# Tab A

## **DRAFT\***

## Statistical Analysis of the Chemical Screening of a Small Sample of Unused Chinese and non-Chinese Drywall

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\*Due to the interrelated nature of these investigations, these technical reports are being released in draft until the final results from further studies are available for interpretation. These studies are staff level documents and have not yet been reviewed or approved by the agencies participating in this investigatory effort.

## **Executive Summary**

This document provides a statistical analysis of the chemical screening conducted to ascertain if differences exist between chemicals found in samples of Chinese and non-Chinese drywall. The chemical analyses of seven Chinese drywall samples and ten non-Chinese samples were conducted by the U.S. Environmental Protection Agency (EPA). The results were provided to the U.S. Consumer Product Safety Commission (CPSC) staff by EPA. All samples were unpainted and uninstalled.

Among the statistical comparisons explored in this document, the average concentration of strontium in gypsum was statistically significantly higher in Chinese drywall samples than in non-Chinese drywall samples. There were significantly more Chinese drywall samples with detectable levels of elemental sulfur than non-Chinese drywall. For the remaining chemicals analyzed in Chinese and non-Chinese drywall samples, the average concentrations of calcium, iron, water soluble fluoride, and water soluble chloride were not significantly different between Chinese and non-Chinese samples. Also for disulfide isomers and disulfide didodecyl, there were no statistically significant differences in the percentages of samples with detectable levels of these chemicals between the two types of drywall. On average, both Chinese and non-Chinese drywall samples were slightly alkaline (i.e., had pH values slightly over 7), but the difference in alkalinity was not statistically significant and several samples of each type of drywall were slightly acidic.

These statistical findings are consistent with previous EPA studies of different drywall samples that showed elevated levels of elemental sulfur and strontium in Chinese drywall.

This statistical analysis is limited by the small number of samples tested. Also, in order to avoid the problem of false discoveries that can occur when many statistical tests are conducted on a small number of samples, the statistical analysis is limited to 13 chemicals and pH. These were identified by CPSC staff as chemicals that might be associated with corrosion or health effects, might be markers for Chinese drywall, or had appeared in previous studies of drywall samples. Statistical methods in this document were selected for the small sample sizes and to control the false discovery rate.

#### Introduction

The purpose of this statistical analysis – which consists of tests of differences, graphical presentation of the chemical results, and assessments of the robustness of the statistical tests to several assumptions – is to determine if there are practically meaningful differences between the amounts and types of chemicals found in Chinese drywall samples and non-Chinese drywall samples. CPSC staff focused on chemicals that have been thought to be related to the adverse health effects or corrosion that consumers have associated with Chinese drywall in homes. A second reason for examining the chemistry

of drywall samples is to find substances that might have different levels in Chinese drywall than non-Chinese drywall. Such differences in chemical concentrations might be markers for Chinese drywall.

The chemical analyses were conducted by Lockheed Martin Inc. under Response Engineering and Analytical Contract (REAC) for the U.S. Environmental Protection Agency (EPA) on seven samples of Chinese drywall and ten samples of non-Chinese drywall. Fifteen samples (five Chinese and ten non-Chinese drywall samples) were collected by CPSC staff between April 7, 2009 and July 11, 2009. The five Chinese drywall samples were imported into the U.S. during 2006. An additional two Chinese drywall samples were collected from warehouses by the EPA in May 2009. The ten non-Chinese samples were manufactured in the U.S., Canada, or Mexico between April and May of 2009. All samples were collected from warehouses, except for two non-Chinese samples; one was obtained from the manufacturer and the second purchased from a retail store. Descriptions of the samples are in Appendix 1. Results from the EPA chemical analyses are in Appendix 2 and Appendix 3.

The statistical analysis described in this document builds on two earlier EPA studies that analyzed the chemical composition of Chinese and non-Chinese drywall samples. In the first study, two samples of Chinese drywall were provided by the Florida Department of Health from homes where they had been installed and four comparison samples of U.S. drywall were purchased from stores in New Jersey.<sup>1</sup> In a second EPA study, chemical analyses were conducted on five Chinese drywall samples, of which three were obtained from homes and two were obtained from warehouses.<sup>2</sup> In summary, the findings of those two studies were:

- All but one of the Chinese drywall samples had detectible levels of elemental sulfur. No U.S. drywall samples had detectible levels of elemental sulfur.
- Chinese drywall samples had higher levels of strontium on average than U.S. drywall.
- No acid soluble sulfides were detected in samples of either type of drywall.
- The average iron and calcium in Chinese and non-Chinese drywall samples were at similar concentrations.

Chemical analytical data reported in the second EPA study for the two Chinese drywall samples that were obtained from warehouses (Appendix 3) are included in the statistical analysis reported in this document. Thus all the drywall samples in this study are from warehouses and have never been painted or installed in buildings. Previous studies include drywall samples obtained from warehouses or removed from homes. The reason for limiting the present study to uninstalled drywall is to restrict the chemical analyses to the drywall itself instead of including substances that may have originated in the home environment or paint applied to the drywall surface.

<sup>&</sup>lt;sup>1</sup> Letter from Raj Singhvi, EPA to Lynn Wilder, ATSDR, May 7, 2009.

<sup>&</sup>lt;sup>2</sup> Memorandum from Raj Singhvi, EPA to Arnold E. Layne, EPA, August 27, 2009. See Appendix 3.

The analysis of the chemical composition of Chinese drywall is limited by the small number of samples and may not have captured all the variability in the different types of Chinese drywall.

This document continues with a description of chemical analytical methods, followed by a statistical analysis of a subset of the chemicals found in the drywall samples. This is then followed by a discussion section. Three appendices follow.

#### Methods

Chemical methods are described first, then statistical methods.

#### **Chemical Methods**

Drywall sample preparation included mechanically separating the top and bottom layers of paper from the gypsum. The paper components of the drywall samples were analyzed for strontium, elemental sulfur, and semivolatile organic compounds.<sup>3</sup> The gypsum components of the drywall samples were analyzed for metals, semivolatile organic compounds, volatile organic compounds, elemental sulfur, total acid soluble sulfides, total organic carbon, sulfate, water soluble chlorides and fluorides, pH, and loss on ignition. Full details of the chemical analyses are found in the appendices and in a report from Lockheed Martin.<sup>4</sup>

The results of the chemical analyses of the composition of the drywall samples including a listing of metals and organic compounds are in Table 1 of Appendices 2 and 3, X-Ray Fluorescence (XRF) X-Ray Diffraction (XRD) results are in Table 2, Tentatively Identified Semivolatile Organic Compounds appear in Table 3, and Tentatively Identified Volatile Organic Compounds are in Table 4. The XRF and XRD analyses show the presence or absence of a substance with reasonable accuracy, but are not as accurate as other chemical analytical methods for obtaining concentration measurements of the chemical tested. The statistical analyses did not include XRF or XRD results.

Results of the chemical analyses in the appendices are reported as the number recorded (typically in units of mg/kg or  $\mu$ g/kg), or with the following notation:

• A number followed by "J" indicating that the reported value is estimated (e.g., 4.43J). There were two reasons for this. Either the value was between the

<sup>&</sup>lt;sup>3</sup> Analytical methods included REAC SOP 1811, 1832, and others. See Appendix 2 and Appendix 3. The chemical analyses of the paper component of the two drywall samples described in the appendices were much more extensive, but were not used in this statistical analysis because there are only two Chinese drywall samples and no comparison non-Chinese drywall samples.

<sup>&</sup>lt;sup>4</sup> Lockheed Martin, Inc. (2009), "Analytical Report: Drywall Investigation." Submitted to R. Singhvi EPA-ERT by V. Kansal. This report is available from CPSC or EPA.

limit of detection (LOD) and the reporting limit (RL), or the value exceeded the reporting limit but the chemical analysis did not pass certain quality control requirements. In either case values with Js following the number are understood to be approximate. In this document, we use these values as reported in computing statistics, which is consistent with standard EPA policy.

• A number prefixed with "<" indicates that the chemical was considered to be not detected and the number following the < is the reporting limit. For example, <25.9 means that the chemical was not detected and the reporting limit was 25.9. In this statistical analysis, values are replaced with half the reporting limit. There are other alternatives, which are considered in a sensitivity analysis found in the discussion section.

Examples of this notation can be found in the tables in Appendix 2 and Appendix 3.

The method used to test for statistical difference (described below), depends on the number of detects and non-detects for that chemical in the drywall samples. When a majority of the samples for a given type of drywall are non-detects, the statistical method tests for the difference of the proportion of detects in Chinese and non-Chinese drywall. For these tests of differences, the values substituted for non-detected measurements are not an issue. When a statistical test of difference about the mean concentrations of a chemical in Chinese and non-Chinese drywall is performed, the value that is substituted does matter, but the influence of the value chosen is limited because there is at most one non-detect sample in each of these analyses.

We present findings from the statistical analysis of 13 chemical substances and pH (acidity-alkalinity) in this document. The reasons for limiting the number of statistical tests of difference are associated with the statistical problems resulting from multiple comparisons. That topic is described in the statistical method section below.

## Statistical Methods

Statistical methods described in this report include the following:

- Graphical and tabular presentation of the chemical results of each sample to help visualize the distribution of the data.
- Non-parametric (bootstrap) statistical methods for the quantitative analysis of means, and exact methods (Fisher exact test) for the qualitative analysis of detects.
- Sensitivity analyses on the assumptions about the reporting limits and on the distribution of the data, and using medians in place of means.
- Limiting the number of statistical tests of differences to a small number of chemicals specified before beginning the statistical testing in order to minimize the effect of multiple comparisons. The statistical analysis also employs corrections for multiple comparisons.

As mentioned above, two types of statistical tests of differences were used. One focused on the difference between the mean level of the chemical in Chinese and non-Chinese drywall, and the second on the difference in the proportion of detects of the chemical in Chinese and non-Chinese drywall. The test of difference of means was chosen when there was no more than one non-detect sample in the chemical results. Otherwise, the test of differences was on the proportion of samples where the chemical was detected.

When the estimated means are statistically tested for differences, the results section begins with a tabular and graphical presentation of the data. In the tables, samples are numbered from 1 to 17, where samples 1-7 are Chinese drywall and 8-17 are non-Chinese drywall. The tables include values with the < and J symbols as described in the previous section. The graphical presentation uses the symbol C (Chinese) for the first seven samples and the symbol N (Non-chinese) for the last 10 samples. When values were below the reporting limits, the graphs show reporting limits with bars under the appropriate symbol (e.g., as  $\underline{C}$ ,  $\underline{N}$ ). Estimates (Js) are shown with bars over the symbol (e.g.,  $\overline{C}$ ,  $\overline{N}$ ).

This is then followed by a table summarizing the statistical analysis. Values denoted as J are included in the statistical at reported values, while measurements below the reporting limit are valued at half the reporting limit. Statistical analysis tables include tests on the differences of means. The estimated means, medians, and standard deviations are also shown in the table. To overcome the small sample sizes (17 total samples) and the typical absence of the normal distribution required by the classical *t-test* for the difference of means, a bootstrap version of the *t-test* is used.<sup>5</sup> The bootstrap tests are two tailed, requiring either substantially higher mean concentrations or substantially lower mean concentrations of the substance in the Chinese drywall as evidence for rejecting the null hypothesis of equal Chinese and non-Chinese drywall means. Graphs and the bootstrap were programmed in *R*, a software environment for statistics, computing, and graphics.<sup>6</sup>

The second type of statistical test of difference focuses on detects and nondetects. The presentation differs for these chemicals, only listing the detected values and the sample numbers where these were found. These data are then analyzed using the Fisher exact test, a test that does not rely on a large sample size. This statistic tests if there is an association between the type of drywall and the frequency of measuring a chemical above the reporting limit.<sup>7</sup> This type of test is used for the sulfide compounds

<sup>&</sup>lt;sup>5</sup> The percentile *t* bootstrap is used. See Efron, Bradley and Tibshirani, Robert J. (1993), *An Introduction to the Bootstrap*. Chapman and Hall, NY, page 170-175. The *t* value is the observed difference between means divided by its standard deviation. The procedure involves repeated resampling of the *t* values from the pooled Chinese and non-Chinese drywall samples in order to generate the distribution of the *t* statistic under the null hypothesis. This is followed by computing the *p*-value as the quantile from the generated bootstrap distribution under the null hypothesis associated with the observed *t* value in the data. The unequal variance version of the *t*-test is used.

<sup>&</sup>lt;sup>6</sup> See <u>http://www.r-project.org/</u>.

<sup>&</sup>lt;sup>7</sup> These calculations were made in SAS version 9.1.3 using Proc Freq. SAS Institute Inc. (2004), SAS/STAT 9.1 Users, Cary, NC, SAS Institute Inc.

and other compounds in Table 3 of the appendices, and for elemental sulfur from Table 1. Even though elemental sulfur was reported quantitatively for the Chinese drywall, all the values for the non-Chinese drywall samples were non-detects.

*P-values* shown in the results section are for the particular test and are not corrected for multiple comparisons. These are *raw p-values* and are smaller than the multiple comparison *p-values*. Multiple comparison *p-values* are shown in a table in the discussion section of the report that follows the results section. These were computed with Proc Multtest in SAS using the stepdown Bonferroni method.<sup>8</sup> Statistical significance should be judged only using the corrected *p-values* in the discussion section.

Before beginning the statistical analysis, the statisticians asked various CPSC technical experts for a list of chemicals that are hypothesized to be associated with health or corrosion effects or might be markers for Chinese drywall. Staff specified four elements (calcium, elemental sulfur, iron, and strontium), two ions (water soluble fluoride, and water soluble chloride), several sulfur or sulfide compounds and pH. When chemical analyses were provided for gypsum and paper, the statistical analysis was conducted separately on each component. Only the results of the statistical analyses for these chemicals and pH are reported in this document.

Elemental sulfur and sulfur compounds were chosen because they were thought to be associated with copper corrosion, possibly from the formation of copper sulfide. Water soluble fluoride and water soluble chloride and pH were also selected due to general relationships with corrosivity that acids, fluorides, and chlorides can have in some cases. Iron, strontium, and calcium were chosen as possible markers for Chinese drywall, and for comparisons with the previous EPA studies.

The reason for conducting the statistical analysis on the specified chemicals despite the large number of chemical analytical results recorded in Tables 1 and 3 of Appendix 2 and 3 is to control the risk of false discoveries in the statistical tests. Conducting a large number of statistical tests, especially with a small number of samples, increases the risk of a statistically significant result that is due to chance alone (i.e., a false discovery). Controlling false discoveries can be done by raising the threshold for what constitutes a discovery (declaring that a difference exists) either by lowering the value of  $\alpha$ , from the classical value of 0.05 denoting statistical significance, or adjusting upward the individual comparison test *p*-values while keeping  $\alpha$  at 0.05.<sup>9</sup> While such procedures do a good job of lowering the risk of a false discovery, they also raise the bar

<sup>&</sup>lt;sup>8</sup> Tests for multiple comparisons used SAS version 9.1.3 with Proc Multtest. SAS Institute Inc. (2004), SAS/STAT 9.1 Users, Cary, NC, SAS Institute Inc. For information on the stepdown Bonferroni method see Hsu, Jason (1996), *Multiple Comparisons*. Chapman and Hall, Boca Raton, FL, pages 18-21.

<sup>&</sup>lt;sup>9</sup> The *p*-value is the smallest value of  $\alpha$  for a computed test statistic in a particular dataset that would lead to rejection of the null hypothesis. The quantity  $\alpha$ , is an arbitrary threshold for statistical significance, that has traditionally been set at 0.05. See Casella, George and Berger, Roger L. (1990), *Statistical Inference*. Wadsworth & Brooks/Cole, Pacific Grove, California, page 364.

for true discoveries, thus increasing the risk of ignoring a true discovery. There is a sizable statistical literature on this problem.<sup>10</sup>

The best way to reduce the risk of a false discovery, while keeping open the chances of finding a true discovery, is to limit the number of statistical tests of differences to those chemicals where differences between Chinese and non-Chinese drywall were thought to contribute to the understanding of the health or corrosion effects or might serve as markers for Chinese drywall. If future findings suggest that other chemicals are of interest, similar analyses can be done then.

#### Results

Results from statistical tests of differences of chemical means begin the section, followed by the statistical tests of differences of the proportion of detects. The analysis of elemental sulfur, which is on the proportion of detects, is in the first section because there is data on the concentration of this substance in the Chinese drywall. *P-values* given in this section are preliminary (denoted as "*raw p-values*" in the discussion section) and do not control for multiple comparisons. Multiple comparison *p-values* and sensitivity analyses are found in the discussion section.

<sup>&</sup>lt;sup>10</sup> For example see Hsu, Jason (1996), *op cit*. Statistical analyses comparing quantities, e.g., begin with a *null* hypothesis of no difference. The next step is defining of a test statistic, which has a known distribution (over repeated testing), when the null hypothesis is true. The null hypothesis is said to be rejected (alternatively, the results are said to be statistically significant) if the computed test statistic is very large or very small; i.e., values that are unlikely to occur if the null hypothesis is true. All of this applies to testing a single null hypothesis. If two independent null hypotheses with  $\alpha$ =0.05 are tested, then there is probability  $1-(1-.05)^2 = 0.0975$  that at least one of the null hypotheses will be rejected by chance alone, when both are true. This is greater than .05, and is not acceptable. With 14 null hypotheses, tested the risk of erroneous rejection of the null hypothesis ( $\alpha$ =0.05). To put this in another way, if the threshold of .05 is used for rejection of the null hypothesis and if 14 statistical analyses are run where the null hypothesis is true in every one, there is about one chance in two that at least one null hypothesis will be rejected by chance alone, i.e., at least one result will be considered statistically significant by chance alone. This is why the *p-values* need to be corrected for multiple comparisons.

Table 1 shows the data for pH. Measurements were made on the gypsum only.

Sample Number	pH
	-
1	6.71
2	6.71
3	7.84
4	7.32
5	8.11
6	8.20
7	8.31
8	8.59
9	7.78
10	7.75
11	7.03
12	6.88
13	7.92
14	8.24
15	7.24
16	8.23
17	6.86

## Table 1 pH Measurements in Drywall

Notes: Samples 1-7 are Chinese Drywall, 8-17 are of U.S., Canadian, or Mexican origin. See Appendix 1 for a description of the samples.

Values for pH are shown graphically in Figure 1.



Figure 1. pH Content of Chinese and Non-Chinese Drywall. C denotes Chinese drywall, N is for non-Chinese drywall. Sample numbers (the marking along the horizontal axis) correspond to the first column of Table 1.

