AIR QUALITY ASSESSMENT
FOR TAYLOR STANLEY MARKETING PTE LTD
71, TANNERY LANE
#-7-07, CITY INDUSTRIAL BUILDING
SINGAPORE 347807

Date of Survey : 03 August 2005
Reported Date : 26 August 2005
Reference No. : ATS/IH/84/05KKL

_______________________    _________________________
Ko Kheng Leng     Yao Kai Wen
Environmental Engineer    General Manager

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KITZ AIR REVITALISOR
Test Location: Taylor Stanley’s Conference Room measuring approx. 7.5m (length) x 4.26m (width) x 3.57m (height) whilst the room volume is approximately 119 m³
Burning of "Marlboro" cigarettes was to introduce Carbon Dioxide, Carbon Monoxide, Dust and Nicotine.
Grade “D-24” Durian Fruit was introduce Nuisance Odour.
Odour sample was collected by using 40L capacity Nalophan bags with air sampling pump.

Air Sampling for Total Bacterial & Fungal Counts
Air Sampling Equipment
1.0 SUBJECT

Air Quality Assessment for Kitz Air Revitalisor was conducted by ALS Technichem (S) Pte Ltd’s Environmental Engineers on 03 August 2005 for Taylor Stanley Marketing Pte Ltd located at No. 71, Tannery Lane, #07-07, City Industrial Building, Singapore 347807.

2.0 OBJECTIVE

The purpose of this study was to evaluate and assess the efficiency of the product namely Kitz Air Revitalising System filled with Kitz Revitalising Concentrate, Kitz ARS – Lavender.

The working principle of the product, Kitz Air Revitalising System is by means of “scrubbing effect” which allows the botanical extracts in the solution to neutralise odour, bacteria, fungi and other air contaminants.

3.0 METHODOLOGY

3.1 Test Location

The assessment for all the air contaminants throughout the entire course of this study was carried out at Taylor Stanley’s conference room size of approx. 7.5m (length) x 4.26m (width) x 3.57m (height) whilst the room volume is approximately 119 m$^3$. A total of 2 sets of Test were carried out during this assessment, consisting of with and without the Kitz Air Revitalisor.

3.2 Test Methodology

a) Temperature and Relative Humidity

Temperature and Relative Humidity were measured using a portable TSI Q-TRAK IAQ Monitor fitted with the respective RTD and Capacitive sensors for 1-minute interval over the desired sampling duration.

b) Carbon Dioxide (CO$_2$) and Carbon Monoxide (CO)

Carbon Dioxide and Carbon Monoxide were measured using a portable TSI Q-TRAK IAQ Monitor fitted with the respective non-dispersive infra-red sensors for 1-minute interval over the desired sampling duration.

c) Total Volatile Organic Compounds (TVOC)

Total Volatile Organic Compounds was measured using a portable IAQRAE Gas Detector fitted with Photoionization Detector (PID) for 1-minute interval over the desired sampling duration.
d) **Total Bacterial Count (TBC) and Total Fungal Count (TFC)**

A portable microbiological air sampler SAS Super 100 was used to collect indoor air particulates for microbial activity. Plate Count Agar for Total Bacterial Count was used as a sample medium for 2-minutes sampling period and was then incubated for 48 hours at 37°C prior to microbial counts. Rose Bengal Agar was used for Total Fungal Count and was then incubated for 5 days at 25°C prior to fungi counts.

e) **Formaldehyde (HCHO)**

Formaldehyde was measured using a portable Environmental Sensor’s Formaldehyde Meter for 1-minute interval over the desired sampling duration.

f) **Respirable Suspended Particulates (RSP)**

Respirable Suspended Particulates was measured using a portable TSI DUST-TRAK Particle Monitor for 1-minute interval over the desired sampling duration.

g) **Nicotine**

Nicotine was collected with reference to NIOSH 2544 using XAD-2 sorbent tube as a collection medium by drawing air through a calibrated air sampling pump with a flow rate of 1.0 l/min over the desired sampling duration. The sample was then analysed with Gas Chromatography – Mass Spectrometry (GC-MS).

