HETA 98-0279-2722
Sunlite Casual Products
Sarasota, Florida

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PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

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ACKNOWLEDGMENTS AND AVAILABILITY OF REPORT

This report was prepared by John Decker and Loren Tapp, of the Hazard Evaluations and Technical Assistance Branch, Division of Surveillance, Hazard Evaluations and Field Studies (DSHEFS). Analytical support was provided by Mark Millson and Ardith Grote of the Division of Physical Sciences and Engineering (DPSE). Desktop publishing was performed by Patricia C. McGraw. Review and preparation for printing was performed by Penny Arthur.

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SUMMARY

In July 1998, the National Institute for Occupational Safety and Health (NIOSH) received a confidential employee request for a health hazard evaluation (HHE) concerning health effects from exposures to chemicals in the office area at Sunlite Casual Furniture Company in Sarasota, Florida. The request indicated that office employees were experiencing a variety of symptoms (including fatigue, dizziness, headache, and nausea) and medical problems (including hematuria [blood in urine]). The health concerns were primarily related to an incident which occurred on May 27, 1998, during which a chemical odor was detected in the office area. In response to the HHE request, NIOSH conducted a site visit on August 27, 1998, during which industrial hygiene and medical evaluations took place.

During the site visit, a walk-through inspection of the facility was conducted to observe the manufacturing processes, ventilation systems, and employee work practices. Subsequently, the NIOSH industrial hygienist reviewed records from consultants who had conducted industrial hygiene evaluations at the facility and collected bulk samples of powder paints in use at the facility. The paint samples were quantitatively analyzed for metals using NIOSH Analytical method 7300. The predominant metals found were aluminum, barium, iron, magnesium, strontium, and titanium. A small sample of each of the powder paints was also heated to a temperature of 150 degrees Celsius for 15 minutes (to simulate conditions in the curing oven) and the organic vapors collected and analyzed. Derivatives of benzene, aldehydes, and caprolactam were identified in this process, but no isocyanates were detected.

The NIOSH medical officer interviewed 14 employees, including the nine employees who worked in the office area. Company injury logs and the office employees' medical records were reviewed. Personal and telephone interviews were conducted with physicians who participated in the evaluation and treatment of some of the office workers.

Information from both production and office workers indicated that there had been an unidentified odor on May 27, 1998, for a period of approximately two to four hours. The nine office employees all reported a combination of the following symptoms: eye, nose, and throat irritation, headache, lightheadedness, nausea, loss of concentration, and short-term memory. One of the nine office employees also reported respiratory symptoms.
Office employees were evaluated in a local medical clinic; some were referred to several physicians and received extensive medical evaluations. Several employees were determined to have persistent hematuria

as determined by dipstick urinalysis. Subsequent microscopic urinalysis found persistent presence of hemoglobin and/or myoglobin in three employees, but no blood (no intact red blood cells). Further renal and urologic (related to the kidneys and urinary bladder) evaluations did not reveal a cause for the abnormal urinalyses. Persistent symptoms of fatigue, headaches, loss of concentration and short term memory were reported by seven of the office employees, even though most of the employees have not worked in the office or production environment for six months.

Office employees experienced an unidentified occupational exposure on May 27, 1998. No source(s) of exposure originating in the office area were found. Although there are a variety of substances (including paints and cleaning agents) and processes in the production area, a route of exposure of the office workers to any of these substances or processes has not been identified. The cause(s) of the acute symptoms among the office staff from the May 27 incident is also unknown, although is likely related to the odor reported by all employees. Symptoms currently being experienced by some of the office employees do not appear related to current occupational exposures. Although hematuria was present in eight workers, no cause for this condition was identified. None of the chemicals in use in the production area are known to cause hematuria. Recommendations are provided regarding ventilation issues, establishing a safety committee to address general health and safety issues, and continued medical evaluation and treatment of employees.

KEYWORDS: SIC 3479 (Coating, Engraving, and Allied Services, Not Elsewhere Classified), powder paints, hematuria, hemoglobinuria, myoglobinuria, urinary toxins, aluminum

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INTRODUCTION

In response to a confidential employee request received in July 1998, the National Institute for Occupational Safety and Health (NIOSH) conducted a health hazard evaluation (HHE) at Sunlite Casual Products on August 27, 1998. The request stated that office employees were experiencing many types of symptoms and health problems (including hematuria [blood in urine]) possibly related to exposures at work. The requesters asked NIOSH to determine if the reported health problems were associated with worksite exposures.