Figure 1 shows that pH in the gypsum samples ranged from 6.7 to 8.6. Sample 8 (non-Chinese drywall) has the highest value, and samples 1 and 2 (both Chinese drywall) have the lowest values. The mean pH in Chinese drywall samples was 7.6, as compared with 7.7 in non-Chinese drywall samples. The difference between means, as shown in Table 2 below, was not statistically significant.<sup>11</sup>

<sup>&</sup>lt;sup>11</sup> The *p*-values in this section are not corrected for multiple comparisons. Correcting for multiple comparisons increases *p*-values, that is, if the uncorrected *p*-value does not indicate statistical significance, the corrected *p*-value will not indicate significance. On the other hand, if the uncorrected *p*-value suggests statistical significance, the corrected *p*-value may or may not indicate statistical significance.

## Table 2Statistical Analysis of pH in Gypsum

Drywall Type	Mean	Median	Standard Deviation
Chinese	7.6	7.8	0.7
Non-Chinese	7.7	7.8	0.6

Notes: As in Table 1, there were 7 samples of Chinese drywall and 10 samples of non-Chinese drywall. Bootstrap *t-test* for difference of means, t=-0.1598, p=0.8698.

## Elemental Sulfur

Table 3 shows the results of the chemical analyses for elemental sulfur in gypsum and paper. Note that all the sulfur measured in non-Chinese drywall samples were non-detects, while in contrast, only one measurement in the Chinese drywall gypsum samples and one in the Chinese drywall paper samples was a non-detect.<sup>12</sup>

<sup>&</sup>lt;sup>12</sup>Note that the reporting limit (RL) in Table 3 is shown to vary for the paper components. According to an e-mail from R. Singhvi, EPA to J. Recht, CPSC on 9/30/09 "... the reporting limit may vary based on the sample weight or the percent solids used to convert the sample result and its corresponding RL to a dry weight basis..."

	Elemental Sulfur in	Elemental Sulfur in
Sample Number	Gypsum (mg/kg)	Paper (mg/kg)
		• · • •
1	36	83
2	<7.56	<40
3	182J	207
4	379	454
5	213	130
6	175	60J
7	15	9.84J
8	<7.78	<40
9	<7.78	<40
10	<7.78	<40
11	<7.78	<40
12	<7.78	<40
13	<7.78	<80
14	<7.78	<80
15	<7.78	<80
16	<7.78	<80
17	<7.78	<80

Table 3Elemental Sulfur Content in Drywall and Paper

Notes: Numbers preceded by < were not detected. The reporting limit for that sample is provided after the "<". Other measurements to be interpreted as follows: sample 7 (paper), the value of 9.84J was between the LOD and RL (40 mg/kg); sample 3 (gypsum) and sample 6 (paper), the values are approximate because certain quality control criteria for the chemical analysis were not met.

The data in Table 3 are also shown in Figure 2. The figure shows four Chinese drywall gypsum samples with concentrations of elemental sulfur over 100 mg/kg and three samples of Chinese drywall in the paper component with concentrations over 100 mg/kg. All of the non-Chinese drywall samples are below the reporting limits, with the graphs displaying the reporting limits with underbars.



Figure 2. Elemental Sulfur Content in Gypsum and Paper. Values below the reporting limit are underlined. Values denoted with J in the table are shown with overbars. See notes for Figure 1.

Table 4 reports the means, medians, and standard deviations for the Chinese and non-Chinese drywall samples from the paper and gypsum components of drywall.

Drywall Type	Drywall	Mean	Median	Standard
	Measurement			Deviation
Chinese	Gypsum	143	175	136
Non-Chinese	Gypsum	4	4	0
Chinese	Paper	138	83	155
Non-Chinese	Paper	30	30	11

Table 4 Statistical Analysis for Elemental Sulfur

Notes: Only one of the Chinese drywall samples was below the reporting limit for paper or gypsum, while all the non-Chinese drywall samples were below the reporting limits. The *p*-values were 0.0006 for both paper and gypsum. The data were analyzed using the Fisher exact test.

Note that all the measurements of elemental sulfur in non-Chinese drywall samples were non-detects. The reporting limits in the paper layer of the drywall varied, providing an artifactual variance (and standard deviation), rather than a statistic based on actual measurements. In this case it seemed better to conduct a statistical test of difference using the Fisher exact test on the percentage of detected samples instead of the t test for difference of means. With six detects in the Chinese drywall samples in either case and none in the non-Chinese drywall samples, the associated *p*-values are 0.0006 for each component and may be statistically significant after correction for multiple comparisons. See the discussion section.

Table 4 suggests that the amount of elemental sulfur in Chinese drywall is more likely to exceed the reporting limit than elemental sulfur in non-Chinese drywall.

## Calcium

Table 5 shows the data for calcium. Measurements were made only in the gypsum part of the drywall.

Sample Number	Calcium in Gypsum (mg/kg)
1	246,000
2	228,000
3	252,000
4	247,000
5	252,000
6	257,000
7	257,000
8	242,000
9	257,000
10	255,000
11	264,000
12	245,000
13	264,000
14	262,000
15	221,000
16	216,000
17	257,000

## Table 5Calcium Measurements in Drywall

Notes: See notes for Table 1.

Figure 3 shows the distribution of calcium measurements in gypsum.



Figure 3. Calcium Content in Gypsum. See notes for Figure 1.

As shown in Figure 3, there are some non-Chinese drywall samples that have more calcium than Chinese drywall samples and some that have less calcium. On average, there is slightly more calcium in Chinese drywall samples, but the statistics in Table 6 indicate that the difference between Chinese drywall samples and non-Chinese drywall samples calcium means are not statistically significant.

Drywall Type	Mean	Median	Standard Deviation
Chinese	248,429	252,000	9,981
Non-Chinese	248,300	256,000	17,372

Table 6 Statistical Analysis for Calcium

Notes: Bootstrap *t-test* for difference of means, t=0.01929, p=0.9855. See notes for Table 2.

Table 7 shows the iron content measured in the gypsum layer of the drywall. There were no non-detects and no estimated values.

Sample Number	Iron in Gypsum (mg/kg)
1	1,860
2	1,650
3	2,310
4	1,990
5	1,620
6	1,350
7	1,820
8	683
9	626
10	3,270
11	808
12	757
13	533
14	344
15	2,700
16	1,020
17	1,520

## Table 7 Iron Measurements in Drywall

Notes: See notes for Table 1.

Figure 4 shows the distribution of the iron content in the gypsum component of the drywall samples.



Figure 4. Iron Content in Gypsum. See notes for Figure 1.

Table 7 and Figure 4 indicate that seven of the ten non-Chinese drywall samples have less iron than Chinese drywall, one sample (sample 17) has about the same amount, and two non-Chinese samples (10 and 15) have more iron than the Chinese drywall samples.

Drywall Type	Mean	Median	Standard Deviation
Chinese	1,800	1,820	305
Non-Chinese	1,226	783	988

## Table 8 Statistical Analysis for Iron

Notes: Bootstrap *t-test* for difference of means, *t*=1.7232, *p*=0.1065.

The relatively large standard deviation of the non-Chinese drywall in Table 8 reflects the large spread of the data. This can be seen in Figure 4, where the quantity of

iron in non-Chinese drywall samples is both above and below that of the Chinese drywall samples. The difference of means is not statistically significant.

## Strontium

Table 9 gives the measurements of strontium found in each drywall sample.

Sample		
Number	Strontium in Gypsum (mg/kg)	Strontium in Paper (mg/kg)
1	1,530	182.0
2	401	24.2
3	3,680	553.0
4	4,110	95.0
5	4,310	153.0
6	2,860	270.0
7	4,220	110.0
8	776	20.1
9	680	20.3
10	633	18.5
11	175	27.9
12	185	17.9
13	140	21.2
14	926	38.5
15	662	49.0
16	2,890	83.4
17	303	31.2

Table 9Strontium Measurements in Drywall

Notes: See notes for Table 1.

Values for strontium are shown graphically in Figure 5.



Figure 5. Strontium Content in Gypsum and Paper. See notes on Figure 1.

The strontium levels in all 17 samples range from 140 to 4310 mg/kg in the gypsum and 17.9 to 553.0 mg/kg in the paper. With the exception of sample 2 at 401 mg/kg and sample 16 at 2,890 mg/kg, all strontium levels in gypsum are higher in Chinese drywall samples than the non-Chinese drywall samples.

The summary statistics (mean, median, and standard deviation) of strontium levels are reported in Table 10 for both gypsum and paper, and Chinese and non-Chinese drywall types. The mean of the strontium level in the gypsum for Chinese drywall samples is higher than the mean of the gypsum strontium level for non-Chinese drywall samples; the same holds for paper measurements. The difference may be statistically significant after correcting for multiple comparisons.

Drywall Type	Drywall	Mean	Median	Standard
	Measurement			Deviation
Chinese	Gypsum	3,016	3,680	1,518
Non-Chinese	Gypsum	737	648	807
Chinese	Paper	198	153	174
Non-Chinese	Paper	33	25	20

# Table 10Statistical Analysis for Strontium

Notes: Bootstrap *t-test* for difference of means for gypsum, t=3.6285, p=0.0036; for paper, t=2.4998, p=0.0134.

#### Water Soluble Fluoride

Table 11 shows the measurements of water soluble fluoride in the gypsum component of the drywall samples. Notice that all values are estimates except for sample 8, which was a non-detect. Data from samples 2 and 4 are not included in the analysis because there were no measurements for water soluble fluoride or water soluble chloride in the drywall samples in Appendix 3.

Sample Number	Water Soluble Fluoride in Gypsum (mg/kg)
1	192.0Ј
2	NA
3	30.1J
4	NA
5	18.4J
6	43.2J
7	12.2J
8	< 1.15J
9	54.2J
10	54.6J
11	52.8J
12	52.4J
13	270.0J
14	103.0J
15	3.3J
16	10.4J
17	48.8J

Table 11Water Soluble Fluoride in Drywall

Note: All measurements except for samples 2, 4, and 8 are estimates; sample 8 is below the reporting limit (i.e., a non-detect). Samples 2 and 4 (shown as NA) are from Appendix 3, where there were no measurements made for fluoride and chloride.

Figure 6 shows the distribution of the water soluble fluoride data.



Figure 7. Water Soluble Fluoride in Gypsum. Overbars are estimates (Js), underbars are nondetects. Data from samples 2 and 4 are not included in the analysis.

Table 12
Statistical Analysis for Water Soluble Fluoride

Drywall Type	Mean	Median	Standard Deviation
Chinese	59.2	30.1	75.2
Non-Chinese	65.0	52.6	78.3

Notes: Bootstrap *t-test* for difference of means t=-0.1395, p=0.8994. Data for samples 2 and 4 are not included in the analysis.

Table 12 shows that on average Chinese drywall samples contained slightly less water soluble fluoride than the non-Chinese drywall samples, but the difference is not statistically significant.

## Water Soluble Chloride

Table 13 shows the measurements of water soluble chloride.

Sample Number	Water Soluble Chloride in Gypsum (mg/kg)
1	110J
2	NA
3	72J
4	NA
5	72J
6	44J
7	27Ј
8	21J
9	13J
10	<10J
11	22J
12	16J
13	32J
14	22J
15	28J
16	92J
17	20Ј

## Table 13 Water Soluble Chloride in Gypsum

Note: All measurements except for samples 2, 4, and 10 are estimates; sample 10 is below the reporting limit. Samples 2 and 4 (shown as NA) are from Appendix 3, where there were no measurements made for fluoride and chloride.

Figure 8 contains the graph of water soluble chloride in gypsum.



Figure 8. Water Soluble Chloride in Gypsum. See notes on Figure 7.

Table 13
Statistical Analysis for Water Soluble Chloride

Source	Mean	Median	Standard Deviation
Chinese	65	72	32
Non-Chinese	27	22	24

Notes: See notes for Table 12. Bootstrap *t-test* for difference of means t=2.3594, p=0.0386.

Table 13 shows that the Chinese drywall samples have on average more than twice the concentration of water soluble chloride than the non-Chinese drywall samples. The difference is on the borderline of being statistically significant (p=0.0386), but may not be significant after correcting for multiple comparisons.

The remainder of the results section contains statistical tests of differences on some semivolatile organic chemical compounds from Table 3 of Appendix 2 and Appendix 3. As mentioned in the methods section of this document, these chemical analyses are labeled as "tentatively identified compounds," and are characterized more by the number of detects and non-detects than the concentrations of the chemicals in the tables.<sup>13</sup> This changes both the way the data are presented and the method used to test for statistical differences. With only a few measurements of the chemical concentration for each chemical, there is little need for any other information than the number of detects and non-detects. The statistical test compares the proportion of detected samples for the two types of drywall using the Fisher exact test. This test involves rejecting the null hypothesis (of an equal number of detects) only when there are significantly more detects among the Chinese drywall. This test was used previously in this document for the statistical analysis of elemental sulfur.

Similar to previous statistical tests of differences, the tests of differences of proportions on these compounds are not corrected for multiple comparisons.

#### Disulfide Isomer

There were two samples of Chinese drywall with values of disulfide isomer above the reporting limit. Both were in the gypsum measurements only, one in sample 3 (427  $\mu$ g/kg) and the other in sample 5 (1268  $\mu$ g/kg). The Fisher exact test comparing two (out of seven) detects in the Chinese drywall with no detects (out of ten) in the non-Chinese drywall had a *p*-value of 0.1544. The results are not statistically significant.

#### Disulfide Compound

There were also two detects in the gypsum layer of the Chinese drywall samples for disulfide compound, in sample 3 at 9,208  $\mu$ g/kg, and sample 5 at 11,900  $\mu$ g/kg. The test statistics had a *p*-value of 0.1544, which is not statistically significant.

### Unknown Sulfide Compound/Unknown

There was only one detect for this compound, in the gypsum layer of sample 1, at 428  $\mu$ g/kg (Chinese drywall). The test had a *p*-value of 0.4118, a value that is not statistically significant.

#### Disulfide didodecyl

For disulfide didodecyl, there was one detect in the drywall paper layer for sample 3 of the Chinese drywall at  $3,750 \,\mu$ g/kg. All ten non-Chinese drywall samples were non-detects. The associated *p*-value is 0.4118, which is not statistically significant.

<sup>&</sup>lt;sup>13</sup> Tentatively identified means that the chemicals were identified based on the interpretation of a mass spectrum for the chemical that eluted at a given time from the gas chromatography-mass spectrometry (GC-MS) device without having the specific chemical available to confirm (as was done in Table 1 of Appendix 2). In some cases, a specific chemical could not be identified and only a class of chemicals was given such as "disulfide isomer."

There was a second measurement for this chemical in the gypsum layer of the drywall samples. This included three detects in gypsum, with sample 2 at 637  $\mu$ g/kg, sample 3 at 1170  $\mu$ g/kg and sample 5 at 966  $\mu$ g/kg. There were no non-detects in the non-Chinese drywall. The statistical results were p = 0.0515, not statistically significant.

### Discussion

The statistical analysis in this document is based on results from seven samples of Chinese drywall and ten samples of non-Chinese drywall used in 14 statistical tests of differences. The critical issue for the analysis was to determine if there were differences in chemicals found in the two types of drywall (Chinese and non-Chinese) that might be associated with corrosion or health effects similar to what has been reported in homes with Chinese drywall. A secondary objective was to examine differences in other chemicals that might ultimately be used as markers for Chinese drywall.

In all cases, the chemicals chosen for the statistical analysis were specified in advance by CPSC staff as chemicals that might be associated with corrosion or health effects, might be markers for Chinese drywall, or had appeared in previous studies of drywall samples. Limiting the number of chemicals that were statistically tested for differences was done to avoid the problem of false discoveries that can occur when a large number of tests are conducted on a small number of samples. Statistical methods in this document were selected for the small sample sizes and to control the false discovery rate.

The analysis considered 13 chemicals and pH, using tests for difference of mean concentrations, or in situations with few results above the reporting limit, differences in the proportions of drywall samples with detectable levels of chemical.

Table 14 summarizes the analysis from the results section and adds *p*-values that are corrected for multiple comparisons. These *p*-values provide the best guidance for determining which results are statistically significant, while at the same time lowering the risk of a false discovery, a risk that often accompanies multiple statistical comparisons.

		p-va	lue
Quantity Tested	Type of	Raw	Corrected for
	Test		Multiplicity
pH (gypsum)	Means	0.8698	1.0000
Elemental Sulfur (paper)	Detects	0.0006	0.0084*
Elemental Sulfur (gypsum)	Detects	0.0006	0.0084*
Calcium (gypsum)	Means	0.9855	1.0000
Iron (gypsum)	Means	0.1065	0.8520
Strontium (gypsum)	Means	0.0036	0.0432*
Strontium (paper)	Means	0.0134	0.1474
Fluoride (gypsum)	Means	0.8994	1.0000
Chloride (gypsum)	Means	0.0386	0.3860
Disulfide isomer (gypsum)	Detects	0.1544	1.0000
Disulfide compound (gypsum)	Detects	0.1544	1.0000
Unknown sulfide (gypsum)	Detects	0.4118	1.0000
Disulfide didodecyl (paper)	Detects	0.4118	1.0000
Disulfide didodecyl (gypsum)	Detects	0.0515	0.4635

Table 14Raw *p-values* and Multiplicity Corrected *p-values* for the Statistical Tests

Notes: Multiplicity corrected *p*-values computed use the stepdown Bonferroni method. Raw *p*-values appeared previously in the results section. An asterisk (\*) indicates a statistically significant difference at  $\alpha = 0.05$ .

From Table 14, it appears that there are statistically significant differences in mean strontium concentrations in the gypsum layer of Chinese drywall samples as compared with non-Chinese drywall samples. Thus strontium may be useful as a marker for Chinese drywall. There was also a significantly higher chance of detecting elemental sulfur in the gypsum and paper layers of Chinese drywall.

Table 14 also indicates that there is no statistical evidence to suggest that sulfides are more likely to be detected or to have higher concentrations in Chinese drywall than in non-Chinese drywall.

A sensitivity analysis of the assumptions used in this in the statistical tests reported in this document was conducted. The analysis of water soluble fluoride and water soluble chloride in gypsum (see Tables 11 and 12), was repeated, using the reporting limited divided by  $\sqrt{2}$ , instead of half the reporting limit. This was done only for water soluble chloride and water soluble fluoride, the only two analytes where the value of the reporting limit could have made a difference. The raw bootstrap *p*-value for the difference of means test for fluoride was 0.8979, and for chloride was 0.0392 at the higher value for reporting limit. Neither value was statistically significant after correcting for multiple comparisons.

