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## **NIOSH HEALTH HAZARD EVALUATION REPORT**

**HETA #2004-0402-2975**

**Indian River County Regional Sludge Facility  
Vero Beach, Florida**

**July 2005**

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**DEPARTMENT OF HEALTH AND HUMAN SERVICES  
Centers for Disease Control and Prevention  
National Institute for Occupational Safety and Health**



## PREFACE

The Hazard Evaluation and Technical Assistance Branch (HETAB) of the National Institute for Occupational Safety and Health (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 (OSHA) 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 employers or authorized representative of workers, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

HETAB also provides, upon request, technical and consultative assistance to federal, state, and local agencies; labor; industry; and other groups or individuals to control occupational health hazards and to prevent related trauma and disease. Mention of company names or products does not constitute endorsement by NIOSH.

## ACKNOWLEDGMENTS AND AVAILABILITY OF REPORT

This report was prepared by Mark Methner, PhD, CIH and Ayodele Adebayo, MD, MPH of HETAB, Division of Surveillance, Hazard Evaluations and Field Studies (DSHEFS). Analytical support was provided by DataChem Laboratories and Ardith Grote, Division of Applied Research and Technology. Desktop publishing was performed by Robin Smith. Editorial assistance was provided by Ellen Galloway.

Copies of this report have been sent to employee and management representatives at Indian River County, Florida, and the International Brotherhood of Teamsters, Local 769. This report is not copyrighted and may be freely reproduced. The report may be viewed and printed from the following internet address: <http://www.cdc.gov/niosh/hhe>. Single copies of this report will be available for a period of three years from the date of this report. To expedite your request, include a self-addressed mailing label along with your written request to:

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## Highlights of the NIOSH Health Hazard Evaluation

### Evaluation of exposure to sulfur-containing compounds and volatile organic compounds during sludge de-watering operations

In February 2005, the National Institute for Occupational Safety and Health (NIOSH) conducted a health hazard evaluation of sludge de-watering operations at Indian River County Regional Sludge Facility in Vero Beach, Florida. Union and management were concerned about exposure to sulfur-containing compounds and other chemical exposures during sewage sludge de-watering operations

#### What NIOSH Did

- We took air samples for sulfur-containing compounds and volatile organic compounds (VOCs).
- We measured air flow in the sludge de-watering plant.
- We interviewed workers about health concerns.
- We observed work practices.

#### What NIOSH Found

- Air concentrations for sulfur-containing compounds and VOCs were extremely low.
- Ventilation in the plant was good.
- A plant exterior door was kept open.
- The air quality in the office could be improved by changing the ventilation system to keep out plant odors.
- Outside air needs to be introduced into the office area.

#### What Indian River County Managers Can Do

- Tell residents within the County about safe disposal techniques for “sharps” (syringes/needles).
- Re-design office ventilation system to keep the office under positive air pressure relative to the plant.

#### What the Indian River County Employees Can Do

- Keep the plant exterior doors closed so the plant ventilation system works properly.
- Do not eat, drink, or smoke in the plant.
- Wash hands with soap and water prior to eating and when leaving the plant.
- Use the laundry service offered at the plant; do not wear work clothes home.



**What To Do For More Information:**  
We encourage you to read the full report. If you would like a copy, either ask your health and safety representative to make you a copy or call 1-513-841-4252 and ask for HETA Report #2004-0402-2975



# Health Hazard Evaluation Report 2004-0402-2975 Indian River County Regional Sludge Facility

Vero Beach, Florida

July 2005

Mark Methner, PhD, CIH

Ayo Adebayo, MD, MPH

## SUMMARY

On September 20, 2004, the National Institute for Occupational Safety and Health (NIOSH) received a health hazard evaluation (HHE) request from the International Brotherhood of Teamsters, Local 769. The union asked NIOSH to evaluate employee chemical exposures during sewage sludge de-watering activities at the Regional Sludge Facility in Vero Beach, Florida. Some employees reported health complaints such as cardiomyopathy, liver and neurological disorders. NIOSH investigators conducted a site visit, collecting personal breathing zone (PBZ) and general area air samples for hydrogen sulfide (H<sub>2</sub>S), other sulfur-containing compounds, and VOCs. The ventilation system used to control odors emanating from the sludge de-watering process was evaluated, and confidential medical interviews with current and past employees were conducted.

Concentrations of sulfur-containing compounds (including dimethyl sulfide and hydrogen sulfide), as well as VOCs were extremely low or not detectable and were below occupational exposure limits. The odor control system in the sludge de-watering area appeared adequate. However, the ventilation system in the adjacent office consisted of a surface-mounted air conditioner/heater that recirculated the room air. This may have drawn odors from the de-watering process into the office through open doors.

