HEALTH HAZARD EVALUATION REPORT

HETA 93-1092-2461
UNR-ROHN MANUFACTURING
PEORIA, ILLINOIS

HETA 93-1092-2461NIOS INVESTIGATORS:
SEPTEMBER 1994 David A. Marlow, BS
UNR-ROHN MANUFACTURING Teresa A. Seitz,CH
PEORIA, ILLINOIS

I. SUMMARY

On September 1, 1993, the National Institute for Occupational Safety and Health (NIOSH) received a confidential request to conduct a health hazard evaluation in the galvanizing department of UNR-Rohn Manufacturing in Peoria, Illinois. The request was to investigate headaches and nausea which were believed to be due to exposures to substances in the galvanizing department. An industrial hygiene survey was conducted on December 13 and 14, 1993, to evaluate worker exposures in the galvanizing department. UNR-Rohn galvanizes parts used to construct broadcasting towers and also does custom galvanizing work for other companies including items such as cooling coil units for heating, ventilating, air-conditioning systems. Personal breathing zone (PBZ) air samples were collected for metals (zinc [Zn], lead [Pb], aluminum [Al], cadmium [Cd], and chromium [Cr]), acid gases (sulfuric and hydrochloric acids), and ammonia. Surface wipe samples were also collected during the survey to assess surface metal contamination. Bulk samples were collected from the galvanizing kettles for quantitative metal analysis.

Seventeen PBZ air samples were collected and analyzed for metals. Personal breathing zone air sample results for Zn ranged from 0.10 to 0.49 milligrams per cubic meter of air (mg/m^3). The Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (PEL) and the NIOSH Recommended Exposure Limit (REL) for Zn oxide fumes (as Zn) is
5 mg/m^3 and all results were well below this concentration. Personal breathing zone air sample results for Pb ranged from trace to 56.1micro- grams per cubic meter of air (µg/m^3). One of the Pb PBZ air sample results had a trace concentration and the other 16 had quantifiable concentrations. The OSHA PEL for Pb is 50 µg/m^3, and one Pb PBZ air sample result exceeded this concentration (56 µg/m^3). Personal breathing zone air sample results for Al ranged from trace to 11.3 µg/m^3. The OSHA PEL and NIOSH REL for Al (respirable dust) is 5,000 µg/m^3, and all sample results were well below this concentration. Personal breathing zone air sample results for Cd ranged from non-detectable (ND) to 0.40 µg/m^3. Four PBZ air sample results for Cd were ND. Nine PBZ air sample results for Cd had trace concen- trations. Four PBZ air sample results for Cd had quantifiable concentrations of 0.26 µg/m^3, 0.40 µg/m^3, 0.34 µg/m^3, and 0.24 µg/m^3. The OSHA PEL for Cd is 5.0 µg/m^3, and all sample results were below this concentration. Because NIOSH considers Cd a potential human carcinogen, the REL for Cd is the lowest feasible limit. Personal breathing zone air sample results for Cr (elemental) ranged from trace to 3.35 µg/m^3. All Cr PBZ air sample results were below the OSHA PEL of 1,000 µg/m^3 and the NIOSH REL of 500 µg/m^3 for elemental Cr. The valence state of the Cr component was not determined.

Seventeen PBZ air samples were collected for sulfuric and hydrochloric acid (HCl) gases. While preparing the samples for analysis, the chemist inadvertently discarded the glass fiber plugs which hold the silica gel sorbent inside the glass sampling tube. Since a large portion of the sulfuric acid collects on the glass fiber plug, the results for sulfuric acid gases are invalid. The concentration of the HCl PBZ air sample results ranged from ND to 0.19 mg/m^3. Since HCl collects mainly on the silica gel, the results for HCl are reported but should be considered minimum concentrations. Some HCl may have been lost.

Seventeen PBZ air samples were collected for ammonia. The ammonia PBZ air sample results ranged from 0.7 to 6.6 parts ammonia per million parts air (ppm). The NIOSH REL-TWA for ammonia is 25 ppm. All ammonia concentrations were below this value. The OSHA PEL for ammonia is a short-term exposure limit (STEL) of 35 ppm.

Ten surface wipe samples were collected from the break area, rest room, and foreman's office in the back of the galvanizing process area. These wipe samples were analyzed for Zn, Pb, Al, Cd, and Cr. The Zn surface wipe sample results ranged from 5.3 to 331 milligrams per square meter of surface area (mg/m^2). The Pb surface wipe sample results ranged from ND to 16.3 mg/m^2. One Pb surface wipe sample result was ND. All of the Cd surface wipe sample results were ND. The Cr (elemental) surface wipe sample results ranged from ND to 4.6 mg/m^2. Two of the ten Cr surface wipe sample results were ND. There are no standards with which to compare these surface wipe concentrations.

Four bulk samples were collected from the galvanizing tanks and analyzed for metal composition. The trace metals found in the bulk zinc were Pb and Cd. Mean results from the bulk analysis were: 1.15% Pb; 0.05% Cd; <0.005% Al; and <0.001% Cr, with the remainder being Zn. These concentrations are consistent with the values reported on the material safety data sheets.

Based on PBZ air sample results, workers in the galvanizing department are potentially exposed to lead levels exceeding the OSHA PEL of 50 µg/m^3. One of 17 lead personal air sample results (56 µg/m^3) exceeded the OSHA PEL. While no cadmium personal air samples exceed the OSHA PEL of 5.0 µg/m^3, detectable levels of cadmium were measured in some of the personal air samples (13 of 17). NIOSH believes that cadmium concentrations should be kept to the lowest feasible limit because it is a suspected human carcinogen. The surface wipe samples demonstrated the potential for exposure to metals from skin contact and ingestion. Efforts should be made to keep surface metal contamination levels to a minimum in areas such as the break area and rest rooms. Recommendations are made in the report to continue exposure monitoring, improve worker personal hygiene at work, and improve workplace cleanliness.

Keywords: SIC 3479 (hot-dip galvanization) zinc, lead, cadmium, aluminum, chromium, sulfuric acid, hydrochloric acid, ammonia, and galvanizing.

II. INTRODUCTION

On September 1, 1993, the National Institute for Occupational Safety and Health (NIOSH) received a confidential request for a health hazard evaluation to investigate exposures arising from a hot-dip galvanizing process which were believed to be causing headaches, nausea, and vomiting. An initial site visit was conducted on November 9, 1993. During this visit, walk-through surveys were conducted during the first and third shifts, and interviews were performed with workers from the galvanizing department (five from the first shift and seven from the third shift). Based on the observations made during the walk-through surveys and the interviews, a return visit was scheduled. The return visit was made on December 13 and 14, 1993, during which time an industrial hygiene survey was conducted on the third shift.