A second sensitivity analysis was conducted by transforming the reported data to natural logarithms and testing the difference of transformed means. This type of analysis would be appropriate if the data followed a lognormal distribution, sometimes occurring with measurement data. pH was not transformed because that data is recorded on a log scale. Raw *p-values* were as follows: calcium 0.9446, iron 0.0414, strontium (gypsum) 0.0040, strontium (paper) 0.0012, fluoride 0.4468, and chloride 0.1662. When employing the multiplicity corrections, only the differences of mean levels of strontium in paper and in gypsum between Chinese and non-Chinese drywall samples were statistically significant. This is essentially the same result as in Table 14.

In a final sensitivity analysis, the tests of differences used medians instead of means. Percentile bootstrap tests were used for the difference of medians. Raw *p-values* were as follows: pH 0.8942, calcium 0.5691, iron, 0.0571, strontium (gypsum) 0.0267, strontium (paper) 0.0263, fluoride 0.3442, and chloride 0.0351. After correcting for multiple comparisons, none of the differences of medians, including the strontium results, were statistically significant. This may result from the small sample distribution of medians that tend to clustered around a few values. It might also be because the sample is not large enough to discover differences in medians when they actually exist.

The analysis is limited by the small sample size, and there is a possibility that such a small sample may not have captured the variability in the different types of Chinese and non-Chinese drywall. Moreover, failure to find higher concentrations or to find more detects of a particular chemical in Chinese drywall does not mean that there are no chemicals in Chinese drywall that are associated with health or corrosion effects. These effects might be caused by combinations of chemicals, different forms of the chemicals present in the drywall, or something else not considered in the elemental analysis.

Like other studies with small sample sizes, it might be useful to replicate this study with new drywall samples, in order to provide more assurance that the strontium and sulfur quantities truly characterize the difference between Chinese and non-Chinese drywall.

## Appendix 1

CPSC	Appendix	REAC	Origin	Source
Sample		Sample		
Number		Number		
1	2	1	China	Warehouse in Louisiana
2	3		China	Warehouse in Louisiana
3	2	2	China	Warehouse in Virginia
4	3		China	Warehouse in Virginia
5	2	3	China	Warehouse in Florida
6	2	4	China	Manufacturer
7	2	5	China	Warehouse in Florida
8	2	6	Mexico	Warehouse in Texas
9	2	7	US	Warehouse in Kentucky
10	2	8	US	Warehouse in Kentucky
11	2	9	US	Warehouse in North Carolina
12	2	10	US	Warehouse in Indiana
13	2	11	US	Warehouse in Indiana
14	2	12	US	Warehouse in Texas
15	2	13	US	Warehouse in Maryland
16	2	14	US	Warehouse in California
17	2	15	Canada	Retail store in Nova Scotia

## **Drywall Sample Identification and Source**

All samples except 2 and 4 were collected by CPSC staff between April 7, 2009 and July 11, 2009. Samples 2 and 4 were received by EPA between May 20 and May 27, 2009. The reason for interspersing the CPSC samples and the EPA samples is that sample 1 and sample 2 were known to be manufactured by the same company, but it is not known if they were manufactured at the same time or if the gypsum came from the same mine. Samples 3 and 4 were also manufactured by the same company (which was different from the company that manufactured 1 and 2).

The Chinese drywall samples gathered were manufactured by the three largest firms which exported to the U.S. All Chinese drywall samples were imported into the U.S. during 2006. The date of manufacture of these samples is not known. All domestic drywall samples were manufactured in April and May of 2009.

The chemical analysis of all samples except samples 2 and 4 is shown in Appendix 2. These can be identified with the tables in this report by matching the CPSC sample numbers with the REAC sample numbers in that appendix. The analysis of samples 2 and 4 is in Appendix 3. Sample 2 is denoted as Warehouse LA and Sample 4 is denoted as Warehouse VA in that appendix.

## Appendix 2 and Appendix 3

## Appendix 2

## Memorandum

From: Raj Singhvi, Drywall Investigation Technical Manager, Environmental Response Team, U.S. Environmental Protection Agency

To: Arnold E. Layne, Director, Drywall Investigation Program Manager, Technology Innovation and Field Services Division, Office of Superfund Remediation and Technology Innovation

Subject: Drywall Investigations: Fifteen CPSC Drywall Sample Analysis Summary Results.

Date: September 16, 2009.

This appendix contains data on samples 1, 3, 5-17.

## Appendix 3

## Memorandum

From: Raj Singhvi, Drywall Investigation Technical Manager, Environmental Response Team, U.S. Environmental Protection Agency

To: Arnold E. Layne, Director, Drywall Investigation Program Manager, Technology Innovation and Field Services Division, Office of Superfund Remediation and Technology Innovation

Subject: Additional Five Drywall Sample Analysis Summary Results

Date: August 27, 2009.

This appendix contains the data on samples 2 and 4.

This appendix also contains data on three Chinese drywall samples that were taken from homes. They are not used in the analysis because the chemistry of the drywalls may have been affected by the home environment or the paint that was applied to the drywall surface.

#### UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

UNITED STATES, LON BOY ON

ENVIRONMENTAL RESPONSE TEAM Edison, NJ – Cincinnati, OH – Las Vegas, NV – Research Triangle Park, NC

September 16, 2009

#### MEMORANDUM

SUBJECT: Drywall Investigations: Fifteen CPSC Drywall Sample Analysis Summary Results

FROM: Raj Singhvi, Chemist ' \_\_\_\_\_ Drywall Investigation Technical Manager Environmental Response Team

TO: Arnold E. Layne, Director Drywall Investigation Program Manager Technology Innovation and Field Services Division Office of Superfund Remediation and Technology Innovation

A total of 15 drywall samples were received (complete package July 16, 2009) by the U.S. Environmental Protection Agency Environmental Response Team (EPA/ERT) for various analyses from the Consumer Product Safety Commission (CPSC). The requested analyses were performed by the on-site contractor for USEPA/ERT under the Response Engineering and Analytical Contract (REAC). The Total Organic Compound (TOC) analysis on gypsum core samples was performed by U.S.EPA Region II laboratory at the request of USEPA/ERT. As per a conversation with Joanna Matheson of CPSC, ERT did not perform formaldehyde analysis on the 15 drywall samples due to technical difficulties; instead, EPA requested that this analysis be performed under the CPSC chamber study.

Fifteen drywall samples were prepared for analysis as follows: For all 15 unpainted drywall samples, the top and bottom layers of paper were separated from the solid material (gypsum) and placed into separate glass jars. Although the separation was performed as effectively as possible, a small amount of residual gypsum material remained on the paper portion. The paper portion of the drywall samples was analyzed for strontium, elemental sulfur and semi volatile organic (SVOCs). The gypsum portion of drywall samples was analyzed for metals, SVOCs, elemental sulfur volatile organic compounds (VOCs), total acid soluble sulfides, total organic carbon (TOC), sulfate, water soluble chlorides, water soluble fluorides, pH, and loss on ignition (LOI). In addition to these requested analyses, the gypsum core samples were also qualitatively analyzed for metals (calcium, strontium, and iron) using X-Ray Fluorescence (XRF), and mineralogy by X-Ray Diffraction (XRD).

A summary of the analytical results for the 15 drywall samples (gypsum, and paper) is presented in Table 1. The qualitative XRD and XRF results for the gypsum portion of the drywall samples are presented in Table 2. Tentatively identified compounds detected by a GC/MS library search for the SVOC and VOC fractions are presented, with estimated concentrations, in Tables 3 and 4 for the drywall (gypsum and paper) samples. The EPA/ERT/REAC analytical methods were modified to meet the objectives of these analyses.

If there are any questions, please call me at 732-321-6761.

Attachments

Table 1. Target Compounds Analysis Results
Table 2. XRD & XRF Analysis Results
Table 3. SVOC's Tentatively Identified Compounds Analysis Results (µg/kg)
Table 4. VOC's Tentatively Identified Compounds Analysis Results (µg/kg)

Chain of custody

cc: Barnes Johnson, OSRTI Jeff Heimerman, OSRTI/TIFSD Dave Wright, ERT Harry Compton, ERT

