Test 6, Test 7, and Gas Standard Analysis Results
Data Compiled by NASA Johnson Space Center White Sands Test Facility

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Contributors to this presentation

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- NASA White Sands Test Facility (WSTF), USA
- NASA Marshall Space Flight Center (MSFC), USA
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Agenda

Statistical Analysis Definitions

Odor Analysis Results,
NASA Standard 6001 Test 6

Toxic Offgassing Analysis Results,
NASA Standard 6001 Test 7

Gas Standard Results,
NASA Standard 6001 Test 7

Discussion

Areas of Concern
Statistical Analysis Definitions

Statistics Reported

- Standard Deviation
- % Relative Standard Deviation (%RSD)
- Relative Percent Difference (RPD)

\[
S = \sqrt{\frac{\sum_{i=1}^{N} X_i^2 - \left(\frac{\sum_{i=1}^{N} X_i}{N}\right)^2}{N-1}}
\]

\[
%RSD = \frac{S}{\bar{X}} \times 100\%
\]

\[
RPD = \frac{(X_1 - X_2)}{\bar{X}} \times 100
\]
Odor Analysis Results

Odor Round Robin Participants

• JAXA
• NASA WSTF
Odor Analysis Results

Odor Round Robin Sample for 2004

04-38703, Aluminized Mylar

Sample Selection by NASA WSTF
# Odor Analysis Results

### 04-38703, Aluminized Mylar Odor Rating

<table>
<thead>
<tr>
<th>Center</th>
<th>Average Odor Value</th>
<th>RPD</th>
</tr>
</thead>
<tbody>
<tr>
<td>NASDA (1/10 dilution)</td>
<td>0.2</td>
<td>--</td>
</tr>
<tr>
<td>NASA (1/10 dilution)</td>
<td>0.8</td>
<td>30</td>
</tr>
<tr>
<td>NASDA (no dilution)</td>
<td>0.8</td>
<td>--</td>
</tr>
<tr>
<td>NASA (no dilution)</td>
<td>1.0</td>
<td>18.0</td>
</tr>
</tbody>
</table>

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Toxic Offgassing Analysis Results

Round Robin Participants

- JAXA
- NASA JSC
- NASA MSFC
- NASA WSTF
Toxic Offgassing Analysis Results

JAXA Intra-laboratory Comparison

• 12 out of 49 offgassed compounds were not detected in all five tests of the film
  – 11 of the 12 compounds were < 0.5 µg when detected
  – these 12 compounds are not included in the statistical analysis

• 6 out of 37 consistently detected compounds yielded a %RSD > 50% for the five tests of the film

• 31 out of 37 consistently detected compounds yielded a %RSD < 50% for the five tests of the film
Toxic Offgassing Analysis Results

JAXA Intra-laboratory Comparison
T-Value Calculation Used for JAXA Results

\[ T = \sum_{n=1}^{k} \frac{\mu g_n}{TL_n} \]

Where:

- \( \mu g_n \) = micrograms of compound \( n \)
- \( TL_n \) = Toxic Limit (\( \mu g \)) for compound \( n \)
- \( TL = SMAC \ (mg/m^3) \times 65000 \)

\( SMAC \ (ppm) \) Conversion = 0.4089 = 22.4 L/mole X (298/273)

- T value for 2 out of the 5 tests of the film was 0.001
- T value for 2 other films out of the 5 tests of the film was 0.0008
- T value for 1 out of the 5 tests of the film was 0.0006
Toxic Offgassing Analysis Results
JSC Intra-Laboratory Comparison

- 47 out of 55 reported offgassed compounds were reported as Trace
  - 39 of the 47 Trace reported compounds were consistently reported as Trace
  - 8 of the 47 Trace reported compounds were not reported as Trace in all five tests of the film
  - the 47 compounds reported as Trace were not included in the statistical analysis

- 50 out of 55 reported offgassed compounds were consistently reported as Trace or a µg quantity in all five tests of the film
  - 8 out of 55 consistently reported compounds reported µg quantities
  - the 8 compounds with reported µg quantities yielded a % RSD < 50 for the five tests of the film
Toxic Offgassing Analysis Results
JSC Intra-Laboratory Comparison