III. BACKGROUND

UNR-Rohn is a division of UNR Industries. The Peoria, Illinois, plant manufactures solid member hot-dip galvanized towers which are used for cellular telephone, microwave, television broadcast, AM/FM radio broadcast, CATV, two-way radio, high-level lighting, and similar structures. The galvanizing department also does custom galvanizing work for other companies' products including items such as cooling coils for heating, ventilating, and air- conditioning (HVAC) systems.

The Peoria plant employs 285 workers. At the time of the NIOSH evaluation 51 employees worked in the galvanizing department. Of the 51 employees working in the galvanizing department, 17, 19, and 15 worked on the first, second, and third shifts, respectively. On each shift there was a foreman and a head galvanizer working in the galvanizing department. The remaining workers were classified as galvanizers.

The workers classified as galvanizers could be differentiated from each other by the tasks they performed. In addition to the galvanizers who performed the operations required to galvanize materials, there were picklers who prepared the materials by dipping them into sulfuric acid tanks to remove rust and other contaminants which might be present on the materials. Material handlers loaded and unloaded trucks, moved materials around, and performed minor work on the galvanized materials such as filing zinc burrs.

The galvanizing process begins by pickling the materials that are to be galvanized. This involves dipping the materials into one of three hot sulfuric acid kettles. The hot, 10% sulfuric acid solution removes any rust and other contaminants present on the materials. The materials are then dipped into a weak sodium hydroxide solution to neutralize the residual acid which may be present. The materials are next dipped into a tank containing a solution of zinc ammonium chloride, which enhances the zinc coating process. The materials are then submerged into one of two galvanizing kettles (front: 27 ft. x 5.5 ft. x 7 ft. and back: 35 ft. x 6.6 ft. x 6.5 ft.) containing molten zinc (820-840^{o}F). The materials are submerged in the zinc for approximately 5 to 10 minutes depending on the size of the material being galvanized, and are then slowly raised. Some of the materials are sprayed with an ammonium chloride flux which is called "sal." The sal is sprayed on the galvanized material to thin the zinc coating on the surface. It is sprayed primarily where the zinc might clump together such as in between fins on cooling coils. Brooms are used to remove excess zinc from the material as it exits the dip tank. After the materials have been galvanized, they are dipped into a quenching tank which contains 1% sodium bichromate.

Informal interviews were conducted with 12 randomly selected workers. Eight of the 12 interviewed workers were concerned about exposures to fumes and smoke in the galvanizing department. Some of the worker said they developed sore throats and coughing from inhalation of acid fumes and others developed runny noses, coughing, and nausea from inhalation of sal fumes. Concerns were expressed because of the lack of shower facilities, lack of a nurse or physician on site, and the fact that the break area where they ate was in the middle of the production area. Also, during the interviews, workers said that they sometimes take home and launder their work coveralls.

The National Institute for Occupational Safety and Health investigators reviewed copies of the most recent industrial hygiene evaluations conducted in the galvanizing department by UNR-Rohn and the Federal Occupational Safety and Health Administration (OSHA), in Peoria, Illinois. The UNR-Rohn industrial hygiene evaluation included personal breathing zone (PBZ) sampling for sulfuric acid, sodium bichromate, lead, and zinc oxide. One PBZ air sample was collected and analyzed for lead. The result for this sample was 4.7 µg/m^3. The OSHA PEL for lead is 50 µg/m^3, with an action limit of 30 µg/m^3. The OSHA evaluation included PBZ air sampling for chromic acid and chromates, sulfuric acid, hydrogen peroxide, respirable dust, total dust, iron oxide, lead, and zinc oxide. The two PBZ air samples for lead contained 5 and 20 µg/m^3 of lead. None of the PBZ air samples contained contaminant concentrations in excess of OSHA PELs.

The material safety data sheet (MSDS) for the galvanizing zinc was reviewed. The chemical composition of the zinc stock as reported on the MSDS was: 98.0 to 99.99% zinc; 1.4% maximum lead; 0.55% maximum aluminum; and 0.20% maximum cadmium.

Based on observations made during the walk-through survey, the worker interview responses, and the lack of PBZ air sampling data for some substances present in the galvanizing department (i.e., aluminum, cadmium, chromium, ammonia, and hydrogen chloride), an industrial hygiene survey was conducted in the galvanizing department on December 13 and 14, 1993.

IV. MATERIALS AND METHODS

Personal breathing zone air samples were collected on galvanizers, picklers, and material handlers. Personal breathing zone air samples were collected on 0.8 micrometer (µm) pore size, 35-millimeter (mm) diameter, cellulose ester membrane filters using an air sampling pump calibrated to an air flow rate of 2.0 liters per minute (lpm). The membrane filters were analyzed for zinc (Zn), lead (Pb), aluminum (Al), cadmium (Cd), and elemental chromium (Cr) using inductively coupled argon plasma (ICP), atomic emission spectroscopy according to procedures in NIOSH Method 7300.[1] Personal breathing zone air samples for acid gases and mists were collected using Orbo 54 washed silica gel tubes (400 milligrams [mg] front section, 200 mg back section) using an air sampling pump calibrated to an air flow rate of 0.20 lpm. The silica gel tubes were analyzed for hydrochloric and sulfuric acid using ion chromatography according to NIOSH Method 7903.[1] Personal breathing zone air samples for ammonia were collected using Draeger ammonia 10/a-D diffusion tubes.
The diffusion tubes are direct reading samplers.

To evaluate the potential for skin exposure and ingestion of metals, surface wipe samples were collected using Wash'n Dri® pre-moistened towelettes. The samples were collected on surfaces of approximately 100 square centimeters (cm^2).[2] Surfaces wiped were those most frequently contacted by the workers such as the break area table tops, desk tops, rest room counter tops, etc. The towelettes were analyzed for Zn, Pb, Al, Cd, and Cr using a modification approached of NIOSH Method 7300.

V. EVALUATION CRITERIA

A. Environmental Criteria

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for the assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed from 8- to 10-hours per day, 40-hours per week, for a working lifetime without experiencing adverse health effects. However, it is important to note that not all workers will be protected from adverse health effects if their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a pre-existing medical condition, and/or a hypersensitivity (allergy). In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the worker to produce adverse health effects even if the occupational exposures are controlled to the level set by the evaluation criteria. Also, some substances are absorbed by direct contact with skin and mucous membranes and by ingestion, thus potentially increasing the overall exposure. Finally, evaluation criteria may change over the years as new information on toxic effects of an agent become available.