Birls Semiphendes         Image: state s								Table 1 T	arget Compo	ounds Analysi	is Results						
COL II SC (Support)         COL	REAC Sample Number			1		2		3		4		5		6		7	
npt (No. No. 1)npt No. 1npt No.	%LOI at 750C (Gypsum)		2	0	2	5	2	25	2	23	2	23	2	1	21		
Stepic         Oppose         Oppose<	pH (5% w/v) ( Gypsum)		6.	71	7.	84	8.	11	8	.2	8.	.31	8.	59	7.	78	
Import one (sine)         Method         mphog         mphog <th>Sample</th> <th></th> <th>Gypsum</th> <th>Paper</th>	Sample		Gypsum	Paper	Gypsum	Paper	Gypsum	Paper	Gypsum	Paper	Gypsum	Paper	Gypsum	Paper	Gypsum	Paper	
Aberian         FRAC SOP 1011         771.         NA         480.         770.1         NA         4800.         178.0         NA         370.0         NA	Target Analytes (Units)	Method	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	
Aform         REAC SOP 1911         270         NA         -2.27         NA         -2.27         NA         -2.28         NA         -2.28         NA           Gatum         REAC SOP 1911         270         NA         2200         NA         2200         NA         2200         NA         25000         NA         25000N	Aluminum	REAC SOP 1811	771J+	NA	845J+	NA	726J+	NA	+L008	NA	1750J+	NA	318J+	NA	289J+	NA	
Salum         FEAC SOP 1811         220         NA         981         NA         983         NA         974         NA         744         NA         743         NA         743         NA         743         NA         743         NA         7400         NA         72000         NA         72000         NA         72000         NA         72000         NA         7200         NA         72000         NA         72000N	Arsenic	REAC SOP 1811	2.93	NA	<2.29	NA	<2.25	NA	<2.37	NA	<2.29	NA	<2.25	NA	<2.28	NA	
Galcum         REAK SQP 1811         20000         NA         10000         NA	Barium	REAC SOP 1811	229	NA	98.1	NA	80.3	NA	38.8	NA	47.4	NA	7.46	NA	13.3	NA	
Sharman         FEAS 50P 1811         187         NA         120         NA         211         NA         212         NA         4.005         NA         212         NA         4.005         NA         0.051         NA <th< td=""><td>Calcium</td><td>REAC SOP 1811</td><td>246000</td><td>NA</td><td>252000</td><td>NA</td><td>252000</td><td>NA</td><td>257000</td><td>NA</td><td>257000</td><td>NA</td><td>242000</td><td>NA</td><td>257000</td><td>NA</td></th<>	Calcium	REAC SOP 1811	246000	NA	252000	NA	252000	NA	257000	NA	257000	NA	242000	NA	257000	NA	
Calait         REAC SOP 1811         0.44         1.66         NA         0.72         NA         0.81         NA         0.61         NA         0.66         NA           Coport         RFAC SOP 1111         1880         NA         1.06         NA         1.00         NA         1.00         NA         1.00         NA         1.00         NA         1.00         NA         1.00         NA         1.01         NA         0.01         NA         0.01         NA         1.00         NA         1.00         NA         1.00         NA         1.01         NA         0.01         NA         1.00         NA         1.00         NA         1.00         NA         1.00         NA         1.00         NA         1.01         NA         0.01         NA         1.01         NA	Chromium	REAC SOP 1811	1.87	NA	1.73	NA	1.20	NA	2.11	NA	2.12	NA	<0.676	NA	2.78	NA	
Organ         PERAC SOP 1811         44.6         NA         286         NA         2.46         NA         1.20         NA         1.67         NA         1.67         NA         1.60         NA           inan         PERAC SOP 1811         15.04         NA         -1.050         NA         -1.050         NA         4.180         NA         4.04         NA         4.03         NA         4.03         NA         4.03         NA         4.01         NA         4.03         NA         4.01         NA	Cobalt	REAC SOP 1811	0.744	NA	1.06	NA	0.773	NA	0.56	NA	1.07	NA	<0.451	NA	< 0.456	NA	
ron         REAC SQP 1811         1180         NA         230         NA         1200         NA         4128         NA         4128         NA         4138         NA         421         NA         420         NA         420        NA <th< td=""><td>Copper</td><td>REAC SOP 1811</td><td>4.69</td><td>NA</td><td>2.86</td><td>NA</td><td>2.45</td><td>NA</td><td>1.78</td><td>NA</td><td>2.41</td><td>NA</td><td>1.07</td><td>NA</td><td>1.42</td><td>NA</td></th<>	Copper	REAC SOP 1811	4.69	NA	2.86	NA	2.45	NA	1.78	NA	2.41	NA	1.07	NA	1.42	NA	
cod         REAC SOP 181         164         NA         1780         NA         1782         NA         1782         NA         1782         NA         1782         NA         1782         NA         1782         NA         1780         NA         1820         NA         100         NA           Ward         REAC SOP 1811         2.21         NA         178         NA         2010         NA         2017         NA         200         NA         2017         NA         203         NA         2017         NA         203         NA         2017         NA         201         NA	Iron	REAC SOP 1811	1860	NA	2310	NA	1620	NA	1350	NA	1820	NA	683	NA	626	NA	
Magnesim         RFAC SOP 311         5130         NA         1700         NA         1700        1700	Lead	REAC SOP 1811	16.4	NA	1.96	NA	<1.35	NA	<1.42	NA	<1.38	NA	2.11	NA	<1.37	NA	
Manuary         REAC SQP 1811         36.7         NA         101         NA         B0.1         NA         17.06         NA         70.64         NA         70.76         70.76         70.76         70.76	Magnesium	REAC SOP 1811	5330	NA	17800	NA	18200	NA	7830	NA	4840	NA	471	NA	1010	NA	
Marcay         REAC SQP 1812         1.24         NA         0.156         NA         0.1019         NA         -0.044         NA         -0.045         NA         -0.014         NA         -0.044         NA         -0.044         NA         -0.044         NA         -0.015         NA         0.019         NA         -0.014         NA         -0.014         NA         -0.014         NA         -0.014         NA         -0.014         NA         -0.015         NA         0.015         NA         -0.014         NA         -0.013         NA         -0.014         NA	Manganese	REAC SOP 1811	36.7	NA	101	NA	86.1	NA	70.6	NA	78.4	NA	93.5	NA	9.25	NA	
Nécuir         BFAC SOP 1311         1.31         NA         1.31         NA         2.10         NA         2.13         NA         0.23         NA           Selestum         BEAC SOP 1311         -2.22         NA         -2.02         NA         7.40         NA         -2.03         NA         -2.05         NA         -2.03         NA         -2.01         NA         2.01         4.03         1.04         2.01         4.03         NA         2.01         NA         2.01         NA         2.01         NA         3.01         NA         3.01         NA         2.01         NA         2.01         NA         2.01         NA         3.01         NA         2.01         NA         3.01         NA	Mercury	REAC SOP 1832	1.24	NA	0.178	NA	0.156	NA	0.119	NA	< 0.044	NA	< 0.045	NA	0.107	NA	
Phassum         REAC SDP 1811         252         NA         344         NA         280         NA         264         NA         602         NA         340         NA         997         NA           Softurn         REAC SDP 1811         371         NA         -226         NA         236         NA         238         NA         237         NA         231         NA         236         NA         236         NA         230         NA         230         NA         230         NA         230         NA         230         NA         230         NA         340         NA         339         NA           Yamsdum         REAC SDP 1811         433         NA         246         NA         231         NA         240         NA         263         NA         340	Nickel	REAC SOP 1811	1.31	NA	1.83	NA	1.31	NA	1.30	NA	2.19	NA	1.33	NA	0.955	NA	
Slanium         REAC SDP 1811         -22         NA         -2.06         NA         -2.07         NA         -2.218         NA         -2.208         NA         2.218         NA         2.208         NA         2.218         NA         2.208         NA         2.218         NA         2.208         NA         2.218         NA         2.208         NA         2.208         NA         1.201         NA         2.201         NA         4.203         NA         2.201         NA         4.201         NA         2.201         NA         4.201         NA         4.201         NA         4.201         NA         4.201         NA         4.211         NA         4.212         <	Potassium	REAC SOP 1811	252	NA	344	NA	280	NA	264	NA	602	NA	340	NA	98.7	NA	
Sodium         RAC SOP 1811         371         NA         533         NA         517         NA         509         NA         248         NA         217         NA         210         766         201         680         203         420         110         776         201         680         203         201         680         203         201         680         203         201         680         203         201         680         203         201         680         203         201         680         203         201         680         203         201         680         203         201         680         203         201         680         203         201         770         NA         210         NA         210         NA         210         NA         210         NA         211         NA         210         NA         210         NA         210         NA         211         NA         211         NA         210         NA         210         NA         210         NA         210	Selenium	REAC SOP 1811	<2.2	NA	<2.06	NA	<2.02	NA	<2.13	NA	<2.06	NA	<2.03	NA	3.46	NA	
Strontum         RAC SOP 1811         150         180         180         553         410         153         280         270         420         110         76         20.1         600         20.3           Vaeadum         REAC SOP 1811         4.43         NA         2.68         NA         2.65         NA         0.44         3.01         NA         2.00         NA         2.65         NA         0.43         3.01         NA         2.00         NA         1.00         NA         2.01         NA         1.00         NA         2.01         NA         1.00         NA         2.00         NA         1.00         NA         2.01         NA         1.01         NA         7.01         NA         1.01         NA         7.01         NA         2.01         NA         4.02         NA         2.01         NA         2.01         NA         2.01         NA         2.01         NA         2.01         NA         2.01         NA         2.00         NA <td< td=""><td>Sodium</td><td>REAC SOP 1811</td><td>371</td><td>NA</td><td>553</td><td>NA</td><td>517</td><td>NA</td><td>509</td><td>NA</td><td>284</td><td>NA</td><td>257</td><td>NA</td><td>&lt;114</td><td>NA</td></td<>	Sodium	REAC SOP 1811	371	NA	553	NA	517	NA	509	NA	284	NA	257	NA	<114	NA	
Vandum         PEAC SOP 1811         1.70         NA         2.6         NA         2.13         NA         2.14         NA         2.66         NA         0.633         NA         3.19         NA           Tail Stallar (SO) <sup>2</sup> EPA Method 37.4         587.000         NA         594.000         NA         597.000         NA         597.00         NA         597.00         NA         597.00         NA         597.00         NA         597.00         NA         597.00         NA         602.0         NA         597.00         NA         602.0         NA         597.00         NA         597.00         NA         602.0         NA         597.00         NA         602.0         NA         597.00         NA         62.0         NA	Strontium	REAC SOP 1811	1530	182	3680	553	4310	153	2860	270	4220	110	776	20.1	680	20.3	
Zinc         REAC SOP 1811         4.43         NA         2.68         NA         1.712         NA         1.240         NA         2.601         NA         3.600         NA         3.600         NA         3.600         NA         4.8000         NA	Vanadium	REAC SOP 1811	1.70	NA	2.6	NA	2.13	NA	2.19	NA	2.65	NA	0.643	NA	3.19	NA	
Total Suble (SQ) <sup>2</sup> EPA Method 375.4         §8000         NA         50400         NA         64020         NA         482000         NA         58000         NA         68000         NA           Wate Soluble Chorde         REAC Drdt SOP         110         NA         721         NA         1814         NA         440         NA         221         NA         721         NA         440         NA         221         NA         721         NA         723         NA         725         NA         720         NA         725         NA         720         NA         720         NA         720         NA         723         NA         725         NA         720         NA         7400         <	Zinc	REAC SOP 1811	4.43J	NA	2.68J	NA	1.77J	NA	1.24J	NA	2.6J	NA	3.6J	NA	3.99J	NA	
Water Souble-Floride         REAC Draft SOP         110         NA         30.1         NA         112         NA         42.1         NA         12.1         NA         12.1         NA         42.1         NA         42.1         NA         42.1         NA         12.1         NA         12.1         NA         42.1         NA         42.1         NA         12.1         NA         42.1         NA         42.1         NA         42.1         NA         42.1         NA         42.0         N	Total Sulfate (SO <sub>4</sub> ) <sup>-2</sup>	EPA Method 375.4	587000	NA	504000	NA	517000	NA	569000	NA	482000	NA	587000	NA	605000	NA	
Water Soluble Chloride         REAC Drail SOP         110.1         NA         72.0         NA         44.0         NA         27.0         NA         27.0        <	Water Soluble Floride	REAC Draft SOP	192J	NA	30.1J	NA	18.4J	NA	43.2J	NA	12.2J	NA	<1.15J	NA	54.2J	NA	
Total adsubile suffice         SW 96 8030/034         <25.9         NA         <25.9	Water Soluble Chloride	REAC Draft SOP	110J	NA	72J	NA	72J	NA	44J	NA	27J	NA	21J	NA	13J	NA	
Elemental sulfur         Mod. REAC SOP 1805         36         182         1207         213         130         175         60.0         175         9.8.4         -778         -40.0         -778         -40.0         NA           Draid Organic Carbon(TOC)         EPA C-38         400         NA         6000         NA         200         NA         400         NA         440         NA         4412         NA         414         NA         415         NA         416         NA         416         NA         416         NA         416         NA         416         NA         4112         NA         414         NA         4112         NA         416         NA         4115         NA         416         NA         4112         NA         4114         NA         4112         NA         416         NA         4115         NA         4116         NA	Total acid soluble sulfide	SW 846 9030/9034	<25.9	NA	<25.9	NA	<25.9	NA	<25.9	NA	<25.9	NA	<25.9	NA	<25.9	NA	
Total Crance Carbon(TOC)         EPA C-88         4400         NA         4000         NA         2000         NA         2010         NA           Units         NA         <11.5         NA         9.31         NA         <11.2         NA         <11.4         NA         <11.5         NA         <11.6	Elemental sulfur	Mod. REAC SOP 1805	36	83	182J	207	213	130	175	60J	15	9.84J	<7.78	<40.0	<7.78	<40.0	
Units         mayKa         ug/Ka         Ug/Ka <th< td=""><td>Total Organic Carbon(TOC)</td><td>EPA C-88</td><td>4400</td><td>NA</td><td>6400</td><td>NA</td><td>2700</td><td>NA</td><td>3000</td><td>NA</td><td>2900</td><td>NA</td><td>2700</td><td>NA</td><td>2100</td><td>NA</td></th<>	Total Organic Carbon(TOC)	EPA C-88	4400	NA	6400	NA	2700	NA	3000	NA	2900	NA	2700	NA	2100	NA	
Tichtoromethane         REAC SOP 1807         <11.5         NA         9.3         NA         <11.2         NA         <11.4         NA         <11.2         NA         <11.6         NA           Acetone         REAC SOP 1807         <16	Units		ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	
Acetone         REAC SOP 1807         <16         NA         <115         NA         <449         NA         <455         NA         1691         NA         <465         NA           Methylene Chloride         REAC SOP 1807         <115	Trichlorofluoromethane	REAC SOP 1807	<11.5	NA	9.3J	NA	<11.2	NA	<11.4	NA	<11.2	NA	<11.5	NA	<11.6	NA	
Methylene Chloide         REAC SOP 1807         <11.5         NA         <11.2         NA         <11.2         NA         <11.2         NA         <11.2         NA         <11.2         NA         <11.2         NA         <11.5         NA         <11.6         NA           Carbon Disulide         REAC SOP 1807         <11.5	Acetone	REAC SOP 1807	<46	NA	11.5J	NA	<44.9	NA	<45.5	NA	16.9J	NA	<46	NA	<46.5	NA	
Carbon Disulfide         REAC SOP 1807         <11.5         NA         3.64.J         NA         <11.2         NA         <11.4         NA         <11.2         NA         <11.4 <th< td=""><td>Methylene Chloride</td><td>REAC SOP 1807</td><td>&lt;11.5</td><td>NA</td><td>&lt;11.2</td><td>NA</td><td>&lt;11.2</td><td>NA</td><td>&lt;11.4</td><td>NA</td><td>&lt;11.2</td><td>NA</td><td>&lt;11.5</td><td>NA</td><td>&lt;11.6</td><td>NA</td></th<>	Methylene Chloride	REAC SOP 1807	<11.5	NA	<11.2	NA	<11.2	NA	<11.4	NA	<11.2	NA	<11.5	NA	<11.6	NA	
2-Butanone         REAC SOP 1807         <1.15         NA         <1.12         NA         <1.15         NA         <1.15         NA         <1.16         NA           Bromdichioromelhane         REAC SOP 1807         <1.15	Carbon Disulfide	REAC SOP 1807	<11.5	NA	3.64J	NA	<11.2	NA	<11.4	NA	<11.2	NA	<11.5	NA	<11.6	NA	
Tichtoroschene         REAC SOP 1807         <11.5         NA         <11.2         NA         <11.4         NA         <11.2         NA         <11.5         NA         <11.6         NA           Bromodichloromethane         REAC SOP 1807         <11.5	2-Butanone	REAC SOP 1807	<11.5	NA	<11.2	NA	<11.2	NA	<11.4	NA	<11.2	NA	<11.5	NA	<11.6	NA	
Bromodichloromethane         REAC SOP 1807         <11.5         NA         <11.2         NA         <11.4         NA         <11.2         NA         <11.5         NA         <11.6         NA           Toluene         REAC SOP 1807         <11.5	Trichloroethene	REAC SOP 1807	<11.5	NA	<11.2	NA	<11.2	NA	<11.4	NA	<11.2	NA	<11.5	NA	<11.6	NA	
4-Methyl-2-Pentanone         REAC SOP 1807         <46.0         NA         <44.9         NA         <41.2         NA         <41.2         NA         <41.2         NA         <41.4         NA         <41.2         NA         <11.2         NA         <11.4         NA         <11.2	Bromodichloromethane	REAC SOP 1807	<11.5	NA	<11.2	NA	<11.2	NA	<11.4	NA	<11.2	NA	<11.5	NA	<11.6	NA	
Toluene         REAC SOP 1807         <11.5         NA         <11.2         NA         <11.2         NA         <11.4         NA         <11.2         NA         <11.2         NA         <11.2         NA         <11.4         NA         <11.2         NA         <11.6         NA         <11.2         NA         <11.4         NA         <11.2         NA         <11.6         NA         <11.6         NA         <11.6         NA         <11.6         NA	4-Methyl-2-Pentanone	REAC SOP 1807	<46.0	NA	<44.9	NA	<44.9	NA	<45.5	NA	<44.9	NA	<46.0	NA	<46.5	NA	
EHtyberzene         REAC SOP 1807         <115         NA         <112         NA         <114         NA         <112         NA	Toluene	REAC SOP 1807	<11.5	NA	<11.2	NA	<11.2	NA	<11.4	NA	<11.2	NA	<11.5	NA	<11.6	NA	
pkm-Kylene         REAC SOP 1807         <23.0         NA         <22.5         NA         <22.7         NA         <22.5         NA         <23.0         NA         <23.3         NA           o-Xylene         REAC SOP 1807         <11.5	Ethylbenzene	REAC SOP 1807	<11.5	NA	<11.2	NA	<11.2	NA	<11.4	NA	<11.2	NA	<11.5	NA	<11.6	NA	
or.Xylene         REAC SOP 1807         <11.5         NA         <11.2         NA         <11.4         NA         <11.2         NA         <11.6         NA           Styrene         REAC SOP 1807         <11.5	p&m-Xylene	REAC SOP 1807	<23.0	NA	<22.5	NA	<22.5	NA	<22.7	NA	<22.5	NA	<23.0	NA	<23.3	NA	
Styrene         REAC SOP 1807         <11.5         NA         <11.2         NA         <11.4         NA         <11.2         NA         <11.6         NA           Isopropulbenzene         REAC SOP 1807         <46.0	o-Xylene	REAC SOP 1807	<11.5	NA	<11.2	NA	<11.2	NA	<11.4	NA	<11.2	NA	<11.5	NA	<11.6	NA	
Isopropylbenzene         REAC SOP 1807         <46.0         NA         <44.9         NA         <44.5         NA         <44.9         NA         <44.9         NA         <44.9         NA         <41.2         NA         <11.2         NA         <11.4         NA         <11.2	Styrene	REAC SOP 1807	<11.5	NA	<11.2	NA	<11.2	NA	<11.4	NA	<11.2	NA	<11.5	NA	<11.6	NA	
1,2,3-Trichloropropane       REAC SOP 1807       <11.5       NA       <11.2       NA       <11.4       NA       <11.2       NA       <11.4       NA       <11.2       NA       <11.6       NA       <11.6       NA         1,2,4-Trimethylbenzene       REAC SOP 1807       <11.5       NA       <11.2       NA       <11.2       NA       <11.4       NA       <11.2       NA       <11.4       NA       <11.2       NA	Isopropylbenzene	REAC SOP 1807	<46.0	NA	<44.9	NA	<44.9	NA	<45.5	NA	<44.9	NA	<46.0	NA	<46.5	NA	
n-Propylbenzene         REAC SOP 1807         <11.5         NA         <11.2         NA         <11.4         NA         <11.2         NA         <11.6         NA         <11.6         NA           1,2.4-Trimethylbenzene         REAC SOP 1807         <11.5	1,2,3-Trichloropropane	REAC SOP 1807	<11.5	NA	<11.2	NA	<11.2	NA	<11.4	NA	<11.2	NA	<11.5	NA	<11.6	NA	
1,3.5-Trimethylbenzene       REAC SOP 1807       <11.5       NA       <11.2       NA       <11.2       NA       <11.4       NA       <11.2       NA       <11.4       NA       <11.2       NA       <11.6       NA       <11.6       NA         sec-Buylbenzene       REAC SOP 1807       <11.5	n-Propylbenzene	REAC SOP 1807	<11.5	NA	<11.2	NA	<11.2	NA	<11.4	NA	<11.2	NA	<11.5	NA	<11.6	NA	
1,2.4-Trimethylbenzene       REAC SOP 1807       <11.5       NA       <11.2       NA       <11.2       NA       <11.4       NA       <11.2       NA       <11.4       NA       <11.2       NA       <11.2       NA       <11.4       NA       <11.2       NA       <11.4       NA       <11.2       NA       <11.2       NA       <11.4       NA       <11.2       NA       <11.4       NA       <11.2       NA       <11.4       NA       <11.2       NA       <11.4       NA       <11.2       NA       <11.6       NA <t< td=""><td>1,3,5-Trimethylbenzene</td><td>REAC SOP 1807</td><td>&lt;11.5</td><td>NA</td><td>&lt;11.2</td><td>NA</td><td>&lt;11.2</td><td>NA</td><td>&lt;11.4</td><td>NA</td><td>&lt;11.2</td><td>NA</td><td>&lt;11.5</td><td>NA</td><td>&lt;11.6</td><td>NA</td></t<>	1,3,5-Trimethylbenzene	REAC SOP 1807	<11.5	NA	<11.2	NA	<11.2	NA	<11.4	NA	<11.2	NA	<11.5	NA	<11.6	NA	
sec-Butylbenzene         REAC SOP 1807         <11.5         NA         <11.2         NA         <11.2         NA         <11.4         NA         <11.2         NA         <11.2         NA         <11.2         NA         <11.4         NA         <11.2         NA         <11.4         NA         <11.2         NA         <11.4         NA         <11.2         NA         <11.6         NA         <11.6         NA           Diethylphthalte         REAC SOP 1805         <382	1,2,4-Trimethylbenzene	REAC SOP 1807	<11.5	NA	<11.2	NA	<11.2	NA	<11.4	NA	<11.2	NA	<11.5	NA	<11.6	NA	
1.4-Dichlorobenzene       REAC SOP 1807       <11.5       NA       <11.2       NA       <11.2       NA       <11.4       NA       <11.2       NA       <11.5       NA       <11.6       NA         Diethylphthalate       REAC SOP 1805       <382	sec-Butylbenzene	REAC SOP 1807	<11.5	NA	<11.2	NA	<11.2	NA	<11.4	NA	<11.2	NA	<11.5	NA	<11.6	NA	
Diethylphthalate         REAC SOP 1805         <382         <2000         <373         <2000         <373         <2000         <373         <2000         <373         <2000         <373         <2000         <373         <2000         <373         <2000         <373         <2000         <373         <2000         <373         <2000         <373         <2000         <373         <2000         <373         <2000         <373         <2000         <373         <2000         <373         <2000         <373         <2000         <373         <2000         <373         <2000         <373         <2000         <373         <2000         <373         <2000         <373         <2000         <373         <2000         <373         <2000         <373         <2000         <373         <2000         <373         <2000         <373         <2000         <373         <2000         <373         <2000         <373         <2000         <373         <2000         <373         <2000         <373         <2000         <373         <2000         <373         <2000         <373         <2000         <373         <2000         <373         <2000         <373         <2000         <373         <2000         <373         <	1,4-Dichlorobenzene	REAC SOP 1807	<11.5	NA	<11.2	NA	<11.2	NA	<11.4	NA	<11.2	NA	<11.5	NA	<11.6	NA	
Di-n-butylphthalate         REAC SOP 1805         150J         1460J         157J         1610J         157J         4390         263000         351J         2050         112J         1790J         248J         624J           Butylbenzylphthalte         REAC SOP 1805         <382	Diethylphthalate	REAC SOP 1805	<382	<2000	<373	<2000	<373	<2000	<379	<40000	<376	<2000	<384J	<2000	100J	<2000	
Butylbenzylphthalte         REAC SOP 1805         <382         <2000         <373         <2000         <373         <2000         <373         <2000         <379         584J         <376         524J         <384J         526J         <386         614J           3,3'-Dichlorobenzidine         REAC SOP 1805         <382	Di-n-butylphthalate	REAC SOP 1805	150J	1460J	157J	1610J	160J	1570J	4390	263000	351J	2050	112J	1790J	248J	624J	
3,3-Dichlorobenzidine         REAC SOP 1805         <382         <2000         <373         <2000         <373         <2000         <379         <40000         <376         <2000         <384J         <2000         <386         <2000           Crysene         REAC SOP 1805         <382	Butylbenzylphthalte	REAC SOP 1805	<382	<2000	<373	<2000	<373	<2000	<379	584J	<376	524J	<384J	526J	<386	614J	
Crysene         REAC SOP 1805         <382         <2000         <373         <2000         <373         <2000         <379         <40000         <376         <2000         <384J         <2000         <386         <2000           Bis-(2-ethylhexyl) phthalate         REAC SOP 1805         318J         1620J         871         1230J         445         1580J         451         3610J         432         1770J         <384J	3,3'-Dichlorobenzidine	REAC SOP 1805	<382	<2000	<373	<2000	<373	<2000	<379	<40000	<376	<2000	<384J	<2000	<386	<2000	
Bis-(2-ethylhexyl) phthalate REAC SOP 1805 318J 1620J 871 1230J 445 1580J 451 3610J 432 1770J <384J 4200 127J 3150	Crysene	REAC SOP 1805	<382	<2000	<373	<2000	<373	<2000	<379	<40000	<376	<2000	<384J	<2000	<386	<2000	
	Bis-(2-ethylhexyl) phthalate	REAC SOP 1805	318J	1620J	871	1230J	445	1580J	451	3610J	432	1770J	<384J	4200	127J	3150	

