the results.

Table 3-1: Summary Test Results for Sorbite Panel Absorption of Ethylene Gas

Trial Number	Time to Achieve X % of Initial Ethylene Gas Concentration		Percentage of Ethylene Gas Absorbed
	75%	50%	
1	~40 min.	~120 min.	79%
2	~175 min.	~775 min.	55%
3	~60 min.	>1200 min.	45%
Average	~92 min.	~698 min.	60%

min. – minutes

% = percentage

3.2 Acetic Acid Absorption

Figure A-2 in Appendix A visually presents the results of the three tests showing Sorbite absorption of acetic acid.

The results of all three acetic acid absorption tests indicate that the absorbent in Sorbite panels absorb acetic acid readily. Table 3-2 summarized the results.

Table 3-2: Summary Test Results for Sorbite Panel Absorption of Acetic Acid Vapour

Trial Number	Time to Achieve X % of Initial Acetic Acid Concentration			Percentage of Ethylene Gas Absorbed
	75%	50%	25%	
1	~ 1.5 min.	~ 6.5 min.	~ 14.5 min.	100%
2	~ 1.5 min.	~ 7 min.	~ 23 min.	100%
3	~ 1.5 min.	~ 6.5 min.	~ 23 min.	96%
Average	~1.5 min.	~6.7 min.	~ 20.2 min.	98.6%

min. – minutes
% = percentage

3.3 Airborne Dust Generation During Installation of Sorbite Test Panels

The results of the airborne dust generation tests conducted during the installation of Sorbite test panels are presented in Tables 3-3 and 3-4 below and in Figures B-1 and B-2 in Appendix B

Table 3-3: Sorbite Panel Installation - Dust Generation Results (Fan Off)

Test	Duration (min)	Activity	Min. (mg/m ³)	Max. (mg/m ³)	Average (mg/m ³)
Test 1	10	Background concentration prior to installation.	0.007	0.015	0.010
	4	Concentration during installation of four panels.	0.012	0.034	0.022
	10	Concentration after installation	0.007	0.024	0.014
Test 2	10	Background concentration prior to installation.	0.004	0.018	0.008
	4	Concentration during installation of four panels.	0.010	0.051	0.018
	10	Concentration after installation	0.005	0.025	0.013
Test 3	10	Background concentration prior to installation.	0.004	0.037	0.009
	4	Concentration during installation of four panels.	0.018	0.094	0.043
	10	Concentration after installation	0.007	0.013	0.010
Average	10	Background concentration prior to installation.	0.004	0.018	0.007
	4	Concentration during installation of four panels.	0.010	0.045	0.021
	10	Concentration after installation	0.005	0.016	0.009

mg/m³ – milligrams of dust per cubic metre of air.
Min. – minimum concentration.
Max. – maximum concentration.
min. - minutes

Table 3-4: Sorbite Panel Installation - Dust Generation Results (Fan On)

Test	Duration (min)	Activity	Min. (mg/m ³)	Max. (mg/m ³)	Average (mg/m ³)
Test 1	10	Background concentration prior to installation.	0.003	0.021	0.006
	4	Concentration during installation of four panels.	0.011	0.073	0.024
	10	Concentration after installation	0.005	0.031	0.012
Test 2	10	Background concentration prior to installation.	0.003	0.017	0.005
	4	Concentration during installation of four panels.	0.005	0.017	0.011
	10	Concentration after installation	0.004	0.015	0.008
Test 3	10	Background concentration prior to installation.	0.004	0.018	0.007
	4	Concentration during installation of four panels.	0.005	0.016	0.009
	10	Concentration after installation	0.007	0.013	0.01
Average	10	Background concentration prior to installation.	0.003	0.019	0.006
	4	Concentration during installation of four panels.	0.007	0.035	0.015
	10	Concentration after installation	0.005	0.020	0.010

mg/m³ – milligrams of dust per cubic metre of air.
 Min. – minimum concentration.
 Max. – maximum concentration.
 min. – minutes

The results of the dust monitoring conducted indicate that very little dust was generated during the installation of the Sorbite panels. On average 0.014 mg/m³ of dust was generated in the test room when the fan was off, and 0.009 mg/m³ of dust was generated when the fan was on. The lower dust levels measured with the fan operating are indicative that dust generated is more rapidly mixed and distributed throughout the room.

The background respirable dust levels in the test room were low relative to ambient dust levels found in many locations where 0.05 mg/m³ dust concentrations are common. Dust levels generated during installations of Sorbite panels peaked slightly for a short duration before returning to background levels. These findings are readily visualized in the example graphs shown in Appendix B.