The primary sources of environmental evaluation criteria for the workplace are: 1) the US Department of Labor, OSHA Permissible Exposure Limits (PELs); 2) NIOSH Criteria Documents and Recommended Exposure Limits (RELs); and 3) the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLVs).[3-5] The OSHA PELs may be required to take into account the feasibility of controlling exposures in various industries where the agents are used; in contrast, the NIOSH RELs are primarily based upon the prevention of occupational disease. In evaluating the exposure levels and the recommendations for reducing those levels found in this report, it should be noted that industry is legally required to meet those levels specified by an OSHA PEL.

A time-weighted average exposure level (TWA) refers to the average airborne concentration of a substance during a normal eight to ten hour workday. Some substances have recommended short-term exposure limits (STELs) or ceiling limits (CLs) values which are intended to supplement the TWA where there are recognized toxic effects from brief high exposures.

Evaluation criteria for specific substances analyzed during this evaluation are listed below. The OSHA PELs, NIOSH RELs, and ACGIH TLVs for these substance are listed in Table 1.

B. Health Effects

Aluminum

Metallic aluminum dust is considered a relatively benign "inert dust."[6]

Cadmium

Cadmium is an irritant to the respiratory tract. Prolonged exposure can cause anosmia (loss of sense of smell) and a yellow stain that gradually appears on the teeth. Cd compounds are poorly absorbed by the intestinal tract, but relatively well absorbed by inhalation. Skin absorption appears negligible. Once absorbed, Cd has a very long half-life, and is retained in the kidney and liver.[7]

Systemic effects have been reported as a result of Cd exposure at concentrations which did not provide warning symptoms of irritation. If enough is inhaled, after a delay of several hours, a person may develop cough, shortness of breath (emphysema), chest pain, sweating, chills, headache, muscle aches, weakness, and nausea. Exposure to Cd has also been reported to cause kidney damage and increased incidence of prostrate cancer in men.[7]

In animal studies, Cd has produced damage to the liver and central nervous system, testicular atrophy, testicular neoplasms, hypertension, and teratogenic effects. None of these conditions have yet been reported resulting from occupational exposure to Cd.[7]

A NIOSH epidemiological study has demonstrated a statistically significant excess of lung cancer mortality among workers exposed to cadmium oxide. A chronic inhalation exposure study with rats provides toxicological evidence that exposure to cadmium chloride aerosol can cause a dose dependent incidence of malignant lung cancer.

The National Institute for Occupational Safety and Health recommends that cadmium and its compounds be regarded as potential occupational carcinogens and that appropriate controls be used to reduce worker exposure to the lowest feasible limit (LFL). The OSHA PEL for Cd is 5.0 $\mu g/m^3$, and the ACGIH TLV is 10.0 $\mu g/m^3$ for total particulate and 2.0 $\mu g/m^3$ for respirable Cd (aerodynamic diameter of 4.0 µm or less).

Chromium

Chromium exists in a variety of chemical forms. For example, elemental chromium is relatively non-toxic.[6] Other Cr compounds may cause skin irritation, sensitization, and allergic dermatitis. In the hexavalent form (Cr(VI)), Cr compounds are corrosive, and possibly carcinogenic. Until recently, the less water-soluble forms were not considered carcinogenic. Recent epidemiological evidence indicates carcinogenicity among workers exposed to soluble Cr(VI) compounds.[8-12] Based on this new evidence, NIOSH recommends that all Cr(VI) compounds be considered as potential carcinogens.

Lead

Inhalation of Pb dust and fumes, and ingestion resulting from hand-to-mouth contact with Pb-contaminated food, cigarettes, clothing, or other objects are the main routes of worker exposure to Pb. Once absorbed, Pb accumulates in the soft tissue and bones. Pb is stored in the bones for decades, and may cause health effects after exposure as it is slowly released over time.

An individual's blood lead level (BLL) is a good indication of recent exposure to, and current absorption of Pb.[13] The frequency and severity of symptoms associated with Pb exposure generally increase with increasing BLL. These symptoms include weakness, excessive tiredness, irritability, constipation, anorexia, fine tremors, and "wrist drop."[6,14,15] Overexposure to Pb may also result in damage to the kidneys, gastrointestinal tract, peripheral and central nervous systems, and blood-forming systems (bone marrow), infertility and reduced sex drive in both sexes, and impotence. The overall mean BLL for the U.S. adult population (ages 20 - 74 years old) declined significantly between 1976 and 1991, from 13.1 to 3.0 micrograms per deciliter of blood (µg/dL), a decline most likely due to reduction of Pb in gasoline.[16]

Under the OSHA general industry Pb standard (29 CFR 1910.1025), the PEL-TWA for Pb is 50 µg/m^3, over an 8-hour shift.[17] The standard requires lowering the PEL for shifts exceeding 8 hours, medical monitoring for employees exposed to airborne lead at or above the Action Level of 30 µg/m^3 (8-hour TWA), medical removal of employees whose average BLL is 50 µg/dL or greater, and provides economic protection for medically removed workers. Medically removed workers cannot return to their jobs involving Pb exposure until their BLL is below 40 µg/dL. The ACGIH has proposed a PEL-TWA for Pb of 50 µg/m^3, with worker BLLs to be controlled to or below 20 µg/dL, and designation as an animal carcinogen.[18] The U.S. Public Health Service has established the goal for worker exposed to Pb to eliminate, by the year 2000, all exposures that result in BLLs greater than 25 µg/dL.[19] Overt symptoms of Pb poisoning in adults generally begin at BLLs above 50 µg/dL.

The occupational exposure criteria (above) are not protective for all known health effects of Pb. For example, studies have found neurological symptoms in workers with BLLs of 40 to 60 µg/dL, and decreased fertility in men at BLLs as low as 40 µg/dL. Blood lead levels are associated with increases in blood pressure, with no apparent threshold through less than 10 µg/dL . Fetal exposure to Pb is associated with reduced gestational age, birthweight, and early mental development with maternal BLLs as low as 10 to 15 µg/dL.[20] Men and women who are planning on having children should limit their exposure to Pb.

In homes with a family member occupationally exposed to Pb, care must be taken to prevent "take home" of Pb, that is, lead contamination carried into the home on clothing, skin, and hair, and in vehicles. High BLLs in resident children, and elevated concentrations of Pb in the house dust, have been found in the homes of workers employed in industries associated with high Pb exposure.[21] Particular effort should be made to ensure that children of persons who work in areas of high Pb exposure receive a BLL test from a qualified health-care provider.