NA: Not Analyzed or Not reported due to sample size J: Value estimated

J+: Value estimated high

ND: not detected

								Table 1 T	arget Compo	unds Analys	is Results						
REAC Sample Number			8		9	1	0	1	1	1	12		13	1	4	1	15
%LOI at 750C (Gypsum)			20	2	20	2	2	2	21	2	22		18	1	19	2	21
pH (5% w/v) ( Gypsum)		7	.75	7.	.03	6.	88	7.	.92	8.	.24	7	24	8.	23	6.	.86
Sample		Gypsum	Paper	Gypsum	Paper	Gypsum	Paper	Gypsum	Paper	Gypsum	Paper	Gypsum	Paper	Gypsum	Paper	Gypsum	Paper
Target Analytes (Units)	Method	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Aluminum	REAC SOP 1811	2220J+	NA	485J+	NA	230J+	NA	179J+	NA	216J+	NA	2720J+	NA	1330J+	NA	234J+	NA
Arsenic	REAC SOP 1811	<2.19	NA	3.22	NA	<2.28	NA	<2.24	NA	<2.15	NA	<2.29	NA	5.70	NA	<2.28	NA
Barium	REAC SOP 1811	96.7	NA	5.18	NA	5.74	NA	2.50	NA	13.8	NA	9.51	NA	20.7	NA	17.5	NA
Calcium	REAC SOP 1811	255000	NA	264000	NA	245000	NA	264000	NA	262000	NA	221000	NA	216000	NA	257000	NA
Chromium	REAC SOP 1811	17.7	NA	1.42	NA	2.68	NA	1.40	NA	0.824	NA	2.97	NA	1.09	NA	2.05	NA
Cobalt	REAC SOP 1811	5.4	NA	< 0.479	NA	< 0.456	NA	<0.447	NA	<0.431	NA	3.20	NA	< 0.479	NA	0.537	NA
Copper	REAC SOP 1811	3.3	NA	0.937	NA	1.97	NA	1.62	NA	0.670	NA	6.86	NA	1.12	NA	3.22	NA
Iron	REAC SOP 1811	3270	NA	808	NA	757	NA	533	NA	344	NA	2700	NA	1020	NA	1520	NA
Lead	REAC SOP 1811	<1.32	NA	<1.44	NA	<1.37	NA	<1.34	NA	<1.29	NA	2.38	NA	<1.44	NA	2.02	NA
Magnesium	REAC SOP 1811	3080	NA	943	NA	1720	NA	989	NA	7270	NA	4800	NA	6590	NA	185	NA
Manganese	REAC SOP 1811	65	NA	3.92	NA	14.1	NA	7.39	NA	8.97	NA	73.3	NA	24.9	NA	46	NA
Mercury	REAC SOP 1832	0.112	NA	0.327	NA	0.305	NA	0.261	NA	0.200	NA	< 0.047	NA	< 0.046	NA	0.119	NA
Nickel	REAC SOP 1811	5.46	NA	0.820	NA	1.86	NA	1.58	NA	<0.646	NA	4.54	NA	0.894	NA	2.45	NA
Potassium	REAC SOP 1811	1320	NA	586	NA	78.5	NA	380	NA	41.4	NA	736	NA	336	NA	388	NA
Selenium	REAC SOP 1811	3.43	NA	12.2	NA	4.93	NA	4.11	NA	12.2	NA	<2.06	NA	<2.16	NA	3.82	NA
Sodium	REAC SOP 1811	<110	NA	<120	NA	162	NA	114	NA	<108	NA	<115	NA	239	NA	131	NA
Strontium	REAC SOP 1811	633	18.5	175	27.9	185	17.9	140	21.2	926	38.5	662	49	2890	83.4	303	31.2
Vanadium	REAC SOP 1811	11.2	NA	0.791	NA	3.6	NA	2.31	NA	2.00	NA	1.98	NA	2.15	NA	2.89	NA
Zinc	REAC SOP 1811	8.52J	NA	<0.838J	NA	6.53J	NA	5.31J	NA	<0.754J	NA	4.22J	NA	1.91J	NA	2.86J	NA
Total Sulfate (SO <sub>4</sub> ) <sup>-2</sup>	EPA Method 375.4	640000	NA	691000	NA	665000	NA	674000	NA	663000	NA	574000	NA	632000	NA	617000	NA
Water Soluble Floride	REAC Draft SOP	54.6J	NA	52.8J	NA	52.4J	NA	270J	NA	103J	NA	3.3J	NA	10.4J	NA	48.8J	NA
Water Soluble Chloride	REAC Draft SOP	<10J	NA	22J	ND	16J	NA	32J	NA	22J	NA	28J	NA	92J	NA	20J	NA
Total acid soluble sulfide	SW 846 9030/9034	<25.9	NA	<25.9	NA	<25.9	NA	<25.9	NA	<25.9	NA	<25.9	NA	<25.9	NA	<25.9	NA
Elemental sulfur	Mod. REAC SOP 1805	<7.78	<40	<7.78	<40	<7.78	<40	<7.78	<80	<7.78	<80	<7.78	<80	<7.78	<80	<7.78	<80
Total Organic Carbon(TOC)	EPA C-88	1600	NA	3600	NA	4800	NA	2600	NA	1100	NA	4000	NA	1800	NA	2700	NA
Units		ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg
Trichlorofluoromethane	REAC SOP 1807	<11.6	NA	<11.5	NA	<11.6	NA	<11.6	NA	<11.6	ŇA	<11.2	ŇA	<11.5	ŇA	<11.6	NA
Acetone	REAC SOP 1807	<46.5	NA	<46	NA	<46.5	NA	<46.5	NA	<46.5	NA	<44.9	NA	29.7J	NA	<46.5	NA
Methylene Chloride	REAC SOP 1807	<11.6	NA	<11.5	NA	<11.6	NA	<11.6	NA	<11.6	NA	<11.2	NA	<11.5	NA	<11.6	NA
Carbon Disulfide	REAC SOP 1807	<11.6	NA	<11.5	NA	<11.6	NA	<11.6	NA	<11.6	NA	<11.2	NA	<11.5	NA	<11.6	NA
2-Butanone	REAC SOP 1807	<11.6	NA	6.44J	NA	<11.6	NA	<11.6	NA	<11.6	NA	<11.2	NA	<11.5	NA	<11.6	NA
Trichloroethene	REAC SOP 1807	<11.6	NA	<11.5	NA	<11.6	NA	<11.6	NA	<11.6	NA	<11.2	NA	<11.5	NA	<11.6	NA
Bromodichloromethane	REAC SOP 1807	<11.6	NA	<11.5	NA	<11.6	NA	<11.6	NA	<11.6	NA	<11.2	NA	<11.5	NA	<11.6	NA
4-Methyl-2-Pentanone	REAC SOP 1807	<46.5	NA	<46.0	NA	<46.5	NA	<46.5	NA	<46.5	NA	<44.9	NA	<46.0	NA	<46.5	NA
Toluene	REAC SOP 1807	<11.6	NA	<11.5	NA	<11.6	NA	<11.6	NA	<11.6	NA	<11.2	NA	<11.5	NA	<11.6	NA
Ethylbenzene	REAC SOP 1807	<11.6	NA	<11.5	NA	<11.6	NA	<11.6	NA	<11.6	NA	<11.2	NA	<11.5	NA	<11.6	NA
p&m-Xylene	REAC SOP 1807	<23.3	NA	<23.0	NA	<23.3	NA	<23.3	NA	<23.3	NA	<22.5	NA	<23.0	NA	<23.3	NA
o-Xylene	REAC SOP 1807	<11.6	NA	<11.5	NA	<11.6	NA	<11.6	NA	<11.6	NA	<11.2	NA	<11.5	NA	<11.6	NA
Styrene	REAC SOP 1807	<11.6	NA	<11.5	NA	<11.6	NA	<11.6	NA	<11.6	NA	<11.2	NA	<11.5	NA	<11.6	NA
Isopropylbenzene	REAC SOP 1807	<46.5	NA	<46.0	NA	<46.5	NA	<46.5	NA	<46.5	NA	<44.9	NA	<46.0	NA	<46.5	NA
1,2,3-Trichloropropane	REAC SOP 1807	<11.6	NA	<11.5	NA	<11.6	NA	<11.6	NA	<11.6	NA	<11.2	NA	<11.5	NA	<11.6	NA
n-Propylbenzene	REAC SOP 1807	<11.6	NA	<11.5	NA	<11.6	NA	<11.6	NA	<11.6	NA	<11.2	NA	<11.5	NA	<11.6	NA
1,3,5-Trimethylbenzene	REAC SOP 1807	<11.6	NA	<11.5	NA	<11.6	NA	<11.6	NA	<11.6	NA	<11.2	NA	<11.5	NA	<11.6	NA
1,2,4-Trimethylbenzene	REAC SOP 1807	<11.6	NA	<11.5	NA	<11.6	NA	<11.6	NA	<11.6	NA	<11.2	NA	<11.5	NA	<11.6	NA
sec-Butylbenzene	REAC SOP 1807	<11.6	NA	<11.5	NA	<11.6	NA	<11.6	NA	<11.6	NA	<11.2	NA	<11.5	NA	<11.6	NA
1,4-Dichlorobenzene	REAC SOP 1807	<11.6	NA	<11.5	NA	<11.6	NA	<11.6	NA	<11.6	NA	<11.2	NA	<11.5	NA	<11.6	NA
	PEAC SOP 1805	<386	<2000	<383	<2000	<386	<2000	<389J	<4000	<386	<4000	<375J	<4000	<383	<4000	<386	<4000
Diethylphthalate	REAC 301 1003									1701	1000						2/501
Diethylphthalate Di-n-butylphthalate	REAC SOF 1805	209J	524J	255J	906J	283J	814J	193J	3200J	179J	<4000	<375J	2720J	131J	3130J	221J	2650J
Diethylphthalate Di-n-butylphthalate Butylbenzylphthalte	REAC SOF 1805 REAC SOP 1805	209J <386	524J <2000	255J <383	906J <2000	283J <386	814J 928J	193J <389J	3200J 1300J	179J < <u>3</u> 86	<4000 <4000	<375J <375J	2720J <4000	131J <383	3130J <4000	221J <386	2650J 3700J
Diethylphthalate Di-n-butylphthalate Butylbenzylphthalte 3,3'-Dichlorobenzidine	REAC SOF 1005           REAC SOP 1805           REAC SOP 1805           REAC SOP 1805           REAC SOP 1805	209J <386 <386	524J <2000 <2000	255J <383 <383	906J <2000 1070J	283J <386 <386	814J 928J <2000J	193J <389J <389J	3200J 1300J <4000	<386 <386	<4000 <4000 <4000	<375J <375J <375J	2720J <4000 <4000	131J <383 <383	3130J <4000 <4000	221J <386 <386	2650J 3700J <4000
Diethylphthalate Di-n-butylphthalate Butylbenzylphthalte 3,3'-Dichlorobenzidine Crysene	REAC SOP 1805 REAC SOP 1805 REAC SOP 1805 REAC SOP 1805 REAC SOP 1805	209J <386 <386 162J	524J <2000 <2000 <2000	255J <383 <383 <383	906J <2000 1070J <2000	283J <386 <386 <386	814J 928J <2000J <2000J	193J <389J <389J <389J	3200J 1300J <4000 <4000	179J <386 <386 <386	<4000 <4000 <4000 <4000	<375J <375J <375J <375J	2720J <4000 <4000 <4000	131J <383 <383 <383	3130J <4000 <4000 <4000	221J <386 <386 <386	2650J 3700J <4000 <4000

NA: Not Analyzed or Not reported due to sample size J: Value estimated

J+: Value estimated high

ND: not detected

				XRD Ana	lysis (%/wt)			
REAC Sample Number	1	2	3	4	5	6	7	8
Ca(SO <sub>4</sub> )(H2O) <sub>2</sub> (Gypsum)	90.8(5)	74.7(5)	76.9(4)	82.6(4)	78.7(4)	90.0(4)	94.3(4)	96.1(5)
CaCO3 (Calcite)		6.0(1)	3.9(1)	5.4(1)	10.3(1)	4.5(1)	0.9(1)	
CaMg(CO <sub>3)</sub> (Dolomite)		12.2(2)	12.8(1)	5.2(1)	5.0(2)		0.8(1)	0.3(1)
SiO <sub>2 (Quartz)</sub>	2.4(1)	1.3(1)	0.8(1)	0.5(1)	1.0(1)	0.5(1)	0.9(1)	0.9(1)
CaSO <sub>4</sub> (Anhydrite)	2.6(1)	0.9(1)	1.0(1)	0.6(1)	0.6(1)	0.5(1)	0.2(1)	0.4(1)
Ca(SO <sub>4</sub> )(H2O) <sub>0.5</sub> (Bassanite)	4.2(1)	4.5(1)	2.8(1)	4.0(1)	2.2(1)	4.4(1)	2.9(1)	2.3(1)
K(AI.Fe)(AI,Si <sub>3</sub> O <sub>10</sub> )(OH) <sub>2</sub> (Muscovite)		0.5(1)	1.7(1)	1.8(1)	2.2(1)			

## Table 2 XRD & XRF Analysis Results

Note: The number in parentheses is the estimated standard deviation. For example, 74.7(5) represents  $74.7 \pm 0.5\%$ .

	XRF Analysis (mg/kg)											
REAC Sample Number	1	2	3	4	5	6	7	8				
Strontium (Sr)	1200	3100	3700	2300	3700	670	550	510				
Calcium ( Ca)	230000	240000	240000	240000	240000	230000	230000	220000				
Iron (Fe)	1200	1600	1300	1100	1600	360	510	1700				

	XRD Analysis (%/wt)											
REAC Sample Number	9	10	11	12	13	14	15					
Ca(SO <sub>4</sub> )(H2O) <sub>2</sub> (Gypsum)	87.2(4)	93.5(4)	96.8(4)	91.7(6)	85.6(5)	91.1(5)	92.9(5)					
CaCO3 (Calcite)		2.0(1)		1.3(1)	0.3(1)							
CaMg(CO <sub>3)</sub> (Dolomite)	0.7(1)											
SiO <sub>2 (Quartz)</sub>		0.3()		0.2(1)	5.3(1)	2.1(1)	2.5(1)					
CaSO <sub>4</sub> (Anhydrite)	1.8(1)	0.3(1)	0.3(1)	1.0(1)	2.7(1)	2.2(1)	0.4(1)					
Ca(SO <sub>4</sub> )(H2O) <sub>0.5</sub> (Bassanite)	10.3(1)	4.0(1)	3.0(1)	4.2(1)	6.1(1)	4.6(1)	3.4(1)					
K(AI.Fe)(AI,Si <sub>3</sub> O <sub>10</sub> )(OH) <sub>2</sub> (Muscovite)				1.5(1)			0.9(1)					

Table 2 XRD & XRF Analysis Results

Note: The number in parentheses is the e. Note: The number in parentheses is the estimated standard deviation. For example, 87.2(4) represents 87.2 ± 0.4%.

	XRF Analysis (mg/kg)										
REAC Sample Number	9	10	11	12	13	14	15				
Strontium (Sr)	140	150	110	730	600	2500	250				
Calcium ( Ca)	500	240000	230000	230000	200000	210000	210000				
Iron (Fe)	230000	570	380	200	2100	850	1400				

REAC Sample Number			1	2	2		3		4		5		6		7		8
Tentatively Identified Compounds	Retention	Gypsum	Paper														
	Time	µg/kg	µg/kg														
1-Hevanal	4 639 - 4 639	100	100	100	100	100	100	100	100	100	100	100	100	98	100	100	100
Disulfide jeamer	<u>+.005 +.005</u>			407		1069								50			
	5.017 - 12.555			427		1200											
2-Pentenoic acid	6.275																
Aniline	7.213 - 7.339										1170						
1-Decene	7.438																
2-Eurancarboxylic acid	8 435	234															
Apotonhonono	9.466 9.507	201															
Acetophenone	0.400 - 0.097																
o-loludine	8.565-8.66																
1-Octanol/C9 Alkyl benzene	8.607																
5-(hvdroxymethyl)-2-furfural	10.573		1530														
2-Eurancarboxaldebyde 5-(bydroxymethyl)-	10 605	270															
	10.025	2.0										224					
	10.935											234					
Isoquinoline	10.956																
Cyclodecane	10.977																
Decane, 1-chloro-	11.087																
1-Decanol	11 118-11 386																
Tridegano	11 202																
	11.302																
Decane, 1-(ethenyloxy)-	11.459																
Unknown	11.606-32.191	233	12730	3938	19650	3061	4726	1675	12670	1104	10539	1232	8086	624	14335	1586	5671
4-Hydroxybenzaldehyde	12.146								1270								
Vanillin	12 612-12 77		2960			553	2940	622	3270	333	3490		2650		4280		2980
4 Dedeserel	12.012 12.11	4070	2000	40.40	0100	2020	2040	022	5210	4240	0400		2000		4200		2300
1-Dodecanol	13.388-13.43	1670	4210	4240	9100	3030				1340							
1-Dodecanethiol	14.111-14.175	623		1690		2620	2300										
Benzophenone	15.202								797								
1-Tetradecanamine, N.N-dimethyl-	15.548																
Molecular Sulfur	15 82 - 18 /0/	10//		0270		17070		3870									
	15.82 - 18.494	1944		9210		17070	44.40	3019									
Nonyi-phenoi isomer	15.936						1140										
Tetradecene	16.114						1870										
2-Propenal, 3-(4-hydroxy-3-methoxyphenyl)-	16.135								908								
Tetradecanethiol	16 172-16 177			970		941											
Malagular Sulfur/Unknown	16 544			010		011		204									
	10.344			4.47				304									
n-Octadecane C18H38/Unknown	16.56			447													
Diethylene glycol monododecyl ether	16.581																
Unknown alkane	16.659-32.149	1725	21550	895	32170	820	16280	2002	9251	2554	12726	1902	5990	2759	10988	1308	4495
Phthalate isomer	17 231-22 31		1480	900				333			743						
Linknown phthalata	17 200		1100	000		1140		000			7 10						
	17.299					1140											
1-Hexadecanamine, N,N-dimethyl-	17.33-17.466				3090												
n-Nonadecane C19H40	17.414															259	
Hexadecanoic acid, methyl ester	17.645							1530									
Hexadecanoic Acid	17 781 - 17 959	1470	6450		8420		6970		2070	298	5560		6870		6810		5060
	17.042	1470	0400		0420		0010		2010	230	5500		0070		0010		3000
n-Hexadecanoic acid	17.943																
n-Eicosane C20H42	18.2 - 18.242	393														269	727
n-Icosane C20H42	18.253							11700									
Disulfide compound	18.342 - 18.347			9280		11900											
Unknown ester	18 557			0200	9670												
A Queleberre A certain dis sold A (4 E dissette	10.557	4700			3070												
1-Cyclonexene-1-carboxylic acid, 4-(1,5-dimethy	18.593	1720															
n-Heneicosane C21H44	18.997 - 19.034										787					340	941
8,11-Octadecadienoic acid, methyl ester	19.013							990	5310								
9-Octadecenoic acid	19 223 - 19 375		3790		6710		5160				3000		5780		6280		4900
Octadoconoio acid mothyl actor	10.250		0.00		01.10		0.00	220			0000		0.00		0200		
	19.259							229									
Linoleic acid	19.343																
cis-9,12-Octadecadienoic acid	19.364																
9-Octadecenoic acid, (E)-	19.374 - 19.38																
Stearic Acid	19 38-19 542		3620		5260		4230		2010		4820		5950		3880		3310
C10 Organic Asid. C10 aster	10.00 10.042		3020		5200		4200		2010		4020		5550		3000		3310
C TO Organic Acid, C TO ester	19.015	ł		-			1077			46.1	00.15	100	4077	0.6.7	0077	0.00	
n-Docosane C22H46	19.647 - 19.81	1					1820	541	2530	461	2910	189	1620	339	2360	302	2310
n-Tricosane C23H48	20.37-20.538	344	3160	627	3410	549	4380	1150	5410	1070	5070	558	3500	857	5310	438	3500
2(3H)-Furanone, dihydro-5-tetradecyl-	20.622																
2-Europone dibydro-5-tetradecyl-	20 732 - 20 722	1	1			1		1	1						1270		906
z Tatrassena COALICO	20.132 - 20.132	710	5000	1000	44000	000	0500	4040	0000	1000	0.400	4000	5740	4070	12/0	740	330
n-retracosane 024H50	21.068-21.235	/16	5330	1090	11000	963	6530	1940	8030	1990	6460	1290	5740	1670	9390	746	5840
Dimethyl Pyrene Isomer C18H14/Unknown	21.676															302	
n-Pentacosane C25H52	21.739-21.906	836	5620	1110	5930	1340	9760	2400	12100	2050	9750	2330	7	2400	17600	1100	10600
n-Pentacosane C25H52/Unknown	21,739-21 87												11200				
Diethylene alvool dibenzoate	21 812 - 21 050	1	5880		6580		7170	283	7960	422	10200		10000	217	15000		11000
Dietryjelle gijool uibenzoate/halman	21.012 - 21.939	000	0000		0000		/1/0	203	1 900	400	10200		10000	211	10900		11000
Dietnyiene glycol dibenzoate/Unknown	21.974 - 21.975	263															
n-Hexacosane C26H54	22.383 - 22.551	995	6540	1040	9510	1210	9270	2210	13400	2460	8330	2710	12300	2850	19600	1500	11300
Unknown//Dehydroabietic acid, methyl_ester	22,776-22,782									412							