Confidential medical interviews and a review of incident reports were conducted to gather information on the health status of de-watering plant employees. Plant employees reported symptoms such as fatigue, headache, diarrhea, vomiting, shortness of breath, and chest tightness. The HHE request indicated that some employees had cardiomyopathy, liver and neurological disorders. Only one of the concerns, cardiomyopathy, had been reportedly diagnosed as work-related by the employee's treating physician. Our investigation and subsequent review of current scientific and medical literature do not support an association between the reported liver and neurological disorders with this particular work environment.

NIOSH investigators conclude that no health hazard existed at this facility since the air contaminants measured on the days of our survey did not exceed any occupational exposure limits. However, the composition of the sludge constantly changes, so the type and concentration of potential airborne contaminants the sludge de-watering process emits do not remain constant. The result is a dynamic work environment with potential health hazards that may change from day to day. Improving office ventilation (see Recommendations section) should reduce the infiltration of airborne contaminants.

Keywords: NAICS 221320 (Sewerage Treatment Facilities), sewage sludge de-watering, septage, sulfur-containing compounds, hydrogen sulfide, volatile organic compounds, VOCs, cardiomyopathy, neurological problems, liver problems

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## INTRODUCTION

On September 20, 2004, the National Institute for Occupational Safety and Health (NIOSH) received a health hazard evaluation (HHE) request from the International Brotherhood of Teamsters, Local 769 asking for assistance in evaluating employee exposure during sewage sludge de-watering activities at the Indian River County Regional Sludge Facility in Vero Beach, Florida. The HHE request was filed on behalf of workers who were concerned that some health problems such as cardiomyopathy, liver and neurological disorders were related to work exposures. Earlier in the year, the facility hired a contractor to perform air quality studies related to an odor problem that facility management believed could have caused the employees' health complaints. The contractor used a portable gas chromatograph/mass spectrometer (GC/MS) to collect and analyze air samples over a 4-day period. The contractor's results indicated that most compounds present were organic sulfides (odor producing compounds) and could possibly be responsible for employee health complaints. Because these samples were collected in various areas, personal exposure to sulfur-containing compounds remained unknown.

Based on the information contained in the contractors' report, NIOSH investigators conducted environmental monitoring on February 7-9, 2005. We collected personal breathing zone (PBZ) and general area air samples for hydrogen sulfide (H<sub>2</sub>S), other sulfur-containing compounds, and volatile organic compounds (VOCs). Additionally, the ventilation system used to control odors emanating from the sludge de-watering process was evaluated. Finally, confidential medical interviews with current and former employees at the de-watering plant were conducted.

## BACKGROUND

The Indian River County Regional Sludge Facility was constructed in 1993 to accept waste products from septage removal contractors (i.e.,

residential/commercial septic tanks and portable toilets, and restaurant cooking grease). Septage is transported to the facility via tanker trucks, unloaded into a holding tank, and then mixed with a de-watering agent (Clarifloc™) to aid in separating water and sludge solids. This slurry is pumped to the de-watering process where agitators and pumps transfer the material onto one of two belt-filter presses (a series of rollers that squeeze liquid from the slurry). To control odors within the two-story building housing the de-watering process, canopy-style exhaust hoods are located above each belt-filter press. Air captured by these hoods is routed via ducts to an odor neutralization system consisting of a tank containing caustic soda followed by another tank containing liquid chlorine. The air is then discharged outdoors. Filter cake, consisting of de-watered sludge solids, drops onto a semi-enclosed conveyor belt at the bottom of the belt-filter press. The filter cake material is conveyed and dumped into a semi-tractor trailer that transfers the material to a sanitary landfill. The original plant design provided for a remote system that would have permitted the plant operators to monitor and control the de-watering process from the control room (office). However, this system was never implemented. In general, 14 employees are scheduled to rotate through this plant on a 3 to 6 month basis, with remaining time spent working at wastewater treatment plants throughout the County. Currently, the two plant employees who operate the de-watering system periodically enter the plant to monitor and adjust de-watering process equipment.

## METHODS

### Industrial Hygiene Evaluation

Full-shift PBZ and general area air samples were collected in the office and sludge de-watering process areas. Based on compounds identified during an earlier survey performed by the contractor mentioned above, an environmental monitoring strategy was developed to examine potential exposure to H<sub>2</sub>S, other sulfur-

containing compounds, and VOCs. H<sub>2</sub>S was measured using calibrated Biosystems Toxilog Ultra® monitors. These direct-reading instruments are equipped with passive diffusion electrochemical sensors that datalog at 1-minute sampling intervals. A Toxilog monitor was clipped to the belt of each plant operator and worn for the entire work shift. For general area air sampling, a monitor was placed in the office or on the catwalk adjacent to the top of each belt-filter press. Stored data were downloaded to a laptop computer after sampling.