BACKGROUND

The Sunlite Casual Furniture operation in Sarasota, Florida produces high-end speciality aluminum patio furniture. At the time of the NIOSH visit, approximately 70 employees were employed in the manufacturing area; because production is seasonal, employment may reach approximately 130 employees in the Spring. The company generally has an office staff of nine employees. The manufacturing operation is located in two one-story buildings (combined square footage: 60-65,000 square feet). The front building houses the offices, cleaning/pretreatment line, the paint line, and packaging/shipping area. The back building contains the aluminum cutting, extruding, bending, welding, and sanding operations. Exhaust stacks (4-5 feet high) for the ovens and heaters are located on the pitched metal roof of the front building.

The office space is a separately-constructed area (about 1000 square feet) adjacent to the manufacturing area of the front building. Air conditioning is provided to the office space by a package unit and a split-type air conditioning unit, neither of which have outdoor air intakes.

The cleaning/pretreatment line is a wash system that cleans and prepares the aluminum surfaces for painting. The system consists of a series of sodium hydroxide and phosphoric acid washes. Some furniture is also washed with Permatreat 615M® (diammoniumhexafluorozirchromate; CAS 16919-31-6). The wash chemicals are heated with two natural gas heaters. As the furniture is conveyed out of the wash line, an employee blows residual chemical off from the furniture with a compressed air hose. The furniture is then conveyed through a drying oven (approximately 250 degrees Fahrenheit [^{o}F]) prior to painting.

After drying, the furniture is conveyed into the electrostatic powder painting operation. The area is climate-controlled to ensure proper coating and adhesion of the paint. One employee, wearing a hooded air-line respirator, applies powder paint with an electrostatic spray gun. The guns produce an aerosol of electrically-charged paint particles with compressed air. The powder paint particles are attracted to the aluminum furniture by the electrical field present between the charged particles and the electrically grounded conveyer. Most of the paint adheres to the aluminum furniture, but some powder is exhausted into the spray booth. The furniture is then conveyed through a natural gas-fired curing oven where the paint "melts" (cures) onto the furniture. The oven temperature is 300^{o}F, and the residence time in the oven is approximately 15 minutes.

At the time of the NIOSH visit, eight types of powder paints were stocked in the painting area. The paints are supplied by TCI, Inc. (Ellavelle, Georgia) and Crosslink Powder Coatings, Inc. (Clearwater, Florida). Paints supplied by Morton International Inc., (Chicago, Illinois) were used in the past. The Material Safety Data Sheets (MSDSs) list the paints as blocked polyisocyanates or polyesters. The manufacturer's MSDSs for the powder

paints generally do not reveal the specific composition of the paint. The polyisocyanate paints are generally made from a reaction of unsaturated organic acids with polyhydroxy-alcohols. The resulting polymers are designed to be cured or cross-linked with an isocyanate or polyisocyanate. In the uncured powders, the isocyanate group is prevented from polymerizing by a moderate-volatility blocking agent which is usually caprolactam. In these formulations, the caprolactam forms a weak bond with the isocyanate groups and prevents them from reacting together or with other materials. When heated, the isocyanate-caprolactam bond breaks and the caprolactam escapes as vapor, leaving the isocyanate groups free to participate in a polymerization reaction. The paints contain other additives such as calcium carbonate, carbon black, titanium dioxide, barium sulfate, and chromium-based pigments. In general, the unheated powder coatings are thought to be low toxicity materials,[1,2] however, chemical pneumonitis has been reported following inhalation of epoxy powders.[3] The major hazard appears to be associated with dermal contact, which can result in both direct irritation and in allergic sensitization.[4, 5, 6]

The polyester paints form thermosetting coatings in a manner similar to that of the polyisocyanates. The chemistry is similar, except that these paints generally use triglycidyl isocyanurate instead of a polyisocyanate. Some polyesters may contain phthalic anhydride or trimellitic anhydride.[1,2]