h) **Nuisance Odour**

Odour sample was collected by using air sampling pump with 40L capacity Nalophan bags with. The Odour analysis performs by Dynamic Olfactometer which conforms to European Standard for Olfactometry (EN 13725:2003). Results are expressed in Standard Odour Units per cubic metre, SOU/m³.

i) **Ozone**

Ozone was measured using a portable Environmental Sensor’s Ozone Meter for 1-minute interval during the sampling regime.

j) **Air Movement**

Air movement was measured using a portable TSI VelociCheck Air Velocity meter for 1-minute interval during the sampling regime.

### 4.0 TEST RESULTS

All the respective test results obtained are tabulated below and reflect our findings on 03 August 2005.

Please refer to Pages 3 to 32 of this report.
## Test Results

### 4.1 Background Condition

<table>
<thead>
<tr>
<th>Time (mins)</th>
<th>CO (ppm)</th>
<th>CO2 (ppm)</th>
<th>RH (%)</th>
<th>Temp (°C)</th>
<th>TVOCs (ppm)</th>
<th>RSP (mg/m³)</th>
<th>Ozone (ppm)</th>
<th>Formaldehyde (ppm)</th>
<th>Bacteria (CFU/m³)</th>
<th>Fungi (CFU/m³)</th>
<th>Air Movement (m/s)</th>
<th>Nicotine mg/m³</th>
<th>Nuisance Odour s.o.u./m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>1100-1130</td>
<td>&lt;1</td>
<td>1360</td>
<td>43</td>
<td>23.2</td>
<td>7.10</td>
<td>0.15</td>
<td>&lt;1</td>
<td>0.44</td>
<td>230</td>
<td>105</td>
<td>0.18</td>
<td>ND(&lt;0.1)</td>
<td>362</td>
</tr>
<tr>
<td>Singapore’s IAQ Guidelines</td>
<td>9</td>
<td>1000</td>
<td>≤ 70</td>
<td>22.5-25.5</td>
<td>3</td>
<td>0.15</td>
<td>0.05</td>
<td>0.10</td>
<td>500</td>
<td>500</td>
<td>≤ 0.25</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>ASHARE’s IAQ Guidelines</td>
<td>9</td>
<td>1000</td>
<td>40-60</td>
<td>22-24</td>
<td>4</td>
<td>0.15</td>
<td>0.12</td>
<td>0.10</td>
<td>500</td>
<td>500</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>
### 4.2 Carbon Monoxide (CO) without Kitz Air Revitalisor

<table>
<thead>
<tr>
<th>Cumulative Time (mins)</th>
<th>CO (ppm)</th>
<th>MOM (PELTS) (ppm)</th>
<th>SIAQG (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>9.2</td>
<td>25</td>
<td>9 (8-hr)</td>
</tr>
<tr>
<td>15</td>
<td>19.3</td>
<td></td>
<td>35 (1-hr)</td>
</tr>
<tr>
<td>30</td>
<td>16.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>11.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>6.9</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Remarks:** Carbon Monoxide (CO) was introduced into the indoor environment by burning of Marlboro cigarettes.

![Graph of Carbon Monoxide Concentration Versus Cumulative Time (Without Kitz Air Revitalisor)](image-url)
4.3 Carbon Monoxide (CO) with Kitz Air Revitalisor

<table>
<thead>
<tr>
<th>Cumulative Time (mins)</th>
<th>CO (ppm)</th>
<th>MOM (PELTS) (ppm)</th>
<th>SIAQG (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>29.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>29.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>20.2</td>
<td>25</td>
<td>9 (8-hr)</td>
</tr>
<tr>
<td>45</td>
<td>6.2</td>
<td></td>
<td>35 (1-hr)</td>
</tr>
<tr>
<td>60</td>
<td>4.7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Remarks: Carbon Monoxide (CO) was introduced into the indoor environment by burning of Marlboro cigarettes.
### 4.4 Carbon Dioxide without Kitz Air Revitalisor