Sulfur-containing compounds were collected in 400 milliliter (mL) evacuated canisters. The captured air was then analyzed via a direct injection method using a sulfur chemiluminescent detector to quantify multiple sulfur-containing compounds. Seven canisters were used across 3 days of sampling (five PBZ and two general area). The canister contents were analyzed quantitatively for the following compounds: methyl mercaptan, ethyl mercaptan, isopropyl mercaptan, n-propyl mercaptan, tetrahydrothiophene, thiophene, n-butyl mercaptan, t-butyl mercaptan, carbon disulfide, carbonyl disulfide, diethyl sulfide, dimethyl disulfide, dimethyl sulfide, and H<sub>2</sub>S.

To screen for VOCs, a thermal desorption tube (TD) was collected in areas where employees spent most of their time each day (office and plant). Each TD tube was attached by Tygon® tubing to SKC® Pocket Pumps® calibrated at a flow rate of 0.05 liters per minute (Lpm). Each TD tube contained three beds of sorbent material (a front section of Carbopack Y™, a middle layer of Carbopack B™, and a rear section of Carboxen 1003™). Each was quantitatively analyzed with a Perkin-Elmer ATD 400 automatic thermal desorption system interfaced directly to a Hewlett-Packard 5890A gas chromatograph with an HP 5970 mass selective detector according to NIOSH Manual of Analytical Methods (NMAM) Method 2549.<sup>1</sup> To analyze specific VOCs (based on the results of the TD samples), PBZ and general area air samples were simultaneously collected on charcoal tubes attached by Tygon® tubing to SKC® Pocket Pumps® calibrated at a flow rate

of 0.2 Lpm. All charcoal tubes were quantitatively analyzed for the following VOCs using NIOSH Methods 1003 and 1501: benzene, toluene, dimethyl disulfide, xylenes, ethyl benzene, hexachlorobenzene, p-dichlorobenzene.<sup>1</sup>

The ventilation systems in the de-watering plant and the adjacent office were examined for visible damage and the direction and magnitude of air flow using ventilation “smoke tubes” and a thermal anemometer.

## Medical Evaluation

Voluntary confidential interviews were conducted with 14 current and past employees. Information was gathered on their health status, work practices, and their concerns regarding perceived work hazards. In addition, the NIOSH medical officer reviewed incident reports and OSHA 300 logs for the past 2 years.

## EVALUATION 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 up to 10 hours per day, 40 hours per week for a working lifetime without experiencing adverse health effects. It is, however, important to note that not all workers will be protected from adverse health effects even though 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 health effects even if the occupational exposures are controlled at the level set by the criterion. These combined effects are often not considered in the evaluation criteria. Also, some substances are absorbed by

direct contact with the skin and mucous membranes, and thus potentially increases the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent become available.

The primary sources of environmental evaluation criteria for the workplace are: (1) NIOSH Recommended Exposure Limits (RELs),<sup>2</sup> (2) the American Conference of Governmental Industrial Hygienists' (ACGIH®) Threshold Limit Values (TLVs®),<sup>3</sup> and (3) the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PELs).<sup>4</sup> Employers are encouraged to follow the OSHA limits, the NIOSH RELs, the ACGIH TLVs, or whichever are the more protective criteria.

OSHA requires an employer to furnish employees a place of employment that is free from recognized hazards that are causing or are likely to cause death or serious physical harm [Occupational Safety and Health Act of 1970, Public Law 91-596, sec. 5(a)(1)]. Thus, employers should understand that not all hazardous chemicals have specific OSHA exposure limits such as PELs and short-term exposure limits (STELs). An employer is still required by OSHA to protect their employees from hazards, even in the absence of a specific OSHA PEL.

A time-weighted average (TWA) exposure refers to the average airborne concentration of a substance during a normal 8- to 10-hour workday. Some substances have recommended STEL or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from higher exposures over the short-term.

## Hydrogen Sulfide

H<sub>2</sub>S is a colorless, flammable gas with a strong odor similar to rotten eggs that has an odor threshold of 0.002 ppm for humans.<sup>5</sup> The smell is considered offensive at 3 to 5 ppm. At 150 ppm, H<sub>2</sub>S causes olfactory nerve paralysis, and the smell is no longer perceptible. Acute

exposure to H<sub>2</sub>S at airborne concentrations above 10 ppm has been associated with the development of conjunctivitis and keratitis.<sup>5</sup> At H<sub>2</sub>S concentrations between 500 and 700 ppm, exposures for 30 minutes to 1 hour can result in unconsciousness and death; between 1000 and 2000 ppm or more, unconsciousness and death can occur within minutes. Repeated exposure to H<sub>2</sub>S results in increased susceptibility, so that eye irritation, cough, and systemic effects may result from concentrations previously tolerated without effect. Therefore, the smell of H<sub>2</sub>S is not a reliable warning of its presence, especially at high concentrations. The NIOSH REL for H<sub>2</sub>S is a 10-minute ceiling concentration of 10 ppm.<sup>2</sup> With exposure to H<sub>2</sub>S at concentrations of 50 ppm or higher, NIOSH recommends continuous monitoring. The OSHA PEL for H<sub>2</sub>S is a 10-minute ceiling concentration of 20 ppm or a maximum allowable peak of 50 ppm for a single 10-minute period, if no other measurable exposures occur.<sup>4</sup> The ACGIH® has a TLV® of 10 ppm, 8-hour TWA and a STEL of 15 ppm.<sup>3</sup>