On May 27, 1998, a chemical odor detected by office staff resulted in the evacuation of the office spaces. The odor reportedly emanated throughout the facility, but was particularly strong in the office area. The office workers stated that, during the 2- to 4-hour time period that they worked while the odor was present, they experienced symptoms including eye, nose, and throat irritation, dizziness, nausea, disorientation, a drunken-feeling, loss of concentration, and short term memory. No specific cause for the odor was identified, but investigations around the time of the incident reportedly found multiple potential causes for the office workers' symptoms, including: (1) a stack serving the natural gas heater for the cleaning/pretreatment process was found to be corroded; (2) an air-conditioning duct serving the office area was reportedly dislodged; (3) a diesel truck was reportedly idling outdoors near the building at the time of the incident; (4) an exhaust fan on the drying oven had reportedly stopped running; (5) there was a leak in the sodium/potassium hydroxide wash tank; and (6) an oiler for the conveyer chain was found to be putting too much oil (Mighty Lube SS-3 lubricant) into the conveyer; the excess oil reportedly smoked as it exited the curing ovens. The MSDS for the conveyor oil [flash point of 145^{O}F] indicated that the oil has the following components: hydrocarbon hydrotreated solvent, polymer ester, various amines, and molybdenum compounds.

The problems listed above were reportedly corrected following the May incident; however, some employees report that the odor has reoccurred since then. Management reported that additional repairs to the air-conditioning systems (cleaning, replacement of ducts, and condensate pans) were subsequently made. In the days following the May incident, all of the office staff were evaluated by local health care providers under contract to Sunlite, and concern grew after the majority of these workers tested positive for blood in the urine (review of that information is included in the "Results" section of this report).

Since the May incident, three private consultants have conducted industrial hygiene evaluations at the facility. The first evaluation was conducted on June 5, 1998, and included visual inspection of the office area, measurement of indoor air quality indicators (temperature, relative humidity, carbon dioxide) in the office areas, and air monitoring

for heavy metals. All the indoor air quality indicators were within the ranges specified by the American Society for Heating, Refrigerating, and Air conditioning Engineers (ASHRAE), and no airborne metals were found. However, the number of occupants in the office area at the time was not noted, and the manufacturing area was not in operation. A follow-up survey was conducted by a different consultant in late June 1998. In that survey airborne solvents and metals were measured in the office area, revealing no metals and very low levels of various solvents. The third evaluation (by a third consultant), in August 1998, consisted of a visual inspection of the office areas. An evaluation of the office air-conditioning system found "slight visible debris" and "slimy texture" inside the condensate pan. Several recommendations were offered, including: (1) regular visual inspections of the air-conditioning systems, (2) isolation (from a ventilation standpoint) of the office area from the production area, (3) removal of dirty insulation in the attic area, (4) positive pressurization of the office area relative to the process area to keep potential contaminants out, and (5) industrial hygiene evaluations in the process areas.

METHODS

The NIOSH evaluation consisted of the following elements:

1. The Occupational Safety and Health Administration Log and Summary of Occupational Injuries and Illnesses, Form 200, (OSHA 200 log) and company injury reports from the past three years were reviewed, and the reports from industrial hygiene consultants were obtained.

2. Bulk samples of eight powder paints were collected. These represented each type/color of paint that was present in the paint room during the NIOSH evaluation. The paint samples were quantitatively analyzed for metals using NIOSH Analytical method 7300 (the list of metals and limits of detection can be found in Table 1).[7] Three replicate aliquots (approximately 50 milligrams each) were weighed, and wet-ashed with concentrated nitric and perchloric acids. The samples were redissolved in 50 milliliters of dilute nitric and perchloric acids and analyzed by inductively coupled argon plasma, atomic emission spectroscopy.

Additionally, the actual coating process was simulated by heating a small sample of each powder paint to a temperature of 150 degrees Celsius for 15 minutes (similar to the conditions in the curing oven). The organic vapors were collected and analyzed by gas chromatography/mass spectrometry (GC-MS).

3. During the site visit, confidential employee interviews were conducted with four of the nine office employees who had been present during the May 27th incident, and five production workers (including one employee who had been in the office area during the incident on May 27th and another who had been working on the plant floor until promoted to an office position on June 1, 1998). The five production workers were chosen because of their knowledge of the May 27th incident. The five office workers not interviewed during the site visit were not present at work on the day of our visit; telephone interviews with these workers were conducted after the site visit.

4. Medical records of the office employees were reviewed by the NIOSH medical officer during a meeting with an occupational medicine physician/toxicologist who had evaluated eight of the nine office employees approximately one month after their initial evaluations. Telephone interviews with other physicians who also evaluated and treated some of the office employees, as well as further medical record reviews, were performed after the site visit.