<table>
<thead>
<tr>
<th>Cumulative Time (mins)</th>
<th>CO(_2) (ppm)</th>
<th>SIAQG (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1500</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>1570</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>1700</td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>1788</td>
<td>1000</td>
</tr>
<tr>
<td>60</td>
<td>1873</td>
<td></td>
</tr>
</tbody>
</table>

**Remarks:** Carbon Monoxide (CO) was introduced into the indoor environment by burning of Marlboro cigarettes.

**Graph of Carbon Dioxide Concentration Versus Cumulative Time (Without Kitz Air Revitalisor)**

![Graph of Carbon Dioxide Concentration Versus Cumulative Time (Without Kitz Air Revitalisor)](image-url)
4.5 Carbon Dioxide with Kitz Air Revitalisor

<table>
<thead>
<tr>
<th>Cumulative Time (mins)</th>
<th>CO₂ (ppm)</th>
<th>SIAQQ (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1270</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>1287</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>1299</td>
<td>1000</td>
</tr>
<tr>
<td>45</td>
<td>1289</td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>1268</td>
<td></td>
</tr>
</tbody>
</table>

Remarks: Carbon Monoxide (CO) was introduced into the indoor environment by burning of Marlboro cigarettes.
4.6 Temperature and Relative Humidity Level without Kitz Air Revitalisor

<table>
<thead>
<tr>
<th>Cumulative Time (mins)</th>
<th>Temperature (°C)</th>
<th>SIAQG / ASHRAE (°C)</th>
<th>Relative Humidity (%)</th>
<th>SIAQG / ASHRAE (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>21.8</td>
<td>22.5 - 25.5 / 22 - 24</td>
<td>33.2</td>
<td>33.2</td>
</tr>
<tr>
<td>15</td>
<td>21.5</td>
<td>36.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>21.5</td>
<td>36.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>21.3</td>
<td>36.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>21.5</td>
<td>38.7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Graph of Temperature and Relative Humidity Level
Versus Cumulative Time (Without Kitz Air Revitalisor)
4.7 Temperature and Relative Humidity Level with Kitz Air Revitalisor

<table>
<thead>
<tr>
<th>Cumulative Time (mins)</th>
<th>Temperature (°C)</th>
<th>SIAQG / ASHRAE (°C)</th>
<th>SIAQG / ASHRAE (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>20.8</td>
<td>22.5 - 25.5 / 22 - 24</td>
<td>36.7</td>
</tr>
<tr>
<td>15</td>
<td>20.6</td>
<td></td>
<td>38.7</td>
</tr>
<tr>
<td>30</td>
<td>20.9</td>
<td></td>
<td>40.4</td>
</tr>
<tr>
<td>45</td>
<td>21.0</td>
<td></td>
<td>38.9</td>
</tr>
<tr>
<td>60</td>
<td>21.5</td>
<td></td>
<td>42.3</td>
</tr>
</tbody>
</table>

Graph on Temperature & Relative Humidity Level Versus Cumulative Time (With Kitz Air Revitalisor)
4.8 Respirable Suspended Particulates (RSP) without Kitz Air Revitalisor

<table>
<thead>
<tr>
<th>Cumulative Time (mins)</th>
<th>RSP (mg/m³)</th>
<th>MOM (PELTS) (mg/m³)</th>
<th>SIAQG (mg/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>3.49</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>11.87</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>7.87</td>
<td></td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>5.60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>4.98</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Remarks: Respirable Suspended Particulates (RSP) was introduced into the indoor environment with burning of Marlboro cigarettes.