There are currently no Federal standards governing the level of Pb in surface dust in either occupational or non-occupational (i.e., residential settings). However, Pb-contaminated surface dust in either setting represents a potential exposure to Pb through ingestion, especially by children. This may occur either by direct hand-to-mouth contact via clothing, cigarettes, or food contaminated by Pb dust. Previous studies have found a significant correlation between resident children's BLLs and house dust Pb levels.[22] The U.S. Department of Housing and Urban Development (HUD) has recommended the following final clearance for lead in house dust on specific interior surfaces following Pb abatement: floors, 200 micrograms per square foot (µg/ft^2); window sills, 500 µg/ft^2, and window wells, 800 µg/ft^2. HUD also recommends the standard for floors be applied to exterior porches.[23] These criteria were established as feasible limits for clearance following final cleaning during residential Pb-based paint abatement.

Zinc

Zinc is an essential trace element for good nutrition. Overexposure to Zn fumes may produce fever and chills (metal fume fever) which subsides within 12 hours but may leave a metallic taste. Ingestion of Zn salts can lead to severe gastrointestinal upset.[6] The OSHA PEL for Zn oxide is
15 mg/m^3 for total dust and 5 mg/m^3 for respirable fraction and fumes. The NIOSH REL for Zn oxide fumes is 5 mg/m^3. The ACGIH TLV for Zn oxide is 10 mg/m^3 for total dust and 5 mg/m^3 for fumes.

Hydrochloric and Sulfuric Acids

Hydrochloric acid (HCl) is a strong irritant of the eyes, mucous membrane, and skin. Sulfuric acid is a severe irritant of the eyes, mucous membrane, and skin that can also affect the respiratory tract. In addition to the irritant effects, exposure to these acids can cause dental erosion.
The major effects of acute exposure to HCl usually are limited to the upper respiratory tract and sufficiently severe to encourage a subject's prompt withdrawal from a contaminated atmosphere.[26] Effects usually are limited to inflammation and occasionally to ulceration of the nose, throat, and larynx.[27] The effects from exposure to sulfuric acid are more severe than HCl because mists can penetrate deeply into the lungs. Inhalation can cause pulmonary fibrosis, residual bronchitis, pulmonary emphysema, tissue necrosis, and pulmonary edema. Concentrated sulfuric acid destroys tissue as a result of its severe dehydrating action, whereas the dilute form acts as a milder irritant due to its acidic properties.[6] A number of studies have indicated that exposure to sulfuric acid or acid mist, in general, are associated with laryngeal cancer.[28-30] Nine cases of laryngeal cancer were identified (versus 3.92 expected) in steelworkers exposed to sulfuric acid mist for a minimum of six months prior to 1965.[29] Exposure levels averaged about 0.2 mg/m^3 and the average duration of exposure was 9.5 years. It is not known if sulfuric acid can act as a direct carcinogen, as a promoter, or in combination with other substances.[6] A promoter is a compound that does not directly

cause cancer, but enhances the carcinogenic effects of other compounds. The OSHA PEL and the NIOSH REL for HCl is 7 mg/m^3 as a CL. The ACGIH TLV for HCl is 7.5 mg/m^3 as a CL. The OSHA PEL, NIOSH REL and ACGIH TLV for sulfuric acid is 1.0 mg/m^3 as a TWA exposure.

Ammonia

Ammonia is a severe irritant of the eyes, respiratory tract, and skin.
It may cause coughing, burning, tearing of the eyes, runny nose, chest pains, cessation of respiration, and death. Symptoms may be delayed in onset. Exposure of the eyes to high gas concentrations may produce temporary blindness and severe eye damage. Exposure of the skin to high concentrations of the gas may cause burning and blistering of the skin. Repeated exposure to ammonia gas may cause chronic irritation of the eyes and upper respiratory tract.[6] The NIOSH REL for ammonia is 25 ppm for up to a 10-hour TWA. NIOSH and OSHA have set STELs of 35 ppm. ACGIH has recommended limits of 25 ppm for an 8-hour TWA and 35 ppm for a STEL. OSHA has not set a standard for ammonia for an 8- or 10-hour TWA.

VI. RESULTS and DISCUSSION

An industrial hygiene survey was conducted in the UNR-Rohn galvanizing department on the third shift of December 13 and 14, 1993. The third shift was selected for sampling because HVAC cooling coils were galvanized during the third shift and several of the workers were particularly concerned about exposures during these operations.

Eighteen air samples were collected and analyzed for Zn, Pb, Al, Cd, and Cr. Seventeen of the samples were PBZ air samples and one was an area air sample collected at the foreman's desk (near the break area). Of the seventeen PBZ air samples collected, 10 were collected on galvanizers (6 on the front kettle and 4 on the back kettle), 5 were collected on material handlers (3 from the back near the back kettle and 2 from the loading dock area), and 2 were collected on picklers. The metal concentrations are listed in Table 2 and are summarized in Table 3.

The PBZ air sampling results for Zn ranged from 0.10 to 0.49 mg/m^3, all well below the NIOSH REL of 5 mg/m^3. As a group, the back kettle galvanizers had the highest mean Zn exposures (0.41 mg/m^3). The mean for Zn concentrations for the picklers, front galvanizers, and material handlers were 0.30 mg/m^3, 0.29 mg/m^3, and 0.15 mg/m^3, respectively.

The PBZ air sampling results for Pb ranged from trace to 56.1 µg/m^3. One PBZ Pb air sampling result exceeded the OSHA PEL of 50 µg/m^3, while the remaining sampling results were below the Action Limit of 30 µg/m^3. Two of the 17 PBZ air sampling results for Pb were at trace concentrations. Trace concentrations are between the minimum detectable concentration (MDC) and the minimum quantifiable concentration (MQC). The limit of detection (LOD) for Pb was 0.4 µg/filter, which equates to a MDC of 0.42 µg/m^3, assuming a sample volume of 960 liters. The limit of quantitation ion (LOQ) for Pb was 1.2 µg/filter, which equates to a MQC of 1.35 µg/m^3, assuming a sample volume of 960 liters. The trace metal concentrations were assumed to be the midpoint between MDC and MQC for the summarizations listed in Table 3. Comparison of the mean Pb PBZ air sampling results in Table 3 shows the galvanizers on the front kettle had the highest mean Pb exposure at 12.8 µg/m^3 and that the material handlers working near the back galvanizing kettle had the lowest mean exposure at 1.69 µg/m^3.