#### Table 3 SVOC Tentatively Identified Compounds Analysis Results

REAC Sample Number			1		2		3		1	ŗ		é	)		1		8
Tentatively Identified Compounds	Retention	Gypsum	Paper														
	Time	µg/kg	µg/kg														
PAH Isomer C19H14	22.986-23.07															708	
n-Heptacosane C27H56	23.007 - 23.17	1060	7570	1140	8870	1280	10900	2080	14900	2490	8330	2840	14600	3040	20900	1550	12000
Benzonaphtho thiopene -dimethyl isomer	23.427															312	
Sterane (Cholestane) isomer	23.458									480							
Unknown alkane /Unknown	23.495-32.149		2800		4850		1100						8166				
Unknown alkane (CnH2n+2)	23.599									292							
n-Octacosane C28H58	23.605-23.767	1010	6080	1160	6960	1020	5380	1330	5720	1740	4090	1440	4650	1050	7050	1180	6360
Organic Acid/Unknown	23.61	268															
PAH Isomer C20H16	23.862-23.94															756	
C30H50 Alkene	23.867																
Unknown alkane/PAH isomer	24.119															269	
n-Nonacosane C29H60	24.192-24.365	689	5130	859	5700	739	5890	971	5980	1230	4700	1150	5900	1130	6670	991	5740
Unknown sulfide compound/Unknown	24.506			428													
Unknown plant sterane	24.564	310															
Disulfide, didodecyl	24.742				3750												
PAH Isomer C20H12/Unknown alkane	24.758															619	
Disulfide, didodecyl	24.789 - 24.79			1170		966											
n-Hentriacontane C31H64	25.549 - 25.764						5660		5470		5690		6050	1130	4750	757	4360
Hopane isomer	25.99 - 28.113				4520					634							
Binaphthyl Sulfone isomer	26.184 - 27.61	774		943		463				1088		2433		492			
n-Dotriacontane C32H66	26.378 - 26.629				4670		4500	241	4860	277	5380	290	5110	920		528	3350
16-Hentriacontanone	27.274-27.489																700
n-Tritriacontane C33H68	27.348-27.557												5370				
Binaphthyl Sulfone isomer/Unknown	27.557																
Alkane/Unknown	30.042 - 30.052																4880
Stigmast-4-en-3-one	30.576		2030														
Unknown Organic Acid /Alkane	32.144																2450
Unknown ketone/Unknown alkane	32.149														2320		

Table 3 SVOC Tentatively Identified Compound Analysis Results

				-		Table 3 34		very luentin	ieu compo	unu Analys	is itesuits				
REAC Sample Number			9	1	10		11	1	2	1	3	1	4		15
Tentatively Identified Compounds	Retention	Gypsum	Paper	Gypsum	Paper	Gypsum	Paper	Gypsum	Paper	Gypsum	Gypsum	Gypsum	Paper	Gypsum	Paper
	Time	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
1-Hevanal	4 639 - 4 639			180						1 2 2	100	100			
	4.039 - 4.039			100											
Disulfide isomer	5.017 - 12.555														
2-Pentenoic acid	6.275						1760								
Aniline	7.213 - 7.339		2610								1270		2640		
1 Docono	7 /29													122	1
	7.430													132	
2-Furancarboxylic acid	8.435														
Acetophenone	8.466 - 8.597			159				94	1190						
o-Toludine	8 565-8 66				674										1760
1 Ostanal/CO Allad hannana	0.000 0.00				074							040			1700
1-Octanol/C9 Alkyl benzene	8.607											242			
5-(hydroxymethyl)-2-furfural	10.573														
2-Furancarboxaldehvde, 5-(hvdroxymethyl)-	10.605														1
Quipoline	10.935														
	10.955														
Isoquinoline	10.956											145			
Cyclodecane	10.977														1690
Decane 1-chloro-	11 087							129							
1 Decemel	11.001							120						040	
1-Decanol	11.118-11.386							86						248	
Tridecane	11.302										1240				
Decane, 1-(ethenyloxy)-	11,459											438			
	11 606.22 101	2200	27/20	1201	8772	507	27920	376	18225	1740	43700	2027	11520	1075	28500
	11.000-32.191	2200	21430	1201	0113	507	21030	3/0	10223	1749	43/90	2921	44000	1075	20000
4-Hydroxybenzaldehyde	12.146		L												1
Vanillin	12.612-12.77		4440		2740		4300		5190		4520		4850		8170
1-Dodecanol	13 388-13 43	l I		İ				İ			. = •			İ	1
1 Dedecenthic	14 144 44 475	ł	t		ł		ł								+
I-Douecanethiol	14.111-14.175		ļ												<u> </u>
Benzophenone	15.202														
1-Tetradecanamine N N-dimethyl-	15 548														4220
Melecular Sulfur	15.92 19.404		1												
Molecular Sullur	15.82 - 18.494														
Nonyl-phenol isomer	15.936														
Tetradecene	16.114														1
2-Propenal 3-(1-bydroxy-3-methoxyphenyl)-	16 135														
	10.100														
Tetradecanethiol	16.172-16.177														
Molecular Sulfur/Unknown	16.544														
n-Octadecane C18H38/Unknown	16.56														1
Distbylana glycal manadadaayl athar	16 591	220													1
Dietriviene givon monododecyr etner	10.301	330													
Unknown alkane	16.659-32.149	2943	19980	992	8345	2529	16660	774	11160	2585	8650	411	11360	918	10290
Phthalate isomer	17.231-22.31	328						152							
Linknown phthalate	17 299														
1 Lleve de segencia en NINI dimethod	17.200														2010
1-Hexadecanamine, N,N-dimethyl-	17.33-17.400														2610
n-Nonadecane C19H40	17.414														
Hexadecanoic acid, methyl ester	17.645														1
Hexadecanoic Acid	17 781 - 17 050	256	10300	531	7660		5070		7600	906	0700		1810	95	0000
	17.701 - 17.939	230	10300	331	7000		3310		1030	300	3130		4040	30	3300
n-Hexadecanoic acid	17.943											282			
n-Eicosane C20H42	18.2 - 18.242														
n-Icosane C20H42	18 253														
Disulfide compound	10 242 10 247		1												
	10.342 - 10.347														
Unknown ester	18.557		2030												<u> </u>
1-Cyclohexene-1-carboxylic acid, 4-(1,5-dimethy	18.593														1
n-Heneicosane C21H44	18 997 - 19 034			163		197				248					1
8 11 Octodopodiopoio poid mothul optor	10.012			100		101				210					
	19.013	ł					40.55						00		
9-Octadecenoic acid	19.223 - 19.375		7330		7220		4360		7770		7770		3320		5960
Octadecanoic acid . methyl ester	19.259														
Lipoleic acid	10 3/3	305													
	19.040	303										040			
cls-9,12-Octadecadienoic acid	19.364											318			
9-Octadecenoic acid, (E)-	19.374 - 19.38			482						1240					
Stearic Acid	19.38-19.542		11800		4290		4260		3430		7440		4980		8940
C10 Organic Acid C10 actor	10.615									270					
Discourse Operation	19.010	010		001	0400	4.10	00.10	07	4.400	219		46.1	4010	400	0070
n-Docosane G22H46	19.647 - 19.81	316	ļ	364	2130	448	2640	87	1460	428		194	1810	138	2850
n-Tricosane C23H48	20.37-20.538	729	L	692	4550	824	7350	253	3150	739	2820	593	2960	368	5430
2(3H)-Furanone, dihydro-5-tetradecyl-	20.622								1070						
2 Europopo dibudro 5 totradocul	20.722 20.722														<u> </u>
	20.132 - 20.132	<u> </u>	<u> </u>		<u> </u>		<u> </u>					L			<u> </u>
n-Tetracosane C24H50	21.068-21.235	1290	3940	1200	8140	1500	13300	515	5880	1440	5240	1190	4590	699	9370
Dimethyl Pyrene Isomer C18H14/Unknown	21.676														1
n-Pentacosane C25H52	21 739-21 006	1650		1550	14400	1760	27100	880	12800	1370		1730		983	22000
	21.100-21.000	1000	0440	1000	1-+00	1100	21100	003	12000	10/0	40000	1750	47000	505	22000
n-Pentacosane U25H52/Unknown	21./39-21.8/		8440								13600		17300		4
Diethylene glycol dibenzoate	21.812 - 21.959	286	8460	265	11700	172	18400	283	16400	262	23000		37100	176	23500
Diethylene glycol dibenzoate/Unknown	21,974 - 21,975											245			
n-Hevacosane C26H54	22 383 22 554	1700	11100	1/60	16500	1720	34500	005	1/700	1500	12500	1670	13500	010	26200
	22.303 - 22.33	1790	11100	1400	10000	1730	34300	905	14700	1090	12000	1070	13500	540	20300
Unknown//Dehvdroabietic acid, methyl ester	22.776-22.782	1	1	1	1	1	1	1	1	300			1	1	1

Table 3 SVOC Tentatively Identified Compound Analysis Results

REAC Sample Number		0	)	1	10	1	1	1	2	1	3	1	4	1	5
Tentatively Identified Compounds	Retention	Gypsum	Paper	Gypsum	Paper	Gypsum	Paper	Gypsum	Paper	Gypsum	Gypsum	Gypsum	Paper	Gypsum	Paper
	Time	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
PAH Isomer C19H14	22.986-23.07														
n-Heptacosane C27H56	23.007 - 23.17	1910	15000	1250	20800	1540	41300	869	18000	1630	18200	1330	21400	786	34800
Benzonaphtho thiopene -dimethyl isomer	23.427														
Sterane (Cholestane) isomer	23.458														
Unknown alkane /Unknown	23.495-32.149			193		208				201					
Unknown alkane (CnH2n+2)	23.599														
n-Octacosane C28H58	23.605-23.767	991	6500	865	6690	873	13300	647	9770	1080	9730	871	10700	632	13000
Organic Acid/Unknown	23.61														
PAH Isomer C20H16	23.862-23.94														
C30H50 Alkene	23.867								1220						
Unknown alkane/PAH isomer	24.119														
n-Nonacosane C29H60	24.192-24.365	935	6040	536	6980	698	13200	468	10000	791	10900	518	11900	389	12500
Unknown sulfide compound/Unknown	24.506														
Unknown plant sterane	24.564														
Disulfide, didodecyl	24.742														
PAH Isomer C20H12/Unknown alkane	24.758														
Disulfide, didodecyl	24.789 - 24.79														
n-Hentriacontane C31H64	25.549 - 25.764				5630		10600		8240		9860		10100		9960
Hopane isomer	25.99 - 28.113														
Binaphthyl Sulfone isomer	26.184 - 27.61			3535		232		852				678		1259	
n-Dotriacontane C32H66	26.378 - 26.629		4360		4490		8480		7010		8190		7940	77	8040
16-Hentriacontanone	27.274-27.489				932		1600		1040		1680		1700		
n-Tritriacontane C33H68	27.348-27.557										3520				
Binaphthyl Sulfone isomer/Unknown	27.557					148									
Alkane/Unknown	30.042 - 30.052				5800										
Stigmast-4-en-3-one	30.576														
Unknown Organic Acid /Alkane	32.144														
Unknown ketone/Unknown alkane	32.149														

#### Table 4 VOC's Tentatively Identified Compound Analysis Results

REAC Sample Number		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Tentatively Identified Compounds	Retention	Gypsum	Gypsum	Gypsum	Gypsum	Gypsum	Gypsum	Gypsum	Gypsum	Gypsum	Gypsum	Gypsum	Gypsum	Gypsum	Gypsum	Gypsum
	Time	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
Pentanal	10.41-10.42							3.09	1.96		6.59			5.81	2.51	
2-Propenoic acid, 2-methyl, methyl ester	10.68							1.97		49.8	27	32.8		43	28.5	
Hexanal	13.13-13.14	2.25	1.93		1.35	14.7	3.58	43.1	26.6	8.95	111	10.7	11.3	41.3	58.1	13.6
2-Propenoic acid, butyl ester	15.26-15.27				4.5			7.05	3.28	2.26	7.08			15.4	9.38	
C7 Ketone/Unknown	15.27					8.08										
Unknown	15.27-26.89	19	21.9	3.53	9.74	12.84	34.03	4.16	12.98	19.17	8.69	3.76	12.36	10.02	6.44	23.41
Heptanal	15.54-15.55					9.01	2.32	5.77	5.21	4	15	2.3		10.1	6.56	2.57
Unknown Aldehyde	16.94-25.81				1.52	16.28	19.66								2.1	
C7 Ketone	17.44					2.38										
Octanal	17.72-17.73	4.86				27.6	12	5.33	7.43	9.64				6.79	11.1	7.77
1-Hexanol, 2-ethyl	18.06	2.68				6.44	18.6	8.25		6.83	6.4	3.72	5.55	5.31	5.08	9.7
1-Hexanol, 2-methyl	18.06				4.14											
2-ethyl-1-Hexanol	18.06								5.09							
Octane, 1-chloro	18.84-23.33									6.3			64.1		7.83	
Octanol	18.96-19.98	16.2				12.3			2.46	10.4				2.65	22.9	3.26
1-Octanol	18.97		21.9													
2-Octenal, (E)-	19.12							6.71								
2-Nonanone	19.68					2.36										
Nonanal	20.05	12.3	5.32			43.3	87.2	13.5	20.5	17.9	10.9			10.7	18.5	57.5
Acetophenone	20.28										2.17		1.92			
Acetic acid, 2-ethylhexyl ester	20.83						59.3	2.98								
Dodecane	21.4						6.19									
C10H18 Cycloalkene	22.06						3.02									
Unknown ester	22.14					1.57										
Decanal	22.31-22.32	4.62	2.6		2.6	17.1	24.7	2.53		12.3			2.53		5.32	31.9
Naphthalene	23.22						1.32									
C10 Alkene/Cycloalkane	23.39					19.9		36.7			4.67	4.72				
Cyclodecane	23.39-23.40	55.9	35.6		14.3		19.7		8.72	42.8			30.5	10.1	40.9	59.5
Unknown cycloalkane	23.4			7.19												
2H-Pyran, 2-(bromomethyl)tetrahydro-	24.83					17.4										
Furan, 2-butyltetrahydro-	25.36					20.2										
Dodecane, 1-chloro-	26.88	7.12														



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY ENVIRONMENTAL RESPONSE TEAM

Edison, NJ - Cincinnati, OH - Las Vegas, NV - Research Triangle Park, NC

#### August 27, 2009

#### MEMORANDUM

SUBJECT: Drywall Investigations: Additional Five Drywall Sample Analysis Summary Results

- FROM: Raj Singhvi, Chemist Drywall Investigation Technical Manager Environmental Response Team
- TO: Arnold E. Layne, Director Drywall Investigation Program Manager Technology Innovation and Field Services Division Office of Superfund Remediation and Technology Innovation

#### 1.0 INTRODUCTION

A total of five drywall samples from Florida, Louisiana, and Virginia were analyzed for various parameters. The purpose of this study was to obtain additional information on the composition of the drywall and confirm the presence or absence of two organic compounds detected in the previous drywall gypsum sample study (May 7, 2009). Parameters were chosen based on: (1) residential odor complaints from the homeowners to the States; (2) available methods to obtain information about the chemical composition and the structure of the material; and (3) available field methods that may be useful in identifying whether imported drywall was used during the construction of homes.

EPA/ERT extracted three painted drywall samples from two homes in Florida and one in Louisiana during the preliminary visit to those States in preparation for conducting air testing efforts. The three drywall samples were imported from China. Samples of the paint used on the drywall were also collected from the same two homes in Florida and the home in Louisiana. In addition one imported drywall sample was collected by EPA/ERT from a warehouse in New Orleans and one drywall sample was received from a warehouse in Virginia. The results from the analysis of these drywall samples will assist EPA in preparing drywall investigation protocols for the U.S. Consumer Product Safety Commission (CPSC) and various States.

### 2.0 SAMPLE PREPARATION

Three painted imported drywall samples were prepared for analysis as follows: First, the thin layer of paint was scraped off of the three imported drywall samples for metals and semivolatile organic compound (SVOC) analyses. For all five drywall samples (three painted and two unpainted), the top and bottom layers of paper were then separated from the solid material (gypsum) and placed into separate glass jars. The paper portion of the drywall samples was analyzed for metals and SVOCs. The gypsum portion of drywall samples was analyzed for metals, SVOCs, volatile organic compounds (VOCs), total acid soluble sulfides, total organic carbon (TOC), sulfate, elemental sulfur, pH, and loss on ignition (LOI). The liquid paint samples were analyzed for strontium and SVOCs, including the

tentatively identified compounds of interest (i.e., propanoic acid, 2-methyl-, 2, 2-dimethyl-1-(2-hydroxy-1-methylethyl) propyl ester, and propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester.