Graph of Respirable Suspended Particulates (RSP) Concentration Versus Cumulative Time (Without Kitz Air Revitalisor)
4.9 Respirable Suspended Particulates (RSP) with Kitz Air Revitalisor

<table>
<thead>
<tr>
<th>Cumulative Time (mins)</th>
<th>RSP (mg/m³)</th>
<th>MOM (PELTS) (mg/m³)</th>
<th>SIAQG (mg/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>2.76</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>11.88</td>
<td>10</td>
<td>0.15 (for reference purpose only)</td>
</tr>
<tr>
<td>30</td>
<td>6.90</td>
<td></td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>1.24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>0.09</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Remarks:** Respirable Suspended Particulates (RSP) was introduced into the indoor environment with burning of Malboro cigarettes.

Graph of Respirable Suspended Particulates (RSP) Concentration Versus Cumulative Time (With Kitz Air Revitalisor)
4.10 Ozone Concentration without Kitz Air Revitalisor

<table>
<thead>
<tr>
<th>Cumulative Time (mins)</th>
<th>RSP (ppm)</th>
<th>MOM (PELTS) (ppm)</th>
<th>SIAQG (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>0.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>0.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>0.01</td>
<td><strong>0.1 (STEL)</strong></td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>0.01</td>
<td>0.01 (for reference purpose only)</td>
<td></td>
</tr>
</tbody>
</table>

Graph of Ozone Concentration Versus Cumulative Time (Without Kitz Air Revitalisor)
### 4.11 Ozone Concentration with Kitz Air Revitalisor

<table>
<thead>
<tr>
<th>Cumulative Time (mins)</th>
<th>Ozone (ppm)</th>
<th>MOM (PELTS) (ppm)</th>
<th>SIAQG (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>0.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>0.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>0.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>0.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.1 (STEL)</td>
<td>0.01 (for reference purpose only)</td>
</tr>
</tbody>
</table>

**Graph of Ozone Concentration Versus Cumulative Time (With Kitz Air Revitalisor)**
4.12 Formaldehyde (HCHO) without Kitz Air Revitalisor

<table>
<thead>
<tr>
<th>Cumulative Time (mins)</th>
<th>HCHO (ppm)</th>
<th>MOM (PELTS) (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>59.7</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>30.7</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>25.8</td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>22.3</td>
<td>0.3 (STEL)</td>
</tr>
<tr>
<td>60</td>
<td>15.3</td>
<td></td>
</tr>
</tbody>
</table>

Remarks: Formaldehyde (HCHO) was introduced into the indoor environment with evaporation of formaldehyde solution.

Graph of Formaldehyde Concentration Versus Cumulative Time (Without Kitz Air Revitalisor)
### 4.13 Formaldehyde (HCHO) With Kitz Air Revitalisor

<table>
<thead>
<tr>
<th>Cumulative Time (mins)</th>
<th>HCHO (ppm)</th>
<th>MOM (PELTS) (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>61.1</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>23.5</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>22.0</td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>7.5</td>
<td>0.3 (STEL)</td>
</tr>
<tr>
<td>60</td>
<td>6.3</td>
<td></td>
</tr>
</tbody>
</table>

Remarks: Formaldehyde (HCHO) was introduced into the indoor environment with evaporation of formaldehyde solution.

*Graph on Formaldehyde Concentration Versus Cumulative Time (With Kitz Air Revitalisor)*
### 4.14 Total Bacterial Count (TBC) and Total Fungal Count (TFC) without Kitz Air Revitalisor

<table>
<thead>
<tr>
<th>Cumulative Time (mins)</th>
<th>TBC (CFU/m³)</th>
<th>TFC (CFU/m³)</th>
<th>SIAQG (CFU/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>305</td>
<td>265</td>
<td>TBC: 500</td>
</tr>
<tr>
<td>15</td>
<td>620</td>
<td>480</td>
<td>TFC: 500</td>
</tr>
<tr>
<td>30</td>
<td>595</td>
<td>480</td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>560</td>
<td>420</td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>550</td>
<td>400</td>
<td></td>
</tr>
</tbody>
</table>

**Remarks:** Both Bacteria and Fungi were introduced into the indoor environment with common airborne bacteria and fungi cultures media.