The PBZ air sampling results for Al ranged from trace to 11.3 µg/m^3. All PBZ air sample results for Al were less than the OSHA PEL and the NIOSH REL of 5 mg/m^3 for respirable dust. Three of the 17 PBZ air samples had trace concentrations of aluminum. The analytical LOD for Al was 1.0 µg/filter, which equates to a MDC of 1.04 µg/m^3, assuming a sample volume of
960 liters. The analytical LOQ for Al was 3.5 µg/filter, which equates to a MQC of 3.75, assuming a sampling volume of 960 liters of air. Examining the mean aluminum concentrations for the different job descriptions listed in Table 3 indicates that there is not any distinguishable differences.

The PBZ air sampling results for Cd ranged from non-detectable (ND) to 0.40 µg/m^3. Four of the seventeen PBZ air samples did not contain detectable levels of Cd. The analytical LOD for Cd was 0.08 µg/filter, which equates to a MDC of 0.08 µg/m^3, assuming a sampling volume of 960 liter of air. The analytical LOQ for cadmium was 0.24 µg/filter, which equates to a MQC of 0.25 µg/m^3, assuming a sampling volume of 960 liters of air. Nine of 17 PBZ air samples had trace concentrations of Cd, indicating that the Cd concentration was between the MDC and MQC. Four of the 17 PBZ air sample results had detectable concentrations of Cd, and these results were 0.26, 0.40, 0.34, and 0.25 µg/m^3. All PBZ air sampling results for cadmium were well below the OSHA PEL of 5 µg/m^3. The NIOSH REL for Cd is the lowest feasible limit (LFL), which in this case is the MDC of 0.08 µg/m^3, therefore, 13 of 17 Cd PBZ air samples had concentrations in excess of this level. The four samples which had quantifiable concentrations of Cd were collected on galvanizers (three from the front kettle and one from the back kettle).

The PBZ air sampling results for Cr ranged from trace to 3.35 µg/m^3. The analytical LOD for Cr was 0.40 µg per sample, which equates to a MDC of 0.42 µg/m^3, assuming a sampling volume of 960 liters of air. The analytical LOQ for Cr was 1.1 µg/filter, which equates to a MQC of 1.15 µg/m^3, assuming a sampling volume of 960 liters of air. All PBZ air sampling results for Cr (elemental) were well below the OSHA PEL of 1,000 µg/m^3 and the NIOSH REL of 500 µg/m^3. Future sampling for Cr should be done to investigate the concentrations of the various valences of Cr present in the workplace. The present Cr analyses were for elemental Cr only and did not include the concentrations of the various valence states, Cr(II), Cr(III), and Cr(VI). The NIOSH REL-ceiling for chromates, based on the designation as a potential carcinogen, is 1 µg/m^3, and the OSHA PEL-ceiling for Cr as CrO_3 is 100 µg/m^3.

Seventeen PBZ and one area air sample (foreman's desk in front near break area) were collected for acid gases and mist. While preparing the tubes for analysis, the glass fiber plug which holds the silica gel inside the glass tube was inadvertently discarded by the chemist and, therefore, was not desorbed with the front section of the tube. Since the sulfuric acid is collected primarily on the glass fiber plug, the sulfuric acid results are considered invalid and are not reported. Since HCl collects mainly on the silica gel, the results for hydrochloric acid are reported but should be considered minimum concentrations. Some HCl may have been lost on the plug. Hydrochloric acid was not used in this galvanizing process, but was thought to be formed when the sal (ammonium chloride) was sprayed on the hot galvanized metals. The analytical LOD for HCl was 2 µg/filter, which equates to a MDC 0.02 mg/m^3, assuming a sampling volume of 96 liters of air. The analytical LOQ for HCl was 4 µg/filter, which equates to a MQC of 0.04 mg/m^3, assuming a sampling volume of 96 liters of air. Twelve PBZ HCl air samples did not contain detectable levels of HCl. Three PBZ HCl air samples had trace concentrations. Two of the PBZ samples contained quantifiable levels of HCl, at 0.10 and 0.19 mg/m^3 as a TWA over the sampling period.
The OSHA PEL and NIOSH REL for HCl is a CL of 7 mg/m^3, which shall at no time be exceeded.

Eighteen ammonia air samples were collected using Draeger direct reading diffusion tubes. These ammonia air sampling results are listed in Table 4. The 17 PBZ air sampling results for ammonia ranged from 0.7 to 6.6 ppm. The results are all well below the NIOSH REL of 25 ppm.

Surface wipe samples were collected to assess metal contamination in the break area, the front rest room, and in the office at the back of the galvanizing department. There are no standards for surface metal contamination. The sample results are shown in Table 5.

Because Zn and Al were present on the unused (blank) towelettes, the results are blank corrected for Zn and Al. The Zn surface wipe sampling results ranged from 5.3 to 331 milligrams of analyte per square meter of surface wiped (mg/m^2). The Pb concentrations ranged from ND (<0.1) to 16.3 mg/m^2. The Al concentrations ranged from 0.3 to 72.7 mg/m^2. None of the surface wipe sample results had detectable amounts of cadmium. The Cr concentrations ranged from ND (<0.1) to 4.6 mg/m^2. The time clock stand in the break area was the most contaminated surface sampled. All four of the surface wipe samples taken from the table tops in the break area showed significant surface contamination, considering that workers sit at these tables to eat at least six times per day (two times per shift and three shifts per day).

Bulk samples of molten Zn from the kettles were collected to compare the chemical composition found in the bulks to that stated in the MSDS.
The results of these analyses are shown in Table 6. The mean composition of the four bulk samples were: 102% Zn; 1.15% Pb; and 0.05% Cd. No Al or Cr were detected in the bulk samples at detection limits of 0.005% for Al and 0.001% for Cr. The bulk sample compositions were similar to that reported on the MSDS. All trace metal concentrations were below the maximum amounts listed on the MSDS.

VII. CONCLUSIONS

The PBZ air samples demonstrated that the workers, particularly the galvanizers, were exposed to Pb and Cd, with one PBZ breathing zone air sample exceeding the OSHA PEL of 50 µg/m^3 for Pb. Thirteen of 17 PBZ air samples had detectable concentrations of Cd. NIOSH recommends that Cd concentrations be reduced to the LFL because Cd is considered a potential carcinogen. Personal breathing zone air sampling for Zn, Al, Cr and ammonia were all below OSHA PELs and NIOSH RELs for those compounds.
The surface wipe samples demonstrated the presence of metal contamination on surfaces frequently contacted by the workers. This represents a potential source of exposure to these metal contaminants through ingestion and skin contact. This is particularly true for the table tops in the break area.