RESULTS

Industrial Hygiene

The results of the metal analysis of the bulk powder paint coating are presented in Table 1. The total number of metals found in the individual powder coating paints ranged from 14 to 19. The predominant metals found were aluminum, barium, iron, magnesium, strontium, and titanium. A small amount of cadmium was found in five of the eight samples. According to an industry publication, the metals found in our analyses would be expected in powder coatings.[2] The only possible exception is strontium, which was found in all our samples.

The results of the paint emissions released following heating of the powder paint coating are presented in Table 2. These results indicate that a wide variety of organic vapors are released during the curing process. The total number of compounds released by each individual coating ranged from 10 to 14, with a total of 45 different compounds identified. As expected, many compounds were derivatives of benzene, which are probably released by the breakdown of the epoxy and/or polyester matrix. Additionally, various aldehydes were detected. As anticipated, caprolactam was released by polyester coatings that used blocked isocyanates; no isocyanates were detected in the emissions.

Medical

There were nine employees present in the office at the time of the May 27th incident. All of these workers were women, with a mean age of 40 years (range 21 - 62). At the time of the NIOSH visit, two employees had resigned, two employees left because their positions were eliminated, and two employees were on medical leave. The remaining office employees were working part-time at the office and part-time at home. One of the workers on leave was interviewed at the time of the site visit.

Two of the nine office workers were evaluated by a local occupational medical clinic on May 29th, 1998. One of the two workers had respiratory symptoms (including shortness-of-breath) and was diagnosed at that time as having reactive airways dysfunction syndrome (RADS) due to chemical exposure; the criteria used in determining this diagnosis were not clear. On June 1, 1998, the other seven office workers had their initial evaluation at the same medical clinic, and the two seen previously were reexamined. The medical reports from May 29th and June 1st indicated that these employees had multiple medical complaints and findings at that time, including various neurologic symptoms, nose and throat irritation, nausea, dizziness, lightheadedness, and microscopic hematuria diagnosed by routine urine dipstick (one worker was noted to be menstruating at the time of the June 1st evaluation). At least six of the nine workers (not all records were available) were seen again on June 3rd in follow-up visits at the same clinic. The reports indicated that the majority of the neurologic and upper respiratory symptoms had resolved, but repeat urinalysis by dipstick showed five of the employees to have persistent microscopic hematuria (1+ to 3+). Of the nine office workers who were interviewed, most have reported to the NIOSH medical officer that some symptoms have persisted to the time of the site visit; these symptoms included fatigue (seven employees), headaches (seven employees), loss of concentration, and short term memory (eight employees).

Most of the employees received further medical evaluations in the weeks following the May 27th incident. Microscopic urinalysis was performed (and results available) for six of the workers. Of these six samples, three (including one from an employee who had a dipstick positive for hematuria) were negative for blood, and three (all previously found to have hematuria by dipstick) showed presence of hemoglobin/myoglobin, but no intact red blood cells. These three employees continued to have persistent hemoglobin/myoglobin detected on urinalysis as recently as October 1998. Tests for heavy metals, carboxyhemoglobin, and renal function were also performed on seven employees. Blood and urine tests for heavy metals were within normal ranges. Four of the seven had elevated levels of carboxyhemoglobin ranging from 3.1 to 9.4 percent with normal range being 0 - 1.5 percent; two of these four employees reported smoking cigarettes. Three

employees of seven had slightly decreased creatinine clearance (which is a measure of kidney function), ranging from 62.3 to 68 milliliters per minute (ml/min) (normal range: 75 - 115 ml/min); these same three workers had been found to be negative for RBC and hemoglobin/myoglobin on microscopic urinalysis.

Eight of the nine employees were subsequently referred to another doctor, who reviewed medical records and obtained further studies, including blood chemistries, complete blood count, renal and abdominal ultrasound, protein electrophoresis, thyroid studies, erythrocyte sedimentation rate, fractionated urine porphyrins, beta-2-microglobulin, pulmonary function testing, and urine cytology. A review of these medical records revealed that three out of five workers tested for blood aluminum levels had elevated levels (range of 23-31 micrograms per liter (mcg/l, with a normal range of 3-10 mcg/l). Repeat testing of blood aluminum in one of the workers revealed a normal level. All results of urine cytologies (four performed), protein electrophoresis (six performed), and beta-2-microglobulin levels (four performed) were normal. No patterns of abnormalities potentially related to workplace exposures were evident in reviewing the other medical tests (including extensive kidney evaluations in some) that were done. Four of the employees have been referred to a urologist.