The American Conference of Governmental Industrial Hygienists (ACGIH) publishes Time Weighted Average Threshold Limit Values (TWA-TLV). A TWA-TLV refers to the airborne concentration of a substance to which it is believed that nearly all workers can be exposed repeatedly during a normal eight-hour workday for 40 hours per week without suffering from adverse health effects. The concentrations measured during the installation of the Sorbite panels were much lower than the ACGIH TWA-TLV for alpha quartz (0.05 mg/m³).

SECTION

4 CONCLUSIONS

The results of the gas absorption tests indicate that Sorbite panels absorb both ethylene gas and acetic acid. The tests results show that airborne acetic acid is absorbed rapidly and completely (approximately 20 minutes for >96% absorption). In contrast, ethylene gas is absorbed at a slower rate. The amount of ethylene gas absorbed was also found to vary. On average a 60% reduction in ethylene gas concentrations was measured after 24 hours.

The amount of airborne dust generated during the installation of Sorbite panels was found to be very low. The average concentrations measured, both with the fan on and off, were well below the ACGIH, TWA-TLV of 0.05 mg/m³ for alpha quartz. Dust concentrations rose slightly during panel installation then returned rapidly towards background levels (less than four minutes).

APPENDIX

A ACETIC ACID AND ETHYLENE GAS ABSORPTION RESULTS

Figure A-1: Sorbite Ethylene Gas Absorption Test Results

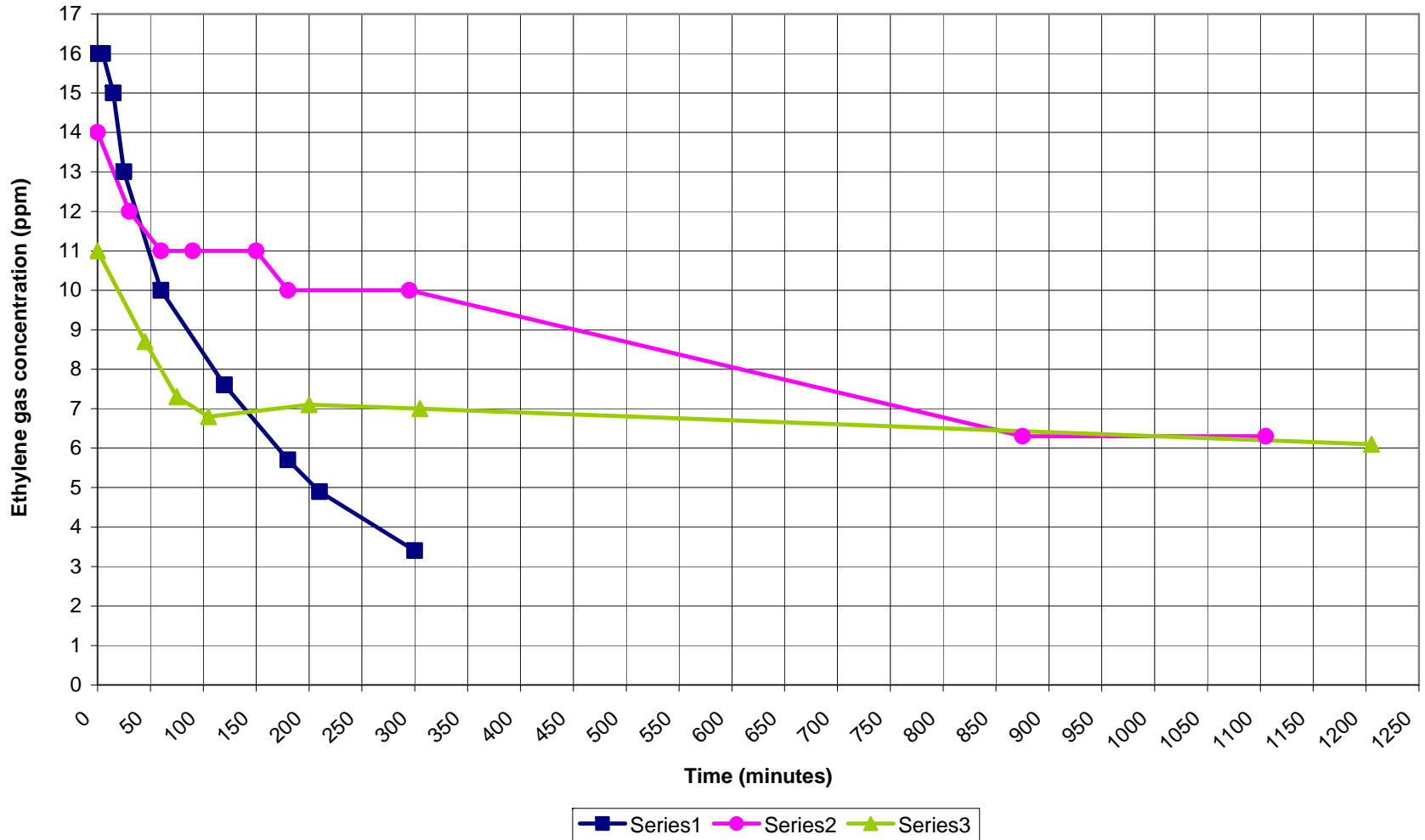
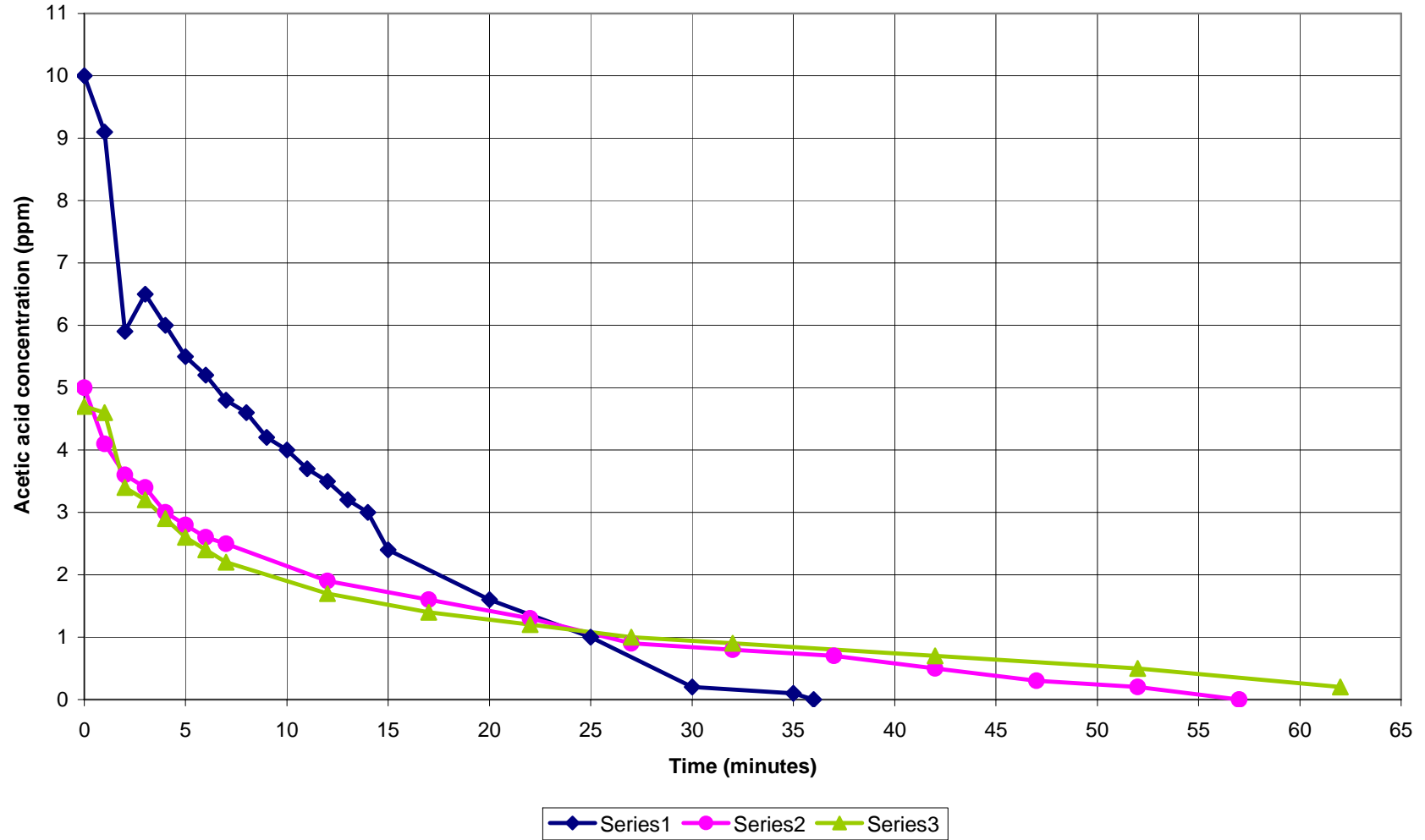