Most of the workers used the proper safety equipment (i.e., picklers wore rubber aprons, gloves, and face shields, and galvanizers wore face shields, gloves and fire retardant coveralls), but there was more than one occasion where the proper safety equipment was not used. This was particularly true for one of the supervisory personnel.

Housekeeping in the galvanizing department was poor, with metal dust and dirt present throughout the workplace. The rest rooms were also dirty and had surface metal contamination as evidenced by the results of the surface wipe samples. There were no showers provided for workers to use after the work shift. Many of the workers were observed leaving the galvanizing department and going to the break area to eat, without first washing their hands. The break area is located in the work area with no walls separating this area from the manufacturing areas. The break area was also dirty.

In addition, workers smoked in the work area. Some workers took home their work coveralls and laundered them.

VIII. RECOMMENDATIONS

1. One of the galvanizers had a PBZ concentration of Pb of 56 $\mu g/m^3$, exceededing the OSHA PEL of 50 $\mu g/m^3$. Further exposure monitoring for Pb should be conducted to assess day-to-day variation in exposure and to determine if exposure to Pb exceeds the PEL or the action level of 30 $\mu g/m^3$. The OSHA lead standard, 29 CFR Part 1910.1025, details the scope of the standard including air and blood monitoring requirements. While respirators can be worn to temporarily reduce exposure, engineering controls should be implemented to reduce exposures below the PEL.

2. The use of appropriate personal protective equipment, while working around the galvanizing kettles or the hot acid dipping tanks should be enforced.

3. No smoking should be permitted in the working areas. Workers smoking in work areas increase their chances of ingesting the metal contaminants present in the work area. To facilitate elimination of tobacco use, employers should implement smoking cessation programs. Information regarding workplace smoking policies and smoking cessation programs can be found in "No Smoking: A Decision Maker's Guide to Reducing Smoking at the Workplace."[31]

4. During the interviews, some of the workers indicated that they took their work clothing (fire retardant coveralls) home for laundering to ensure that they would be able to keep the same garments for use day after day, rather than having to select a new garment from the company laundered garments which may not fit properly or may be torn, etc. We recommend that Rohn make every effort to accommodate the employees' concerns so that they will no longer feel the need to launder these garments at home. Metal contaminants present on the dirty work clothing can represent a hazard to other family members. Exposure levels to metals which do not adversely effect the workers' health can have harmful health effects in children, particularly lead. Lead exposure is especially harmful to fetuses and young children due to potentially irreversibly toxic effects on the developing brain and nervous system.[20] The CDC has found adverse effects in children at blood lead level of 25 $\mu g/dl$[32] as compared to OSHA regulations which specify medical removal of a worker from the workplace whose average personal breathing zone is 50 $\mu g/dl$ or greater. Workers should be encouraged to change their work clothes on a daily basis. By having their work clothes laundered on a regular basis, the potential for exposure to metal contaminants is reduced. One suggestion is to assign two sets of coveralls to each worker in the galvanizing department so that at any given time, they would have a clean garment to wear.

5. The rest room areas should be cleaned on a regular basis. Consideration should be given to providing a shower facility for the workers to use after their shift. The workers should be encouraged to wash their hands prior to eating. Good personal hygiene is important when working around metal fumes and dust to minimize the potential for exposure to metals through ingestion. A hand washing station should be installed near the break area .

6. The break area should be enclosed to minimize potential contamination from the galvanizing department.

7. Future monitoring for the substances evaluated in this study should be done on a regular basis (e.g., annually or semi-annually, or whenever changes in work practices are made which may effect worker exposures) to ensure that workers' exposures do not exceed the applicable exposure standards. In addition, because the sulfuric acid air sample results were invalid (due to laboratory error) and the HCl concentrations may have underestimated workers' exposures, PBZ air sampling should be conducted to evaluate these exposures. Several of the picklers complained about the sulfuric acid fumes irritating and burning their skin.

IX. REFERENCES

1. NIOSH [1984]. NIOSH Manual of Analytical Methods. 3rd ed. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 84-100.

2. NIOSH [1993]. NIOSH Manual of Analytical Methods. 4th ed. Method 9100 Lead in Surface Wipe Samples. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 84-100.

3. Code of Federal Regulations [1989]. Air contaminants-permissible exposure limits. Title 29 Code of Federal Regulations, 29 CFR Part 1910.1018. Washington DC: U.S. Government Printing Office, Federal Register.

4. NIOSH [1992]. NIOSH recommendations for occupational safety and health, compendium of policy documents and statements. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 92-100.

5. ACGIH [1993]. 1993 - 1994 threshold limit values for chemical substances and physical agents and biological exposure indices. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.

6. Hathaway GJ, Proctor NH, Hughes JP, and Fischman ML [1991]. Proctor and Hughes' Chemical Hazards of the Workplace, 3rd Edition. New York, NY: Van Nostrand Reinhold.

7. NIOSH [1984]. Current Intelligence Bulletin 42, September 27, 1984. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, 1984.
(DHHS Publication no. NIOSH 84-116).

8. Blair A, and Mason TJ [1980]. Cancer mortality in the United States counties with metal electroplating industries. Arch Environ Health 35(2):92-94.

9. Franchini I, Magnani F, and Mutti A [1983]. Mortality experience among chromeplating workers: Initial findings. Scand J Work Environ Health 9:247-252.

10. Royle H [1975]. Toxicity of chromic acid in the chromium plating industry. Environ Res 10:39-53.

11. Siverstein M, Mirer F, Kotelchuck D, Silverstein B, and Bennett M [1981]. Mortality among workers in a die-casting and electroplating plant. Scand J Work Environ Health 7(suppl 4):156-165.

12. Sorahan T, Burge DCL, and Waterhouse JAH [1987]. A mortality study of nickel/chromium platers. Br J Ind Med 44:250-258.

13. NIOSH [1978]. Occupational exposure to inorganic lead. Cincinnati, OH: U.S. Department of Health, Education, and Welfare, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHEW (NIOSH) Publication No. 78-158.

14. Hernberg S, et al. [1988]. Lead and its compounds. In: Occupational medicine. 2nd ed. Chicago, IL: Year Book Medical Publishers.