Graph on Total Bacterial & Fungal Counts Versus Cumulative Time (Without Kitz Air Revitalisor)
### 4.15 Total Bacterial Count (TBC) and Total Fungal Count (TFC) with Kitz Air Revitalisor

<table>
<thead>
<tr>
<th>Cumulative Time (mins)</th>
<th>TBC (CFU/m³)</th>
<th>TFC (CFU/m³)</th>
<th>SIAQG (CFU/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>285</td>
<td>340</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>580</td>
<td>450</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>465</td>
<td>310</td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>360</td>
<td>265</td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>310</td>
<td>140</td>
<td></td>
</tr>
</tbody>
</table>

**Remarks:** Both Bacteria and Fungi were introduced into the indoor environment with common airborne bacteria and fungi cultures media.

Graph on Total Bacterial and Fungal Counts Versus Cumulative Time (With Kitz Air Revitalisor)
### 4.16 Nicotine Concentration without Kitz Air Revitalisor

<table>
<thead>
<tr>
<th>Cumulative Time (mins)</th>
<th>Nicotine (mg/m$^3$)</th>
<th>OSHA / NIOSH / ACGIH (mg/m$^3$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.02</td>
<td>0.5 (for reference purpose only)</td>
</tr>
<tr>
<td>15</td>
<td>0.06</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>0.04</td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>0.04</td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>0.04</td>
<td></td>
</tr>
</tbody>
</table>

**Remarks:** Nicotine was introduced into the indoor environment by burning of Marlboro cigarettes.

---

**Graph on Nicotine Concentration Versus Cumulative Time (Without Kitz Air Revitalisor)**

![Graph showing nicotine concentration over time](image_url)
## 4.17 Nicotine Concentration with Kitz Air Revitalisor

<table>
<thead>
<tr>
<th>Cumulative Time (mins)</th>
<th>Nicotine (mg/m³)</th>
<th>OSHA / NIOSH / ACGIH (mg/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>0.08 (for reference purpose only)</td>
</tr>
<tr>
<td>15</td>
<td>0.04</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>0.01</td>
<td></td>
</tr>
</tbody>
</table>

**Remarks:** Nicotine was introduced into the indoor environment by burning of Marlboro cigarettes.

Graph on Nicotine Concentration Versus Cumulative Time (With Kitz Air Revitalisor)
4.18 Total Volatile Organic Compounds (TVOC) without Kitz Air Revitalisor

<table>
<thead>
<tr>
<th>Cumulative Time (mins)</th>
<th>TVOC (ppm)</th>
<th>MOM (PELTS) (ppm)</th>
<th>SIAQQG (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>6.98</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>7.43</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>7.36</td>
<td></td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>7.16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>7.17</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Remarks: Total Volatile Organic Compounds (TVOC) was introduced into the indoor environment with evaporation of acetone solution.
### 4.19 Total Volatile Organic Compounds (TVOC) with Kitz Air Revitalisor

<table>
<thead>
<tr>
<th>Cumulative Time (mins)</th>
<th>TVOC (ppm)</th>
<th>MOM (PELTS) (ppm)</th>
<th>SIAQG (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>7.80</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>6.67</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>5.57</td>
<td></td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>4.21</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>3.02</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Remarks:** Total Volatile Organic Compounds (TVOC) was introduced into the indoor environment with evaporation of acetone solution.

Graph on Total Volatile Organic Compounds Concentration Versus Cumulative Time (With Kitz Air Revitalisor)
4.20 Nuisance Odour without Kitz Air Revitalisor

<table>
<thead>
<tr>
<th>Cumulative Time (mins)</th>
<th>Nuisance Odour (s.o.u./m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>362</td>
</tr>
<tr>
<td>15</td>
<td>362</td>
</tr>
<tr>
<td>30</td>
<td>475</td>
</tr>
<tr>
<td>45</td>
<td>724</td>
</tr>
<tr>
<td>60</td>
<td>609</td>
</tr>
</tbody>
</table>

Remarks: Nuisance Odour was introduced into the indoor environment with D24 Durian Fruit.