T-Value calculation and values provided by JSC

\[ T = \sum_{n=1}^{k} \frac{\mu g_n \times 0.001}{100 \times SMAC_n \times MW_n \times 0.4089} \]

Where:
- \( \mu g_n \) = micrograms of compound \( n \)
- \( SMAC_n \) = Toxic Limit (mg/m\(^3\)) for compound \( n \)
- \( MW_n \) = Molecular Weight for Compound \( n \)
- 100 = Volume of Space Hum Module
- 0.001 = 1mg/1000 \( \mu g \)
- SMAC (ppm) Conversion = 0.4089 = 22.4 L/mole X (298/273)

- T value for 4 out of the 5 tests of the film was 0.0004
- T value for the other test of the film was 0.0005
Toxic Offgassing Analysis Results
MSFC Intra-laboratory Comparison

• 15 out of 29 reported offgassed compounds were reported as Trace
  – 8 of the 15 Trace reported compounds were consistently reported as Trace
  – 7 of the 47 Trace reported compounds were not reported as Trace in all five tests of the film
  – the 29 compounds reported as Trace were not included in the statistical analysis

• 22 out of 29 reported offgassed compounds were consistently reported as Trace or as µg quantity in all five tests of the film
  – 14 out of 22 consistently reported compounds reported µg quantities
  – 13 out of the 14 consistently reported compounds with reported µg quantities yielded a % RSD < 50 % for the five tests of the film
  – 1 out of the 14 consistently reported compounds with reported µg quantities yielded a % RSD > 50 % for the five tests of the film
Toxic Offgassing Analysis Results

MSFC Intra-laboratory Comparison

T-Values calculation used for MSFC results

Where:

\[ T = \sum_{n=1}^{k} \frac{\mu g_n}{T L_n} \]

- \( \mu g_n \) = micrograms of compound \( n \)
- \( T L_n \) = Toxic Limit (ug) for compound \( n \)
- \( T L = SMAC \ (mg/m^3) \times 65000 \)
  - SMAC (ppm) Conversion = 0.4089 = 22.4 L/mole \( \times \) (298/273)

- T value for 4 out of the 5 tests of the film was 0.05
- T value for the other test of the film was 0.04

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Toxic Offgassing Analysis Results
MSFC Intra-laboratory Comparison

T-Values calculation used for MSFC results substituting the high concentration unidentified component with 2,2-dimethoxypropane

\[
T = \sum_{n=1}^{k} \frac{\mu g_n}{T L_n}
\]

Where:
- \(\mu g_n\) = micrograms of compound \(n\)
- \(T L_n\) = Toxic Limit (ug) for compound \(n\)
- \(T L = SMAC (mg/m^3) \times 65000\)
- SMAC (ppm) Conversion = 0.4089 = 22.4 L/mole X (298/273)

- T value for 3 out of the 5 tests of the film was 0.0008
- T value for 1 of the other tests of the film was 0.001
- T value for 1 of the other tests of the film was 0.0007
Toxic Offgassing Analysis Results
WSTF Intra-laboratory Comparison

- 29 out of 39 reported offgassed compounds were consistently reported with a μg quantity in all five tests of the film
  - 6 out of the 29 consistently reported compounds with reported μg quantities yielded a % RSD > 50 % for the five tests of the film
  - 23 out of the 29 consistently reported compounds with reported μg quantities yielded a % RSD < 50 % for the five tests of the film
Toxic Offgassing Analysis Results

WSTF Intra-laboratory Comparison

T-Values calculation used for WSTF results

\[ T = \sum_{n=1}^{k} \frac{\mu g_n}{T L_n} \]

Where:

- \( \mu g_n \) = micrograms of compound \( n \)
- \( T L_n \) = Toxic Limit (ug) for compound \( n \)

\[ TL = SMAC (mg/m^3) \times 65000 \]

65000 = 65 m\(^3\) Shuttle X 1000 (\( \mu g/1mg \))

- T value for 4 out of the 5 tests of the film was 0.002
- T value for the other test of the film was 0.003

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