15. Landrigan PJ, et al. [1985]. Body lead burden: Summary of epidemiological data on its relation to environmental sources and toxic effects. In: Dietary and environmental lead: Human health effects. Amsterdam: Elsevier Science Publishers.

16. Pirkle JL, et al [1994]. The decline in Personal breathing zones in the United States. J Am Med Assoc 272: 284-291.

17. Code of Federal Regulations [1992]. OSHA lead standard. 29 CFR, Part 1910.1025. Washington, DC: U.S. Government Printing Office, Federal Register 24686, May 31, 1992.

18. ACGIH [1993]. 1993-1994 Threshold limit values for chemical substances and physical agents and biological indices. Cincinnati, OH: American Conference of Governmental Industrial Hygienist.

19. DHHS [1990]. Healthy people 2000: National health promotion and disease objectives. Washington, DC: U.S. Department of Health and Human Services, Public Health Service, DHHS Publication No. (PHS) 91-50212.

20. ATSDR [1990]. Toxicological profile for lead. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry. DHHS (ATSDR) Publication No. TP-88/17.

21. Grandjean P and Bach E [1986]. Indirect exposures: the significance of bystandards at work and at home. Am Ind Hyg Assoc J 47(12): 819-824.

22. Farfel MR and Chisholm JJ [1990]. Health and environmental outcomes of traditional and modified practices for abatement of residential lead-based paint. Am J Public Health 80(10): 1240-1245.

23. HUD [1990]. Lead-based paint: interim guidelines for hazard identification and abatement in public and indian housing. Washington, D.C.: U.S. Department of Housing and Urban Development, Office of Pubic and Indian Housing, September, 1990.

24. CDC [1991]. Strategic plan for the elimination of childhood lead poisoning. U.S. Department of Health Education, and Welfare, Public Health Service, Centers for Disease Control and Prevention.

25. Brody DJ, et al [1994]. Personal breathing zones in the U.S. population. J Am Med Assoc 272: 277-283.

26. NAS [1976]. Committee on medical and biological effects of environmental pollutants. Chlorine and hydrogen chloride. Washington, D.C.: National Academy of Sciences, pp. 138-144.

27. MCA Chemical Safety Data Sheet [1970]. Hydrochloric acid, SD-39. Washington, D.C.: MCA, Inc., pp. 5-6, 24-26.

28. Soskolne CL, et al. [1984]. Laryngeal cancer and occupational exposure to sulfuric acid. Am J Epidemiol 120:358-369.

29. Steenland K, Schnorr T, Beaumont J, et al. [1988]. Incidence of laryngeal cancer and exposure to acid mists. Br J Ind Med 45:766-776.

30. Ahlborg G, Hogstedt C, Sundell L, et al. [1981]. Laryngeal cancer and pickling house vapors. Scand J Work Environ Health 7:239-240.

31. DHHS [1985]. No smoking: a decision maker's guide to reducing smoking at the worksite. American Cancer Society, American Heart Association, American Lung Association. Washington, DC: U.S. Department of Health and Human Services, Public Health Service, Office of Disease Prevention and Health Promotion, and Office on Smoking and Health.

32. CDC [1991]. Preventing lead poisoning in young children -- a statement by the Centers for Disease Control - October 1991. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention.

X. AUTHORSHIP AND ACKNOWLEDGEMENTS

Report Prepared By:	David A. Marlow, B.S. Industrial Hygienist Industrial Hygiene Section
Field Assistance:	Teresa A. Seitz, M.P.H., C.I.H. Supervisory Industrial Hygienist Industrial Hygiene Section
Analytical Support:	Data Chem Laboratories Robert B. Copenhafer (bulk & air samples for metals) Doe A. Kley (hydrochloric & sulfuric acids)
	NIOSH Mark Millson (surface wipe samples for metals)
Report Formatted By:	Caren B. Day Office Automation Assistant Industrial Hygiene Section
Originating Office:	Hazard Evaluations and Technical Assistance Branch Division of Surveillance, Hazard Evaluations and Field Studies

XI. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report may be freely reproduced and are not copyrighted. Single copies of this report will be available for a period of 90 days from the date of this report from the NIOSH Publications Office, 4676 Columbia Parkway, Cincinnati, Ohio 45226. To expedite your request, include a self-addressed mailing label along with your written request. After this time, copies may be purchased from the National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, Virginia 22161. Information regarding the NTIS stock number may be obtained from the NIOSH Publications Office at the Cincinnati address.

Copies of this report have been sent to:

1. Personnel Manager, UNR-Rohn Manufacturing
2. Union Representative, UAW Local 1494
3. Confidential Requestor
4. Director, Health & Safety Department, International Union, UAW

For the purpose of informing affected employees, copies of this report shall be posted by the employer in a prominent place accessible to the employees for a period of 30 calendar days.

Table 1

Summary of Select Occupational Exposure Limits
UNR-Rohn Manufacturing
Peoria, Illinois
HETA 93-1092

Substance (units)	NIOSH REL-TWA	OSHA PEL-TWA	ACGIH TLV-TWA
Aluminum (mg/m^3)	10 total 5 resp	15 total 5 resp	10 total 5 resp
Ammonia (ppm)	25 35(STEL)	35(STEL)	25 35(STEL)
Cadmium (µg/m^3)	LFL	5.0	2.0 resp 10 total
Chromium (metal) (µg/m^3)	500	1,000	500
Hydrochloric acid (mg/m^3)	7(CL)	7(CL)	7(CL)
Lead (µg/m^3)	<100*	50	150
Sulfuric acid (mg/m^3)	1	1	1 3(STEL)
Zinc oxide as (Zn) (mg/m^3)	5	15 5 resp or fume	10 total 5 fume

NIOSH = National Institute for Occupational Safety and Health
OSHA = Occupational Safety and Health Administration
ACGIH = American Conference of Governmental Industrial Hygienists
REL = recommended exposure limit
PEL = permissible exposure limit
TLV = threshold limit value
TWA = time-weighted average
STEL = short-term exposure limit over 15-minutes unless otherwise noted
CL = ceiling exposure to which shall at no time be exceeded
total = total dust/particulate
resp = respirable faction of dust (respirable particulate mass) for the substance listed
* = air level to be maintained so that worker blood levels remain <60µg/100g of whole blood
LFL = because this substance is a potential occupational carcinogen, the NIOSH policy for exposure is lowest feasible limit
mg/m^3 = milligrams of analyte per cubic meter of air
µg/m^3 = micrograms of analyte per cubic meter of air
ppm = parts of analyte per million parts air