Graph on Nuisance Odour Concentration Versus Cumulative Time (Without Kitz Air Revitalisor)
4.21 Nuisance Odour with Kitz Air Revitalisor

<table>
<thead>
<tr>
<th>Cumulative Time (mins)</th>
<th>Nuisance Odour (s.o.u./m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>274</td>
</tr>
<tr>
<td>15</td>
<td>630</td>
</tr>
<tr>
<td>30</td>
<td>512</td>
</tr>
<tr>
<td>45</td>
<td>351</td>
</tr>
<tr>
<td>60</td>
<td>119</td>
</tr>
</tbody>
</table>

Remarks: Nuisance Odour was introduced into the indoor environment with D24 Durian Fruit.

Graph on Odour Concentration Versus Cumulative Time
(With Kitz Air Revitalisor)
4.22 Air Velocity without Kitz Air Revitalisor

<table>
<thead>
<tr>
<th>Cumulative Time (mins)</th>
<th>Air Velocity (m/s)</th>
<th>SIAQG (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.16</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>0.18</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>0.18</td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>0.20</td>
<td>(\leq 0.25) for reference purpose only</td>
</tr>
<tr>
<td>60</td>
<td>0.21</td>
<td></td>
</tr>
</tbody>
</table>

Graph on Air Movement Versus Cumulative Time (Without Kitz Air Revitalisor)
### 4.23 Air Velocity without Kitz Air Revitalisor

<table>
<thead>
<tr>
<th>Cumulative Time (mins)</th>
<th>Air Velocity (m/s)</th>
<th>SIAQG (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.18</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>0.19</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>0.17</td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>0.18</td>
<td>&lt; 0.25 (for reference purpose only)</td>
</tr>
<tr>
<td>60</td>
<td>0.16</td>
<td></td>
</tr>
</tbody>
</table>

**Graph on Air Movement Versus Cumulative Time (With Kitz Air Revitalisor)**

![Graph showing air velocity over time with Kitz Air Revitalisor]
5.0 CONCLUSION

In general, most of the results obtained showed a significant improvement to the Indoor Air Quality.

It should be noted that this study is based upon limited information gathered during the execution of this project and reflects our findings at the date/time and location monitored.
6.0 ABBREVIATIONS GUIDE

SIAQG    Singapore Indoor Air Quality Guidelines
AIHA     American Industrial Hygiene Association
ASHRAE   American Society of Heating, Refrigeration and Air-Conditioning Engineers
MOM      Ministry of Manpower, Singapore
NPAAQS   National Primary Ambient Air Quality Standards
PELTS    Permissible Exposure Levels of Toxic Substances
IAQ      Indoor Air Quality
CO$_2$   Carbon Dioxide
CFU      Colony Forming Units
mg/m$^3$ milligram per cubic metre
ppm      Parts per million