## 3.0 ANALYTICAL RESULTS

#### 3.1 Strontium and Elemental Sulfur

The analysis shows the presence of elemental sulfur and strontium in four out of five imported drywall samples (gypsum portions) ranging from 71.4 parts per million (ppm) to 419 ppm, and from 3,030 ppm to 4,110 ppm, respectively. No elemental sulfur was detected in the gypsum sample from the New Orleans warehouse, but strontium was detected at a concentration of 401 ppm, approximately 10 times less than that found in the other gypsum samples. Elemental sulfur was also detected in the paper portion of the four imported drywall samples ranging from 41.7 ppm to 454 ppm. The presence of elemental sulfur in the paper could be attributed to the sulfur leaching out of the gypsum, or it may have been added in some form of sulfur compound during the manufacturing process.

## 3.2 Organic Compounds of Primary Interest

Analytical results show the presence of two organic compounds in the three paint samples collected from the two homes in Florida and the home in Louisiana, and from the painted gypsum portion of the drywall samples. The two compounds tentatively identified by the mass spectrometry library search were propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl) propyl ester (CAS # 74367-33-2) at estimated concentrations ranging from 1.78 to 10.6 ppm, and propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester (CAS # 74367-34-3) at estimated concentrations ranging from 2.04 to 10.7 ppm in the gypsum samples. These compounds were also detected in the paper portion of the drywall sample collected from the Louisiana home. These two compounds were detected in the liquid paint samples collected from the two homes in Florida and the home in Louisiana at a much higher concentration than that found in the gypsum portion of the drywall (see Table 1). The results of the investigation show that these two compounds are components of the paint and not necessarily from the gypsum portion of the drywall sample. The presence of these two compounds in the gypsum portion is attributed to diffusion from the paint to the gypsum core.

### 3.3 Reduced Sulfur Off-Gases from Gypsum-Headspace Analysis

The five gypsum core (without paper or paint) samples were qualitatively analyzed for sulfur compounds using a recently acquired gas chromatograph equipped with a sulfur chemiluminescence detector (GC/SCD) using a headspace technique. The experiments were performed to determine the presence of sulfur containing compounds in the drywall gypsum samples under dry and wet conditions. Due to the limited amount of sample, available paper and paint from the drywall were not included in these experiments. Five grams of each gypsum sample were sealed in 40-milliliter (mL) VOA vials for two days to simulate dry conditions; the headspace in each 40-mL vial was analyzed for sulfur gases using GC/SCD. Hydrogen sulfide, carbonyl sulfide and carbon disulfide were detected in the headspace in four drywall samples collected from the Florida and Louisiana homes, and a Virginia warehouse. Low levels of carbonyl sulfide and carbon disulfide were detected for a drywall sample collected from a warehouse in New Orleans. Next, 15-20 mL of water was added to each of the 40mL vials to submerge each sample. These samples were placed in a room for two days to simulate wet conditions. After two days, the headspaces in these vials were analyzed. An increase in the carbonyl sulfide and carbon disulfide concentrations was noted, whereas hydrogen sulfide concentrations decreased upon the addition of water to the drywall gypsum samples. Hydrogen sulfide has a greater solubility in water than carbonyl sulfide and carbon disulfide; water solutions of hydrogen sulfide are

not stable, adsorbed oxygen causes the formation of elemental sulfur. Additional work is necessary to better characterize and understand the relationship of the headspace vapor concentrations of hydrogen sulfide, carbonyl sulfide, and carbon disulfide under dry and wet conditions.

## 3.4 Analytical Results Summary

The results of these experiments showed that elemental sulfur and strontium were found in the gypsum core of many of the drywall samples. Two organic compounds were attributable to the paint on the drywall. Hydrogen sulfide, carbonyl sulfide and carbon disulfide were produced from the gypsum core under dry conditions; the carbonyl sulfide and carbon disulfide concentrations increased dramatically when the gypsum core was submerged in water. Conversely, hydrogen sulfide was detected at higher concentration from dry samples of the gypsum core.

A summary of the analytical results for the five drywall samples (gypsum, paper and paint chip portions) and the liquid paint samples is presented in Table 1. The qualitative XRD and XRF results for the gypsum portion of the drywall samples are presented in Table 2. Tentatively identified compounds detected by a GC/MS library search for the SVOC and VOC fractions are presented with estimated concentrations in Tables 3 and 4 for the drywall (gypsum, paper and paint chips) samples, and the liquid paint samples. A summary of qualitative headspace reduced sulfur compound off-gases results is presented in Table 5.

## 4.0 RELATED WORK IN PROGRESS

ERT is now analyzing 15 drywall samples (imported and domestic) received from the U.S. CPSC on July 8 and 20, 2009. A recommended procedure for identifying imported drywall in the field will be developed based on all the drywall composition analyses that ERT has performed.

If there are any questions, please call me at 732-321-6761.

## Attachments

- Table 1. Target Compound Analysis Results of Imported Drywall
- Table 2. XRD & XRF Analysis Results of Imported Drywall
- Table 3. SVOC Tentatively Identified Compounds (mg/kg)
- Table 4. VOC Tentatively Identified Compounds (mg/kg)
- Table 5. Headspace Screening Results for Reduced Sulfur Compounds in Gypsum by GC/SCD (ppbv)
- cc: Barnes Johnson, OSRTI Jeff Heimerman, OSRTI/TIFSD Dave Wright, ERT Harry Compton, ERT

				Table 1. Tar	get Comp	ounds An	alysis Re	esults of Im	ported D	rywall							
Sample Location			19	3 FL			23	3 FL			7	01 LA		Warehou	use, VA	Warehous	e, LA
%LOI at 750C				25				23				23		25	5	20	
pH (5% w/v)			7	.24			7	.37				7.45		7.3	2	6.71	
Sample	Matrix	Gypsum	Paper	Paint Chips	Paint	Gypsum	Paper	Paint Chips	Paint	Gypsum	Paper	Paint Chips	Paint	Gypsum	Paper	Gypsum	Paper
Target Analytes (Units)	Method	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Aluminum	REAC SOP 1811	737 J	5500	11900	NA	695 J	1810	4430	NA	578 J	1870	2640	NA	888 J	6000	678 J	5870
Arsenic	REAC SOP 1811	<2.33	<2.00	<1.96 J	NA	<2.50	<1.92	<2.08 J	NA	<2.33	<1.85	<2.00 J	NA	<2.42	<1.72	3.37	<1.82
Barium	REAC SOP 1811	69.6	31.1	13.3	NA	44.6	27.4	42.8	NA	39.0	30.5	27.9	NA	82.5	23.8	258	28.6
Cadmium	REAC SOP 1811	< 0.233	0.215	<0.196	NA	< 0.250	<0.192	<0.208	NA	<0.233	<0.185	< 0.200	NA	< 0.242	< 0.172	<0.228	< 0.182
Calcium	REAC SOP 1811	245000	13500	227000	NA	256000	15500	210000	NA	250000	21000	232000	NA	247000	10700	228000	10500
Chromium	REAC SOP 1811	1.48	4.48 J	17.2 J	NA	1.84	3.13 J	3.72 J	NA	1.74	3.06 J	5.28 J	NA	1.46	3.38 J	2.47	4.06 J
Cobalt	REAC SOP 1811	0.847	< 0.400	1.61	NA	0.620	< 0.385	0.597	NA	< 0.467	< 0.370	0.526	NA	0.904	< 0.345	0.511	0.427
Copper	REAC SOP 1811	2.72	26.8	3.98	NA	2.08	21.6	1.67	NA	1.57	20.0	1.29	NA	2.44	20.9	6.16	18.8
Iron	REAC SOP 1811	2010	625	2210	NA	1620	340	1800	NA	1100	333	693	NA	1990	445	1650	486
Lead	REAC SOP 1811	1.90	5.40	2.96	NA	4.54	4.02	3.11	NA	<1.40	3.97	3.55	NA	<1.45	3.28	21.3	3.86
Magnesium	REAC SOP 1811	17400	1040	8670	NA	8740	878	5080	NA	4100	890	4180	NA	20100	830	158	1110
Manganese	REAC SOP 1811	96.7	19.5	82.5 J	NA	77.7	30.9	61.6 J	NA	57.5	30.8	51.0 J	NA	93.3	17.1	8.61	36.1
Mercury	REAC SOP 1832	0.0873	NA	NA	NA	0.0603	NA	NA	NA	< 0.0486	NA	NA	NA	< 0.0506	NA	1.55	NA
Nickel	REAC SOP 1811	1.50	2.06	6.52	NA	1.48	1.10	0.971	NA	1.17	1.02	1.73	NA	1.50	0.914	1.06	1.32
Potassium	REAC SOP 1811	269 J	168	421 J	NA	251 J	98.7	625 J	NA	141 J	97.9	665 J	NA	302 J	104	206 J	346
Selenium	REAC SOP 1811	<2.09	2.00	<1.76	NA	<2.25	1.95	<1.88	NA	<2.10	<1.67	<1.80	NA	<2.18	<1.55	<2.05	<1.64
Silver	REAC SOP 1811	<0.581	< 0.500	< 0.490	NA	<0.626	0.767	<0.521	NA	< 0.584	< 0.46	< 0.500	NA	<0.606	< 0.431	<0.570	< 0.455
Sodium	REAC SOP 1811	592	2840	2150	NA	642	3670	1040	NA	414	2320	1040	NA	666	2170	316	1880
Strontium	REAC SOP 1811	3640	81.6	653	15	3030	70.5	454	26	3190	111	169	4.65 J	4110	95.0	401	24.2
Vanadium	REAC SOP 1811	2.37	2.95	8.19	NA	1.97	1.78	5.62	NA	1.62	1.57	2.38	NA	2.61	2.97	1.38	2.99
Zinc	REAC SOP 1811	3.07	37.4 J	91.2 J	NA	2.53	39.5 J	167 J	NA	0.945	30.5 J	11.6 J	NA	2.40	20.9 J	4.56	22.9 J
Total Sulfate (SO <sub>4</sub> ) <sup>-2</sup>	EPA Method 375.4	444000	NA	NA	NA	514000	NA	NA	NA	542000	NA	NA	NA	482000	NA	563000	NA
Total acid soluble sulfide	SW/ 846 9030/9034	<12.6	NA	NA	NA	<12.8	NA	NA	NA	<12.9	NA	NA	NA	<12.6	NA	<12.9	NA
Flemental sulfur	Mod_REAC SOP 1805	254	223	**	NA	71.4	41.7	**	NA	419	58.3	**	NA	379	454	<7.75	<40.0
TOC	FPA C-88	6900	NA	NA	NA	4500	NA	NA	NA	4700	NA	NA	NA	6600	NA	4200	NA
Units	21110-00	ug/Kg	ug/Kg	ug/Kg	ua/Ka	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	na/Ka	ug/Kg	ug/Kg	ug/Kg
Trichlorofluoromethane	REAC SOP 1807	7.51	NΔ	NA	<25.0	5 58 1	NΔ	NΔ	<25 0	<11 Q	NA NA	NΔ	<62.5	7.81	NΔ	<11.6	NΔ
Acetone	REAC SOP 1807	21700 1	NΔ	NΔ	11800 1	163 L	NΔ	NΔ	60.2.1	<17.6	NΔ	NΔ	45200 1	7601	NΔ	<46.5	NΔ
Methylene Chloride	REAC SOP 1807	21700 3	NA	NA	1890	7.69	NA	NA	4460 I	<11.0	NA	NA	<62.5	<11.6	NA	<11.6	NA
Carbon Disulfide	REAC SOP 1807	<11.6	NA	NA	<25.0	<11.8	NA	NA	<25.0	<11.9	NA	NA	<62.5	9.81 J	NA	<11.6	NA
2-Butanone	REAC SOP 1807	<11.6	NA	NA	7150	<11.8	NA	NA	<25.0	<11.9	NA	NA	367	<11.6	NA	<11.6	NA
Trichloroethene	REAC SOP 1807	<11.6	NA	NA	<25.0	<11.8	NA	NA	<25.0	<11.9	NA	NA	<62.5	8.65 J	NA	<11.6	NA
Bromodichloromethane	REAC SOP 1807	<11.6	NA	NA	<25.0	<11.8	NA	NA	<25.0	<11.9	NA	NA	<62.5	<11.6	NA	<11.6	NA
4-Methyl-2-Pentanone	REAC SOP 1807	<11.6	NA	NA	149	<11.8	NA	NA	19.9.1	<11.9	NA	NA	36.5 J	<11.6	NA	<11.6	NA
Toluene	REAC SOP 1807	<11.6	NA	NA	91.6	<11.8	NA	NA	13.1 J	<11.9	NA	NA	58.0 J	68.2	NA	<11.6	NA
Fthylbenzene	REAC SOP 1807	11.0 J	NA	NA	53.8	6.66 J	NA	NA	<25.0	<11.9	NA	NA	<62.5	3.14 J	NA	<11.6	NA
p&m-Xylene	REAC SOP 1807	47.5	NA	NA	91.8	33.9	NA	NA	8.20 J	<23.8	NA	NA	<125	9.79 J	NA	<23.3	NA
o-Xylene	REAC SOP 1807	13.9	NA	NA	34.4	6.47 J	NA	NA	<25.0	<11.9	NA	NA	<62.5	4.16 J	NA	<11.6	NA
Styrene	REAC SOP 1807	<11.6	NA	NA	226	<11.8	NA	NA	<25.0	<11.9	NA	NA	<62.5	3.95 J	NA	<11.6	NA
Isopropylbenzene	REAC SOP 1807	<11.6	NA	NA	68.4	<11.8	NA	NA	<25.0	<11.9	NA	NA	<62.5	<11.6	NA	<11.6	NA
1.2.3 Trichloropropane	REAC SOP 1807	<11.6	NA	NA	<25.0	<11.8	NA	NA	<25.0	<11.9	NA	NA	<62.5	<11.6	NA	<11.6	NA
n-Propylbenzene	REAC SOP 1807	5.95 J	NA	NA	47.7	3.34 J	NA	NA	<25.0	<11.9	NA	NA	<62.5	<11.6	NA	<11.6	NA
1.3.5-Trimethylbenzene	REAC SOP 1807	8.51 J	NA	NA	<25.0	<11.8	NA	NA	<25.0	<11.9	NA	NA	<62.5	<11.6	NA	<11.6	NA
1.2.4-Trimethylbenzene	REAC SOP 1807	35.8	NA	NA	15.6 J	15.6	NA	NA	<25.0	<11.9	NA	NA	<62.5	<11.6	NA	<11.6	NA
sec-Butylbenzene	REAC SOP 1807	<11.6	NA	NA	9.8	<11.8	NA	NA	<25.0	<11.9	NA	NA	<62.5	<11.6	NA	<11.6	NA
1,4-Dichlorobenzene	REAC SOP 1807	<11.6	NA	NA	<25.0	<11.8	NA	NA	<25.0	<11.9	NA	NA	<62.5	3.88 J	NA	<11.6	NA
Diethylphthalate	REAC SOP 1805	247 J	<2000	<10000	NA	128 J	<2000	<10000	NA	338 J	<2000	<20000	NA	<388	<2000	<388	<2000
Di-n-butylphthalate	REAC SOP 1805	379 J	2210	4070 J	NA	874	3470	5940 J	NA	1790	6010	9320	NA	125 J	1670 J	122 J	1310 J
3,3'-Dichlorobenzidine	REAC SOP 1805	<388	<2000	<10000	NA	<392	<2000	<10000	NA	<397	<2000	<20000	NA	<388	890 J	<388	<2000
Bis-(2-ethylhexyl) phthalate	REAC SOP 1805	499	3710	4370 J	NA	429	2040	6730 J	NA	769	1270	10300	NA	358 J	1930	223 J	1780 J
TIC'S of interest from Previous	s Analysis Report	ma/ka	ma/ka	mg/ka	ma/ka	ma/ka	ma/ka	ma/ka	ma/ka	ma/ka	ma/ka	ma/ka	ma/ka	ma/ka	mg/kg	ma/ka	ma/ka
Propanoic acid ester \$	REAC SOP 1805	1.78	ND	ND	1860	3,98	ND	ND	3020	10.6	4,77	ND	3600	ND	ND	ND	ND
Propanoic acid ester \$\$	REAC SOP 1805	2.04	ND	ND	2680	4.24	ND	ND	4190	10.7	9.33	ND	5600	ND	ND	ND	ND

NA: Not Analyzed or Not reported due to sample size \$: Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester \$\$:Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester

ND: Not detected

J: Concentration estimated

\*\*Elemental sulfur detection level is higher in case of paint chip due to insufficient sample

All drywall samples analyzed are imported.

Table 2. XRD & X	RF Analysis F	Results of Impo	rted Drywall	(Gypsum)	
XRD Q	uantitative Pha	ase Analysis (Wt	%)		
Sample Location	193 FL	233 FL	701 LA	Warehouse, VA	Warehouse, LA
$Ca(SO_4)(H2O)_2(Gypsum)$	77.5 (6)	80.7(6)	81.6(6)	77.2(7)	89.4(6)
CaCO3 (Calcite)	5.2(1)	6.2(1)	7.4(1)	4.7(1)	0.2(1)
CaMg(CO <sub>3)</sub> (Dolomite)	12.5(2)	6.1(1)	3.7(2)	11.9(2)	0.6(1)
SiO <sub>2</sub> (Quartz)	1.1(1)	0.9(1)	1.2(1)	0.7(1)	2.9(1)
CaSO <sub>4</sub> (Anhydrite)	0.3(1)	2.0(1)	1.5(1)	1.6(1)	2.2(1)
$Ca(SO_4)(H2O)_{0.5}$ (Bassanite)	2.5(1)	2.9(1)	2.9(1)	2.0(1)	3.0(1)
K(AI.Fe)(AI,Si <sub>3</sub> O <sub>10</sub> )(OH) <sub>2</sub> (Muscovite)	0.9(1)	1.2(2)	1.7(1)	1.9(1)	1.7(1)

Note: The number in parentheses is the estimated standard deviation. For example, 77.5(6) represents  $77.5 \pm 0.6\%$ .