Four of the five production workers who were interviewed reported no health problems that they felt were due to their work environment, although one did notice an unusual odor in the production area on May 27th. One of the five, who had been inside the office area at the time the odor was present stated that, after 20 minutes in the office, his eyes and nose started burning, and he became dizzy and felt as if he were in a drunken state. These symptoms resolved in about five minutes after he went outside in the fresh air. None of the five reported any urinary symptoms. Three of the five were evaluated by a health professional within one month of the May 27th episode; none reported having hematuria after routine urinalysis testing was performed.

In 1996 and 1997, all entries on the OSHA 200 log involved musculoskeletal or laceration-type injuries. In 1998, there were 24 entries; nine entries were from the May 27th episode, all involving office staff. There was also a fume exposure on May 17, 1998, involving an office worker, an eye exposure to paint thinner involving a production worker in 1998, and the rest were musculoskeletal in nature.

DISCUSSION AND CONCLUSIONS

Microscopic hematuria is present when a urine specimen (collected and prepared in a standard manner) contains greater than three to five red blood cells (RBC) per high powered field (HPF) when viewed with a microscope.[8,9,10] A common method of analyzing urine specimens without the use of a microscope is the use of a urine test strip ('dipstick'), which can detect the equivalent of five or greater RBC per HPF with excellent sensitivity; however, the specificity of the urine dipstick is poor, and many false positive results occur.[8] When present in urine, hemoglobin and myoglobin, substances found in RBC and in muscle cells, respectively, will result in a positive urine dipstick test for hematuria.

Microscopic hematuria is present relatively frequently among healthy men and women; for example, one study showed that 39 % of a healthy, male population had microscopic hematuria on routine urinalysis at least once over a 15 year period.[11] The cause of asymptomatic microscopic hematuria is frequently not determined.[8] Many medical conditions and medications, and menstruation, can cause hematuria.[8,9,11] There are also many occupational exposures which can cause hematuria, including exposures to substances known to be urinary tract carcinogens (benzidine, aniline dyes, asbestos, and gasoline), hydrocarbon solvents, silica, many metals (including lead, cadmium, mercury, arsenic, antimony, bismuth, silver, gold, lithium, and platinum), methanol, ethylene glycol,

carbon tetrachloride, and ethylene dichloride.[12] However, using urinalysis to screen for occupational disease has, in general, been shown to be unreliable, and, some authors feel, should be avoided.[11,13]

From the record review and interviews it is clear that the office employees experienced an occupational exposure on May 27,1998; the substance(s) to which the employees were exposed are unknown. No source(s) of exposure originating in the office area have been found. Although there are a variety of substances (including paints and cleaning agents) and processes in the production area, a route by which office workers were exposed to any of these substances or processes has not been identified. Our bulk sampling of the powder paints, and the analyses of the compounds formed when simulating the curing process, were done in expectation that some pathway of exposure between these industrial processes and the reported health effects of the office employees might be identified. After our site visit, interviews with employees, and review of the consultants' reports, no connection between any specific industrial process and the May 27th incident was identified; therefore we have no reason to believe that office workers had significant exposure to any of the substances listed in Tables 1 and 2.

The acute symptoms of the office staff from the May 27th incident (nausea, disorientation, feeling inebriated, headache, dizziness, burning eyes and nose) are compatible with symptoms seen with exposure to organic solvents;[14] however, these symptoms are not specific for solvent exposure and, in general, would not persist after the exposure ended. Yet many of the nine office workers continued to report fatigue, headaches, loss of concentration, and short term memory six months afterward, even though most of these workers are no longer exposed to the office (or production) environment. The cause of these persistent symptoms has not been determined, but are not readily explained by occupational exposures at Sunlite.