7.0 REFERENCES


# TABLE 1

## AIR QUALITY STANDARDS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Air Quality Standard</th>
<th>Organisation</th>
<th>Health Hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon monoxide</td>
<td>35 ppm/40,000 µg/m³ as 1 hour average</td>
<td>USEPA</td>
<td>dizziness, loss of memory, fatigue, headaches, loss of muscular control</td>
</tr>
<tr>
<td></td>
<td>9 ppm/10,000 µg/m³ as 8 hour average</td>
<td>NPAAQS</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>SIAQG</td>
<td></td>
</tr>
<tr>
<td>Carbon dioxide</td>
<td>Ventilation rate/air exchange rate to achieve carbon dioxide level below 1,000 ppm / 1800 mg/m³</td>
<td>ASHRAE</td>
<td>headache, sensation of shortage of breath, discomfort effects</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SIAQG</td>
<td></td>
</tr>
<tr>
<td>Total volatile organic compounds</td>
<td>4 ppm/5 mg/m³ for total VOCs</td>
<td>AIHA</td>
<td>acute bronchitis, humidifier fever, allergies, skin irritation</td>
</tr>
<tr>
<td></td>
<td>3 ppm</td>
<td>SIAQG</td>
<td></td>
</tr>
<tr>
<td>Ozone</td>
<td>120 ppb/235 µg/m³ as 1 hour average</td>
<td>USEPA</td>
<td>0.1 ppm eye irritation</td>
</tr>
<tr>
<td></td>
<td>0.05 ppm/100 µg/m³ as 8 hour average</td>
<td>NPAAQS</td>
<td>0.15 ppm increase asthmatic effect, bronchitis, bronchopneumonia, abscesses of lung &amp; lung tumours</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ASHRAE</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>SIAQG</td>
<td></td>
</tr>
<tr>
<td>Respirable Suspended Particulates</td>
<td>150 µg/m³ as 24 hour average</td>
<td>USEPA</td>
<td>eye, nose irritation, cough, sneezing, asthmatic effects</td>
</tr>
<tr>
<td></td>
<td>50 µg/m³ as annual mean</td>
<td>NPAAQS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>150 µg/m³ as 24 hour average</td>
<td>ASHRAE</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>SIAQG</td>
<td></td>
</tr>
<tr>
<td>Formaldehyde</td>
<td>0.4 ppm for indoor exposure</td>
<td>ASHRAE</td>
<td>carcinogenic, miscellaneous hypersensitivity fatigue</td>
</tr>
<tr>
<td></td>
<td>0.1 ppm / 120 µg/m³</td>
<td>SIAQG</td>
<td></td>
</tr>
<tr>
<td>Temperature</td>
<td>22°C - 24°C</td>
<td>ASHRAE</td>
<td>discomfort, difficulty in concentration, fatigue, sleepiness</td>
</tr>
<tr>
<td></td>
<td>22.5°C - 25.5°C</td>
<td>SIAQG</td>
<td></td>
</tr>
<tr>
<td>Relative Humidity</td>
<td>40% - 60 %</td>
<td>ASHRAE</td>
<td>discomfort, stuffy, headache, dry throat, skin discomfort, eye discomfort (contact lens wearer)</td>
</tr>
<tr>
<td></td>
<td>≤ 70%</td>
<td>SIAQG</td>
<td></td>
</tr>
<tr>
<td>Bacteria</td>
<td>500 CFU/m³ as a maximum value</td>
<td>AIHA</td>
<td>infections, Pontiac fever, legionnaire disease</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SIAQG</td>
<td></td>
</tr>
<tr>
<td>Fungus</td>
<td>500 CFU/m³ as a maximum value</td>
<td>AIHA</td>
<td>stimulate the outbreak of asthma</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SIAQG</td>
<td></td>
</tr>
<tr>
<td>Air Movement</td>
<td>≤ 0.25 m/s</td>
<td>SIAQG</td>
<td>physical discomfort, stuffy, headache</td>
</tr>
</tbody>
</table>
Odour Analysis

The quantity or the concentration of an air sample is measured by number of dilutions with odour-free air required to render it barely detectable by an odour observer. Odour concentration is typically expressed in terms of odour units per cubic metre of odour free air (ou/m³). This is the amount of odour necessary to contaminate 1m³ of clean, odour-free air to the threshold level of the observer. Odour measurement involves diluting the odourous air sample with clean deodorized air and presenting the diluted air mixture to a group odour observer, who have been selected and calibrated against a standard reference gas, for determining the odour thresholds.

Methodology

Air Sampling
Odorous air sample was collected using a portable Teflon Air Pump with Nalophan (polyethyleneterephthalate) sampling bag. The air samples shall be analysed within 24 hours upon sampling.

Odour Analysis
Odour concentration was measured using a Dynamic Olfactometer that conforms to the European standard for Olfactometry (EN 13725:2003). Air samples were presented using the “binary forced-choice method” to a panel of odour observers who had been selected based on a known sensitivity to the reference odorant n-butanol. All odour analysis shall be carried out in an odour quality room specially designed for odour assessment. Results of odour concentration were expressed in standard odour units per m³, (sou/ m³).