Note: Samples were analyzed by sub-contract laboratory

	XRF An	alysis (mg/kg)			
Sample Location	193 FL	233 FL	701 LA	Warehouse, VA	Warehouse, LA
Strontium (Sr)	3200	2500	2750	3600	340
Calcium ( Ca)	240000	240000	245000	240000	220000
Iron (Fe)	1400	1200	785	1500	935

		Table	3. SV	OC Tentat	tively I	dentified	d Com	pounds (n	ng/kg	)							
	Sample Location		19	93 FL	, j		23	3 FL			7	01 LA		Warehous	se , VA	Warehou	se, LA
	Matrix	Gypsum	Paper	Paint Chips	Paint	Gypsum	Paper	Paint Chips	Paint	Gypsum	Paper	Paint Chips	Paint	Gypsum	Paper	Gypsum	Paper
RT	Tentatively Identified Compounds																
3.2	Ethylene Glycol		3.72										1700				
3.4	Unknown				630				762								
3.5	C5 Organic Acid							0.400									
3.9	Propylene glycol	0.497			3680				139								
4.1	2-Methyl-propanoic Acid	-			144				140					-			
4.6	Unknown			0.000	130												
5.1	C6 Organic Acid/ester			0.660										0.500	<u> </u>		<u> </u>
5.2	Unknown alsuilide compound	0.502	2.51											0.598			
5.2	2 Europearboxaldebyda	0.503	2.31											ł		0.0496	
5.5														0.448		0.0400	
5.8	Diethylene glycol	-											5710	0.440			
6.2	Styrene			2.02									5710	1			
6.8	Unknown disulfide compound			2.02										0.601			
6.8	Diethyl Disulfide	0.517												0.001			
7.2	Diethylene Glycol	0.377			592	2.12	31.3			1.18	7.55						
7.2	C4 Alcohol		4.03														
7.3	C7 Aldehyde/Unknown			0.951													
7.4	C6 Organic Acid\Unknown					0.559				0.638							1
7.4	C6 Organic Acid	0.807														0.0807	0.763
7.6	Aniline						0.648				1.82				2.69		1.12
7.7	Alkyl-benzene isomer C9H12																
7.7	Ethanol, 2-(2-butoxyethoxy)-												3490				
7.8	Ethanol, 2-(ethoxyethoxy)									0.989	1.49						
8.1	Ethyl hexanol isomer				62.4			1.16	106								
8.2	Unknown disulfide compound	0.271		0.813										0.367			<u> </u>
8.4	I ripropylene glycol monomethyl ether (C10H22O4 isomer)												306				<u> </u>
8.2	Unknown									0.508						0.0700	
8.4	C5 Organic Acid															0.0793	2.05
8.0	2-Furancarboxylic acid	-				0.400								ł		0.306	3.05
8.7		-				0.400								ł			1 15
8.7										0 323							1.15
8.7	Unknown	0.252						0.670		0.020				0.236		0.0850	-
8.8	Acetophenone	0.202		0.919				0.010						0.200		0.0000	
8.8	Acetophenone+unknown		1.27	01010											1		<u> </u>
8.9	o-Toluidine						0.486								0.876		
8.9	2.5-Furancarboxylic acid															0.0416	
9.2	C9 Aldehyde		1.64														1
9.6	Unknown disulfide compound													0.343			
9.6	C8 Organic Acid/ester			1.15													
9.6	Unknown	0.192						1.13									
9.8	Trimethyl Pentanediol				1340				961								
10.0	C8 Organic Acid/ester					0.543				1.25							
10.0	2-Decyne-4,7-diol, 2,4,7,9-tetramethyl					0.509			L						L		<u> </u>
10.0	Phthalic anhydride/Unknown			0.547										ļ			<b> </b>
10.3	2-Dodecene, (Z)-	0.55	0			0.000				0.5		4.19				0.0267	───
10.4	Etnanol, 1-(2-butoxyethoxy)-	2.36	2.07		ļ	0.281				0.508	7.43		148	ļ	<b> </b>		0.00
10.7	Hydroxy Wethyl Furan Carboxaldehyde								<u> </u>					0.010			2.22
10.9	Unknown Benzethiezele) I Inknown				<u> </u>		0.450						<u> </u>	0.213			┣───┤
11.0	Benzotniazoie/UNKNOWN				<u> </u>	1 00	0.453						<u> </u>	<u> </u>			┣───┤
11.0						1.03						l					<u> </u>
11.0						1.90			1						1		0.880
11.0	Caprolactum + unknown					2 15			<u> </u>						<u> </u>		0.000
11.1	Unknown					2.10	0.377		1						1		<u> </u>
11.1	1-Phenoxy-2-propanol		5.81		1170		0.011	1	1			1		t	1	-	
11.2	C9 Organic Acid		0.01				0.624	1	1	2.04	2,98	1			1		
11.2	Quinoline	0.296							1				1	Ì	1		1
11.3	1,4- Dimethylcyclooctane				1		1		1		l		1	0.205	İ.		1
11.3	Propanediol ethyl isomer				82.8												
11.3	Caprolactum	0.267					0.589										

		Table	3. SV	OC Tentat	tively I	dentifie	d Com	pounds (n	ng/kg	I)							
	Sample Location		19	93 FL	,		23	3 FL	<u> </u>	/	7	01 LA		Warehous	se,VA	Warehou	ise, LA
	Matrix	Gypsum	Paper	Paint Chips	Paint	Gypsum	Paper	Paint Chips	Paint	Gypsum	Paper	Paint Chips	Paint	Gypsum	Paper	Gypsum	Paper
RT	Tentatively Identified Compounds																
12.1	1-Decanethiol	0.103												0.217		L	
12.4	4-Hydroxybenzaldehyde						0.355								0.782	<b> </b>	
12.5	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1- methylethyl)propyl ester	1.78			1860	3.98	0.982		3020	10.6	4.77		3600			ł	
	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester															l	
12.8	Lieknown	2.04			2680	4.24		0.380	4190	10.7	9.33		5600	0.448		<u> </u>	
13.0				1.05		0.509		0.530						0.440		[	
13.0	Vanillin	0.286	2 78	1.00		0.000	0.835	0.000		0 444	2 37				6.04	0 117	3 49
13.3	1,4-Methanoazulene, decahydro-4,8,8-trimethyl-9-methylene-														0.847		
13.6	Unknown																7.67
13.6	Dodecanol				42.0						2.04			2.38	4.51	í	
13.7	C12 Alcohol															L	
13.6	C12 Chlorinated Alkane											3.20				0.394	
13.7	Dodecenol	2.81	9.88													<b> </b>	
13.8	Unknown (column bleed?)				91.6				55.6							I	_
14.0	2,6-Di(t-butyl)-4-hydroxy-4-methyl-2,5-cyclohexadiene-1-one		1.07							0.242				0.40	4.40	I	_
14.4	1-Dodecanethiol	0.896	1.07	0.690				0.250				0.062		2.42	4.16		-
14.9	Unknown			0.680				0.350	57.0			0.962				i	-
14.9	C12 Organic Acid ester/ethelate			0.759	27.6				57.2							i	
14.9	Hydroxy methoxy phenyl ketone			0.750	57.0		1								0 740		
15.0								0 790							0.740	(	
15.1	Phenol. 4-octvl			1.15				01100								í	
15.4	Cedran-8-ol									0.713						i	
15.4	Unknown			0.702													2.74
16.0	Unknown							0.420			2.02					1	
16.2	C10 Organic Acid										2.34					Í .	
16.3	Unknown											1.37				í	
16.3	Unknown			0.729				0.570		1.33	3.44				0.981	Ļ	
16.4	2-Tetradecene/Cyclotetradecane	0.304														I	
16.4	C14 Organic Acid/Benzoic acid, propy; ester isomer									0.736						<b> </b>	0.785
16.4	C14 Organic Acid/Unknown		1.75				0.428							1.01	0.07	I	_
16.4	I etradecanethiol													1.04	2.87	0.0240	-
16.7	Alkane/Unknown	-				-	-	0.200				0.040				0.0346	-
16.8	Benzenesulfonamide n-butyl-							0.390				0.949					-
16.9	C20 Alkane							0.000						0 186		(	
16.7	Benzyl Benzoate			0.617										0.100			
16.9	Fyrol PCF							0.390								i	
17.1	Unknown			1.06				0.380				1.62				1	
17.1	Unknown			2.20												í	
17.1	Unknown							0.590								L	
17.4	C16 Organic Acid ester/phthalate			1.80				2.23		0.579						L	
17.6	1,2-Benzenedicarboxylic acid, butyl decyl ether	0.196			ļ	0.557	0.439									0.0336	
17.8	Unknown	0 700	44.0	0.077	ļ	0 700	0.00	0.430		4.00	40.0			0 770	40.0	4 ==	1.36
18.2	U16 Urganic Acid	0.738	14.6	0.855		0.788	3.90	0.510		1.36	12.6			0.770	13.6	1.57	16.0
18.8	Dihutuliseeettaalete							0.510							1.31		-
10.9					100			0.510				0.031					-
19.4	Unknown	1		4 40	130		<u> </u>	1.66				1 10	-	0.361		í	t
19.3	Unknown Alkane	1					0.601	1.00		1.20		1.10		0.001		0.0345	+
19.6	Octadecenoic Acid	1	1.78				4.38	1			9.67				17.5	0.248	9.88
19.6	Unknown			0.987												1	1
19.7	Alkyl maleate			5.17												i	9.20
19.8	Benzoic Acid alkylester		9.72			0.249				1.14	2.14	16.2			9.10	0.199	
19.9	Bis (2-ethylhexyl) maleate							16.0									
19.9	Unknown			0.767												ļ	
20.1	Unknown	ļ	ļ	1.21			ļ									<b> </b>	+
20.1	Unknown			0.607	ļ		<u> </u>	0.350	075							<b></b>	+
20.1	Fumaric Acid Co ester								375	0.710						0.0000	
20.0	Unknown Alkane							L		0.712						0.0923	

		Table	3. SV	OC Tentat	tively I	dentified	d Com	pounds (n	ng/kg	)							
	Sample Location		19	93 FL			23	3 FL			7	01 LA		Warehous	se , VA	Warehou	ise, LA
	Matrix	Gypsum	Paper	Paint Chips	Paint	Gypsum	Paper	Paint Chips	Paint	Gypsum	Paper	Paint Chips	Paint	Gypsum	Paper	Gypsum	Paper
RT	Tentatively Identified Compounds																
20.1	C22 Alkane					0.319	1.27				2.29				0.954		0.840
20.8	Unknown Alkane															0.233	
20.7	C23 Alkane																2.16
20.8	C21 Alkane	0.315															
20.5	Unknown														1.09		
20.6	Fumaric Acid, bis (2-ethylhexyl) ester							183									
20.6	Unknown Alkane					0.247					5.31						
20.8	Unknown Alkane		2.03			0.935	2.71			1.47				0.534	2.45		
21.0	Unknown														0.766		
21.0	Unknown Alkane					0.242											
21.3	Unknown							0.410									_
21.3	Benzyl butyl phthalate			0.573				1.11				2.27					
21.5	Unknown Alkane	0.383	3.59			1.48	4.25			2.33	8.96			0.808	5.55	0.396	5.18
21.8	Phosphoric Acid, 2-ethylhexyldiphenyl ester			1.14								3.62					_
21.8	C20 Alkane							0.430									_
21.9	Unknown					0.253											_
22.2	Unknown Alkane	0.579				1.98								1.05		0.560	7.61
22.1	4-Phenyl Morpholine						9.18	1.75				631					_
22.2	4-Phenyl Morpholine											840					_
22.1	Unknown		6.80					20.4		17.4	59.0				8.15		_
22.2	Unknown			12.4		0.360				16.8	98.7					0.123	_
22.4	Unknown Alkane					0.290											
22.3	Diethylene glycol dibenzoate		6.45				19.9	63.2		2.59	9.71				7.75		4.55
22.3	Dipropylene glycol dibenzoate											121					
22.7	Unknown			1.56						2.88							
22.8	Unknown Alkane	0.455	4.69			1.74	6.51				15.8			0.971	6.61	0.606	5.82
23.2	Unknown Alkane					0.287											
23.2	Unknown	0.000		2.36		4.05				0.40				4.40	7.00	0.570	
23.4	Unknown Alkane	0.636	6.39			1.95	8.41			3.12	21.8			1.19	7.88	0.578	7.01
23.8		0.007	7.00			4.00	4.00			4.00	F 40			0.293	0.04	0.0643	
24.0		0.387	7.08			1.09	4.06			1.28	5.49			0.685	3.81	0.415	4.11
24.7	Unknown Alkane	0.580	4.63			1.06	4.86			1.15	6.37			0.878	5.18	0.359	4.44
25.1	Disulfide, didodecyi	0.000						0.04						0.637			-
25.2		0.230	5.05			0.500	5 50	2.64		0.450	0.40			0.500	F 75	0.4.47	4.00
26.2		0.403	5.65			0.592	5.58			0.456	6.10			0.583	5.75	0.147	4.23
26.9											5.03			0.400			-
20.8			4.00			0.004	4 7 4			0.000				0.408	4.40	0.0050	-
27.1	Dinanbthyleufana isamar	0.277	4.20			0.221	4.74			0.230				0.272	4.10	0.0003	+
27.2		0.377												0.273		0.225	2.70
20.0																0.211	2.70
20.0	Dirknown Binanthyl auffana	0.160														0.211	
20.1		0.109	4.20				1 22				4.06				2.74		
20.1			4.20				4.23				4.00				3.74		1 96
29.4			3.20				3.20				3.01				2.40		2.20
23.3	Unknown Aikalle	+	1.02														2.39
30.0	I Inknown Alkane	+	1.02				1 70				1.91						2.20
32.3			1 90				1.70				1.01				1		+
33.5			3.58												1		2 4 3
55.5	Total TIC Concentration mg/Kg	19.9	128	49.8	12700	32.9	127	304	9810	86.4	325	1630	20900	10 1	132	7 39	110
	Total SVOC ma/Ka	1 8/	5.92	8 44	NA	1 /3	5.51	12.7	NA	2 00.4	7 28	10.50	NA	0.483	1 10	0.345	3.00
	Total mg/Kg	22	134	58	12700	2/	133	317	0810	2.50	332	1650	20000	20	136	0.545	122
	Irotaringing		134	50	12100	54	155	317	3010	03	332	1050	20300	20	150	U	122

	Table 4. VO	C Tentatively	Identified Cor	npounds (mg/	kg)				
	Sample Location	193	3 FL	233	FL	701	LA	Warehouse, VA	Warehouse, LA
	Matrix	Gypsum	Paint	Gypsum	Paint	Gypsum	Paint	Gypsum	Gypsum
RT	Tentatively Identified Compounds								
	Isopropanol						4.04		
4.8	2-Propanol, 2-methyl-		1.02		1.46		4.61		
7.2	Propanal, 2,2-dimethyl-		0.088						
10.4	Pentanal+TCE			0.00357		0.00357			
12.6	2-Pentanone,4,4-dimethyl		0.00831						
12.8	C7 Ketone (2,4,dimethyl,3-pentanone)		0.00726				0.00699		
13.2	Hexanal			0.00464		0.00464		0.00713	0.00186
13.3	Acetic acid, butyl ester						0.0407		
14	C7 Ketone (4-heptanone)		0.00285				0.00879		
14.3	Benzene, 1-chloro-4-(trifluoromethyl)-		0.0314						
14.6	n-Butyl ether		0.25		0.25		0.625		
14.8	4-Heptanone				0.0164		0.0272		
15.5	Propanoic acid, butyl ester		0.00718				0.249		
15.6	Heptanal			0.00419		0.00419		0.00168	
17.1	Ethyl Methyl Benzene Isomer	0.0437		0.0404		0.0404			
17.3	Butanoic acid butyl ester isomer						0.0118		
17.6	Ethyl Methyl Benzene Isomer			0.00244		0.00244		0.00203	
17.7	Benzaldehyde		0.00582				0.0183		
17.7	Unknown							0.00459	0.00179
17.8	Ethyl Methyl Benzene Isomer								
17.8	Octanal			0.00425		0.00425			
17.9	Butanoic acid butyl ester isomer						0.0067		
18.1	Unknown aldehyde			0.00245		0.00245			
18.1	1-Hexanol, 2-ethyl-		0.149		1.14			0.00488	
18.2	C10 Alkene\Cycloalkane						0.00909		
18.4	Limonene							0.00251	
18.6	2-Butenoic acid, butyl ester						0.0334		
19	C8 alcohol							0.0065	0.0043
20.1	Unknown			0.00547		0.00547		0.00973	0.00349
20.8	Unknown aldehyde							0.00219	
23.3	Unknown								0.00191
23.4	Unknown							0.00221	
24.5	Unknown			0.00134		0.00134			
25.5	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester		0.0469		0.216		0.0937		0.00793
25.7	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester		0.0266		0.125		0.0854		0.00735
26.9	Unknown								0.0
	Total VOC Concentration (mg/Kg)	21.9	21.6	0.242	4.56	0.242	45.7	0.195	0
	Total VOC TIC Concentration (mg/Kg)	0.0437	1.64	0.0688	3.21	0.0688	9.87	0.0435	0.0286
	Total mg/Kg	21.9	23.3	0.311	7.77	0.311	55.5	0.238	0.0286

Table 5. Headspace Screening Results for Reduced Sulfur Compounds in Gypsum by GC/SCD (PPBV)												
Sample Location	Method Blank		193 FL		233 FL		701 LA		Warehouse, VA		Warehouse, LA	
Target Analytes	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
Hydrogen SUlfide	<2.0	<2.0	130	76	72	4.3	45	6.9	130	35	<2.0	2.8
Carbonyl Sulfide	<2.0	<2.0	270	640E	130	700E	160	1100 E	270	2100 E	9.5	29
Methyl Mercaptan	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Ethyl Mercaptan	<2.0	<2.0	<2.0	7.0	<2.0	3.8	<2.0	<2.0	7.1	7.1	<2.0	<2.0
Dimethyl Sulfide	<2.0	<2.0	<2.0	<2.0	<2.0	3.6	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Carbon Disulfide	<2.0	<2.0	72	400E	50	420E	63	570E	81	1100E	8.2	24
Isopropyl Mercaptan	<2.0	<2.0	8.9	44	7.8	15	<2.0	18	7.7	36	<2.0	3.1
t-Butyl Mercaptan	<2.0	<2.0	<2.0	4.3	<2.0	<2.0	<2.0	<2.0	<2.0	6.7	<2.0	<2.0
n-Propyl Mercaptan	<2.0	<2.0	<2.0	3.7	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Ethyl Methyl Sulfide	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Thiophene/2-Methyl-Propanethiol	<4.0	<4.0	<4.0	25	<4.0	7.4	<4.0	7.2	11	17	<4.0	<4.0
Methyl Isopropyl Sulfide	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
1-Methyl-Propanethiol	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
n-Butyl Mercaptan	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0

E: estimated, above calibration range