Table 2

Air Sample Results for Metals
UNR - Rohn Manufacturing
Peoria, Illinois
HETA 93-1092

Sampling Date	Job/Area Description	Job/Area Location	Sample		Conc.	Concentrations (µg/m^3)			
			Time (min)	Volume (liters)	mg/m^3 Zn	Pb	Al	Cd	Cr
13 Dec 93	Foreman's desk	Near break area	444	888	0.07	ND	trace	trace	trace
13 Dec 93	Galvanizer	Back galvanizing tank	474	948	0.36	2.00	<1.05	trace	1.48
14 Dec 93	Galvanizer	Back galvanizing tank	485	970	0.49	3.51	11.3	0.26	1.24
13 Dec 93	Galvanizer	Back galvanizing tank	463	926	0.38	3.02	6.70	trace	3.02
14 Dec 93	Galvanizer	Back galvanizing tank	485	970	0.42	3.30	8.35	trace	2.68
14 Dec 93	Galvanizer	Front galvanizing tank	488	976	0.19	2.87	4.82	trace	1.23
13 Dec 93	Galvanizer	Front galvanizing tank	477	954	0.19	2.41	<1.05	trace	trace
13 Dec 93	Galvanizer	Front galvanizing tank	490	980	0.43	56.1	8.67	0.40	1.53
13 Dec 93	Galvanizer	Front galvanizing tank	254	508	0.26	trace	<1.97	trace	trace
14 Dec 93	Galvanizer	Front galvanizing tank	517	1034	0.37	3.19	9.48	0.34	1.26
14 Dec 93	Galvanizer	Front galvanizing tank	488	976	0.32	11.3	7.07	0.25	1.43
14 Dec 93	Material handler	Back galvanizing tank	477	954	0.16	1.57	5.24	ND	3.35
14 Dec 93	Material handler	Back galvanizing tank	481	962	0.14	1.35	3.74	ND	1.77
13 Dec 93	Material handler	Back galvanizing tank	444	888	0.21	2.14	6.31	ND	2.93
14 Dec 93	Material handler	Loading dock	387	774	0.14	2.33	9.56	trace	1.55
13 Dec 93	Material handler	Loading dock	452	904	0.10	12.2	5.53	ND	trace
13 Dec 93	Pickler	Acid dipping tanks	456	912	0.30	trace	3.84	trace	trace
14 Dec 93	Pickler	Acid dipping tanks	490	980	0.30	3.27	8.37	trace	1.22
Minimum detectable concentration (MDC)					0.001	0.42	1.04	0.08	0.42

Table 3

Summary of Personal Air Sampling Results for Metals
UNR-Rohn Manufacturing
Peoria, Illinois
HETA 93-1092

Job Description	Job Location	No. of Samples	Conc. (mg/m^3) Zn	Concentrations ($\mu g/m^3$) Pb	Al	Cd	Cr
Galvanizer	Back galvanizing kettle	4	0.41	2.96	7.91	0.15	2.11
Galvanizer	Front galvanizing kettle	6	0.29	12.8	5.81	0.18	1.17
Material handler	Back galvanizing kettle	3	0.17	1.69	5.10	0.09	2.68
Material handler	Loading dock	2	0.12	7.27	7.55	0.09	1.17
Pickler	Acid dipping tanks	2	0.30	2.08	6.11	0.06	1.01

mg/m^3 = milligrams of analyte per cubic meter of air
$\mu g/m^3$ = micrograms of analyte per cubic meter of air

Table 4

Air Sampling Results for Ammonia
UNR-Rohn Manufacturing
Peoria, Illinois
HETA 93-1092

Sampling Date	Job Title/Area	Job/Area Location	Sample Time (hr)	Ammonia Conc. (ppm)
13 Dec 93	Foreman's desk	Near break area	7.42	0.7
13 Dec 93	Galvanizer	Back galvanizing tank	7.90	4.4
13 Dec 93	Galvanizer	Back galvanizing tank	7.70	4.5
14 Dec 93	Galvanizer	Back galvanizing tank	8.02	3.7
14 Dec 93	Galvanizer	Back galvanizing tank	8.08	4.3
13 Dec 93	Galvanizer	Front galvanizing tank	8.13	4.9
13 Dec 93	Galvanizer	Front galvanizing tank	8.08	3.1
13 Dec 93	Galvanizer	Front galvanizing tank	7.95	3.1
14 Dec 93	Galvanizer	Front galvanizing tank	8.13	2.2
14 Dec 93	Galvanizer	Front galvanizing tank	8.13	4.7
14 Dec 93	Galvanizer	Front galvanizing tank	8.38	6.6
13 Dec 93	Material handler	Back galvanizing tank	7.45	2.3
13 Dec 93	Material handler	Loading dock	7.53	0.7

Table 5

Surface Wipe Sampling Results for Metals
UNR - Rohn Manufacturing
Peoria, Illinois
HETA 93-1092

Sampling Date	Sample Description	Sample Concentration (mg/m^2)				
		Zn	Pb	Al	Cd	Cr
13 Dec 93	Break area table top	44.4	1.5	1.8	ND	0.4
13 Dec 93	Break area table top	59.5	2.4	3.2	ND	0.6
13 Dec 93	Break are table top	44.7	1.1	2.1	ND	0.6
13 Dec 93	Front bathroom sink counter top	77.2	5.5	7.1	ND	2.7
13 Dec 93	Desk top in office at the back of the building	5.3	ND	0.3	ND	<0.1
14 Dec 93	Microwave oven door front in break area	9.8	0.3	0.9	ND	<0.1
14 Dec 93	break area table top	29.4	0.7	1.8	ND	0.4
14 Dec 93	Break area locker door front	15.5	0.4	0.8	ND	0.1

Table 6

Bulk Galvanizing Kettle Sample Metal Analyses
UNR - Rohn Manufacturing
Peoria, Illinois
HETA 93-1092

Sample Date	Sample Description	% Concentration				
		Zn	Pb	Al	Cd	Cr
13 Dec 93	Front tank sample	100%	1.20%	<0.005%	0.06%	<0.001%
13 Dec 93	Back tank sample	110%	1.20%	<0.005%	0.05%	<0.001%
14 Dec 93	Front tank sample	96%	1.10%	<0.005%	0.05%	<0.001%
14 Dec 93	Back tank sample	100%	1.10%	<0.005<	0.04%	<0.001%
Mean Conc (n = 4)		102%	1.15%	<0.005%	0.05%	<0.001%
Standard Deviation		5%	0.05%	----	0.00%	----