Figure A-2: Sorbite Acetic Acid Absorption Test Results



APPENDIX

B DUST GENERATION RESULTS

Figure B-1: Installation of Sorbite Panels - Peak Dust Concentration with Fans Off

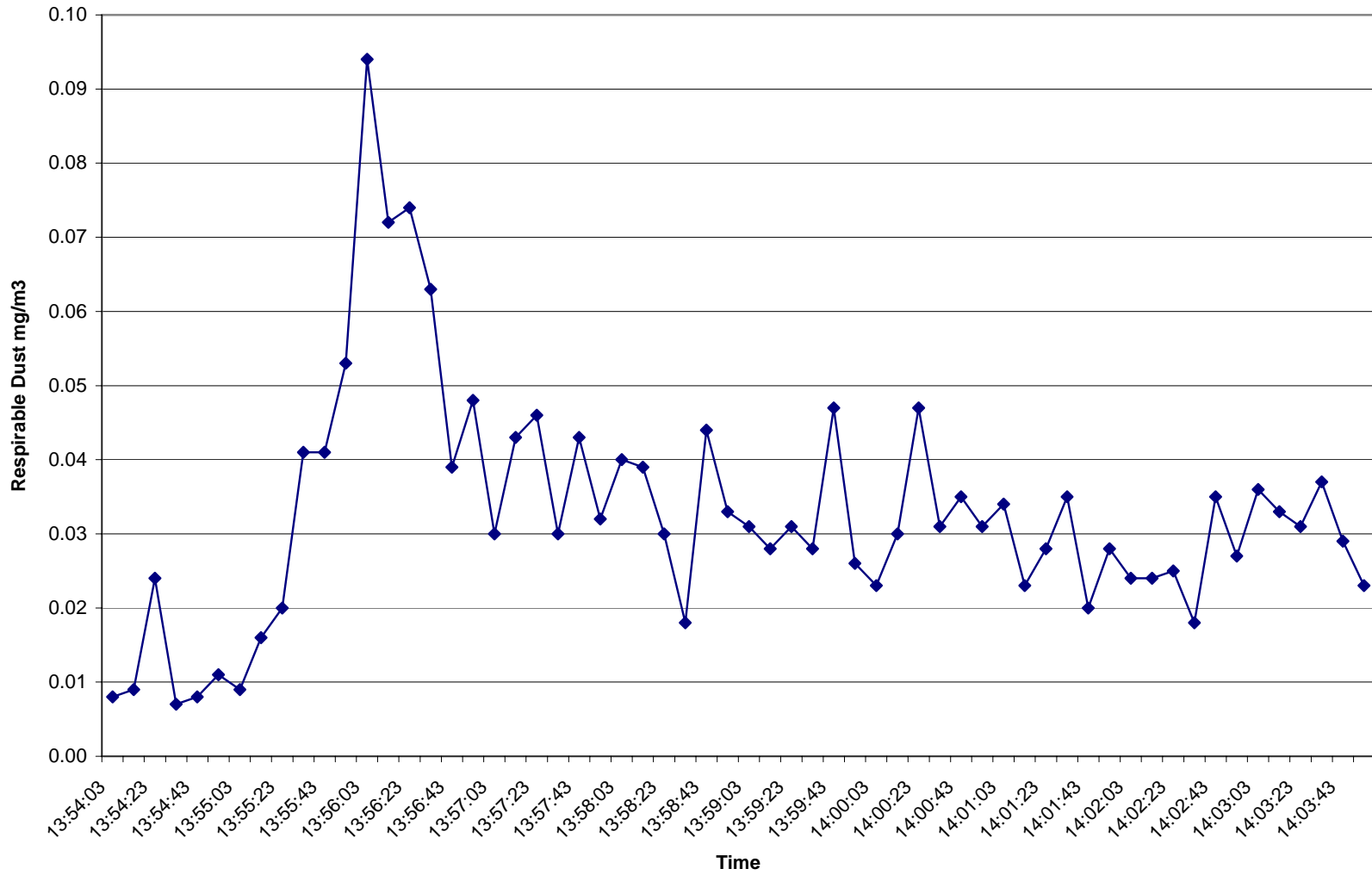


Figure B-2: Installation of Sorbite Panels - Peak Dust Concentration with Fans Running