Eight of the nine office workers were diagnosed as having hematuria by dipstick urinalyses, the etiology for which remains unknown. Of the six employees who had a laboratory (microscopic) urinalysis performed, three were abnormal, and indicated that the source of the positive result for blood on the urine dipstick test was not intact RBCs, but rather hemoglobin or myoglobin. Hemoglobin may be present in urine when RBCs have hemolyzed (broken apart); myoglobin may be present in urine when there has been a breakdown of muscle cells. Hemoglobinuria (hemoglobin in urine) and myoglobinuria (myoglobin in urine) may be found in persons with a number of medical conditions (including hemolytic anemia, acute renal failure, paroxysmal hemoglobinuria), after vigorous exercise, or after toxin exposure.[15,16] Myoglobin may be seen in excess amounts after injuries such as crush syndrome, electric shock, hypo- and hyperthermia, and with exposures to ethanol, isopropyl alcohol, and carbon monoxide.[15,17] Hemolysis causing elevated serum hemoglobin can be seen with exposures to aniline, arsine, benzene, tribromoethanol, cresol, phenol, and hydrazaline burns.[15] If the level of serum hemoglobin or myoglobin exceeds the binding capacity of plasma proteins, the free hemoglobin or myoglobin products are passed through the kidneys resulting in hemoglobinuria and/or myoglobinuria.[17]

The renal and urologic evaluations of the workers with abnormal urinalyses have not shown a loss of renal function. Occupational exposures causing hemoglobinuria, myoglobinuria, or microscopic hematuria as a component of kidney damage would most likely also lead to some abnormalities in the levels of low molecular weight proteins, e.g. beta-2-microglobulin, which are used as early indicators of damage to the kidneys;[18] these abnormalities were not found in these workers. We have no way of knowing if the same mechanism caused all of the abnormal urinalyses (dipstick and laboratory) seen in the office workers; it is possible that there are several different causes of these findings.

Although three of the office workers had elevated blood aluminum levels at one time, adverse renal effects have not been detected after exposure to aluminum by inhalation or ingestion in an

occupational setting.[19] Despite the fact that some of the powder paints did contain aluminum, no exposure pathway of aluminum into the office environment was identified. In addition, aluminum is in many products commonly used in the home, such as antacids, antiperspirants, and other drug store items, and is also found in foods grown in aluminum-containing soil.[19]

RECOMMENDATIONS

1. Sunlite Casual Products should have an engineering evaluation of the oven and wash heater stacks on the roof to ensure that the exhaust is not re-entrained into the building under various climatic conditions.

2. To address general health and safety issues and improve communication regarding health and safety, a safety committee, including employer and employee representatives should be established. Routine safety inspections should be conducted. These should include an inspection of ventilation ducts, and of burners and exhausts on gas-fired ovens and heaters, as well as an evaluation of general housekeeping.

3. Employees with medical problems or symptoms potentially related to the workplace should continue to receive appropriate evaluation and treatment by the occupational medicine provider.

4. Although no health effects related to dermal exposures were reported, it would be good practice for employees handling powder paints to wear protective gloves.

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Table 1
Sunlite Casual Products
HETA 98-0279 - August 27, 1998
Metal Analysis of Bulk Powder Paints
(micrograms metal per gram of powder paint)

	Speckle Pearl[1] #81217	Bronz Tech[1] #91230	TCI Tex Trade White[2]	Bone White[1] #99219	Stucco[1] #81224	Black Tech[1] #91918	Midnight Green[1] #91615	TCI Carbide Black[2]	Limit of Detection	Limit of Quantification
Aluminum	3800	812	6680	6060	3020	[30][3]	958	509	10	39
Barium	88500	85900	16.5	31700	90600	97500	96800	71700	0.3	0.99
Calcium	570	558	211	460	644	608	532	111000	4	12
Cadmium	0.6	2.6	ND	ND	0.8	ND	1.3	[0.2]	0.1	0.33
Cobalt	11.2	8.1	4.3	7.9	10.1	7.9	8.6	5.7	0.6	2.0
Chromium	3.6	10.4	[1]	[1]	2.3	ND	6.0	3.6	0.6	2.0
Copper	ND	[7]	[6]	ND	ND	ND	1173	ND	2	7.9
Iron	5500	31200	19.3	1140	1280	47.9	17000	1620	1	3.6
Potassium	14.8	[10]	[10]	[9]	ND	[10]	[10]	31.8	0.2	14
Magnesium	96.9	102	27.8	69.9	140	127	99.8	1050	3	11
Manganese	2.8	8.9	0.8	1.8	1.7	1.5	5.4	3.8	0.1	0.33
Nickel	8.6	2.4	4.2	4.1	4.3	ND	2.47	[1]	0.6	2.0
Phosphorous	245	115	372	389	82.1	51.8	114	17.2	3	9.2
Tin	24.2	178	16.1	28.3	30.9	163	149	295	2	6.3
Strontium	1100	977	2.1	687	1470	1220	1090	1330	0.1	0.33
Titanium	2110	290	2260	2610	1880	ND	[3]	[4]	3	8.6
Vanadium	7.8	[3]	14.6	11.3	ND	ND	ND	ND	2	6.9
Zinc	[8]	67.8	53.2	60.1	11.3	53.8	61.2	41.0	3	9.9
Zirconium	602	132	1130	854	33.3	ND	162	ND	2	5.3

Other metals analyzed, but not detected, included the following: silver, arsenic, lanthanum, lithium, molybdenum (except Black Tech #91918 had 28.9 µg/gram), lead, platinum, antimony, scandium, selenium, tellurium, thallium, tungsten, and yttrium.
[1] Manufactured by CrossLink Powder Coatings, Inc., Clearwater, FL
[2] Manufactured by TCI, Inc, Ellaville, GA
[3] Values in [ ] indicate that the quantities found were between the limits of detection and quantification. These trace quantities are subject to analytical inaccuracy.

Table 2
Sunlite Casual Products
HETA 98-0279 - August 27, 1998
Qualitative Analysis of Heated Bulk Powder Paints (15 minutes @ 150°C)
(Thermal Desorption-Gas Chromatography-Mass Spectrometry Analyses)

	Speckle Pearl[1] #81217	Bronz Tech[1] #91230	TCI Tex Trade White[2]	Bone White[1] #99219	Stucco[1] #81224	Black Tech[1] #91918	Midnight Green[1] #91615	TCI Carbide Black[2]
Acrolein		X	X	X		X	X	
Formaldehyde				X				
Propanal				X				
Acetone								X
Nitromethane						X		
2-Methyl propanal	X	X		X	X	X	X	X
Acetic acid	X		X			X		X
Isobutanol				X	X			
Methyl butenal					X			
Butanol				X				
Ethyl acrolein	X							
Epichlorohydrin		X		X		X	X	
Cyclopentanol	X				X			
Cyclopentanone	X				X			
Iosbutyrone	X				X			
Methyl propanoic acid						X	X	
Propylene glycol								X
Butanoic acid			X					X
Aliphatic oxy-compound	X		X		XX	X		X
Xylene isomer	XX						XX	
2,2-Dimethyl-1,3-propanediol	XX				X			XX
Ethyl-hydroxymethyl-propanediol?	X							
Benzaldehyde			X	X				
Ethenyloxypentane?			X	X				
Phenol		X	X	X		X	X	
Methyl benzaldehyde								
2-Ethyl hexanol			X	XX			X	
Benzyl alcohol								X
2-Ethylhexanoic acid					X			XX
Benzoic acid			X					
Caprolactam	XX				XX			XX
Fatty Acid						X		
MW 176, phenyl containing		X					X	
$C_9H_8O_3$ isomer		X					X	
Tetradecane		X				X	X	
Hexyl phenol								

Table 2 Continued
Sunlite Casual Products
HETA 98-0279 - August 27, 1998
Qualitative Analysis of Heated Bulk Powder Paints (15 minutes @ 150ºC)
(Thermal Desorption-Gas Chromatography-Mass Spectrometry Analyses)

Dimethylphthalate		X				X	X	
Pentadecane								X
Butylated hydroxy toluene								X
Aliphatic acid ester?								X
Hexadecane	X	X			X	X	X	
Heptadecane								X
Octadecane	X	X				X	X	
Benzil			X	X				
Benzoin			XX	XX				

[1] Manufactured by Crosslink Coatings, Clearwater, FL
[2] Manufactured by TCI, Inc, Ellaville, GA
[3] "XX" indicates a relatively larger abundance of this chemical was found, relative to the other chemicals in the bulk sample. Values with a "?" indicate some uncertainty in the chemical identification

For Information on Other
Occupational Safety and Health Concerns

Call NIOSH at:
1–800–35–NIOSH (356–4674)
or visit the NIOSH Homepage at:
http://www.cdc.gov/niosh/homepage.html

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