## Dimethyl Sulfide

Inhalation and skin contact are expected to be the primary routes of occupational exposure to this material. Animal tests show that dimethyl sulfide may severely irritate the eyes and slightly to moderately irritate the skin.<sup>6</sup> This material has a strong garlic-like odor that may cause headaches or nausea or irritate the eyes and respiratory tract. Exposure to high concentrations in a confined space has caused death, possibly due to lack of oxygen. Employees may become tolerant to the odor in a relatively short time. The odor threshold is approximately 0.001 ppm. There are no occupational exposure limits for dimethyl sulfide.

## Volatile Organic Compounds (VOCs)

Volatile organic compounds describe a large class of chemicals that are organic (i.e., contain carbon) and have a sufficiently high vapor pressure to allow some of the compound to exist in the gaseous state at room temperature. These



compounds are emitted in varying concentrations from numerous indoor sources including, but not limited to, carpeting, fabrics, adhesives, solvents, paints, cleaners, waxes, cigarettes, and combustion sources. Many of the organic solvents (i.e., acetone, benzene, toluene, and xylenes) are irritants of the eyes, mucous membranes, and upper respiratory tract. In addition, organic solvents can cause acute and chronic neurotoxic health effects.<sup>3</sup> Acute neurotoxic effects include headache, lightheadedness, dizziness, weakness, poor concentration incoordination, impaired balance, confusion, drowsiness and loss of consciousness, and respiratory depression

## RESULTS

### Industrial Hygiene

Contaminant concentrations in all air samples were extremely low. The results shown in Table 1 indicate that all but one of the canister samples collected for sulfur-containing compounds were considered “non-detectable.” The exception, dimethyl sulfide, was present at a concentration of 0.05 ppm (the minimum detectable concentration). Table 2 presents the results for VOCs based on the quantitation of charcoal tubes. Similar to the results for the canisters, all VOCs results were non-detectable. The results for H<sub>2</sub>S, as measured by the Toxilog Ultra<sup>®</sup> are presented in Table 3. All TWA concentrations were zero, with peak values ranging from zero to 5 ppm. Overall, no contaminant approached any occupational exposure limit, with the highest values at one half the NIOSH REL for H<sub>2</sub>S.

The ventilation system in the de-watering plant was used for odor control. Ventilation smoke tubes and a thermal anemometer were used to evaluate air flow patterns and air flow rates, respectively. Supply air drawn from outdoors entered the area through two louvered intake vents located on the east wall at a height of 2 feet above the floor. Air velocities through these intake vents ranged from 175 to 200 feet per minute (fpm). Canopy exhaust hoods were installed over each belt filter-press to improve odor capture. Air velocities measured at the

perimeter of these hoods averaged approximately 60 fpm. The ventilation system, when operating, kept the process area under a slight negative pressure to prevent odoriferous compounds from migrating out of the process area. However, when a nearby entry/exit door was propped open (a common practice), air velocities through the two intake louvers decreased to approximately 30 fpm and, in turn, reduced the overall negative pressure within the building.

The office area had a recirculating surface-mounted air conditioner/heater. There were no intake or exhaust vents in the office area. When the door leading into the office from outside (near outbound truck lane) was opened, the door leading from the office into the plant process area also opened, drawing odors from the process area into the office.

### Medical Evaluation

#### *Interviews:*

All 14 people interviewed were men with an average age of 44 years (range 29 to 57 years). The average length of time these employees had worked at this facility was 12 years (range 5 to 16 years). Only two employees operated the sludge de-watering facility daily, with a normal tour of duty lasting 40 hours per week for a period of 3 to 6 months. The remaining plant employees rotated through the other treatment plants within the County. The plant employees interviewed included nine plant operators, two mechanics, one electrician, one lawn technician and one lift station supervisor. Among those interviewed were six current smokers, two former smokers and six people who had never smoked tobacco products.

Interviewees indicated that the County provided work uniforms and laundry services, rubber gloves, goggles, rubber boots, and rain/water resistant coveralls. Showers were available at some of the County wastewater treatment plants, but not at the de-watering plant. Although management informed NIOSH that the respiratory protection program had been discontinued because chlorine gas use had been

eliminated, employees reported periodic use of a nuisance dust respirator when they cleaned open tanks. All employees must attend a confined space training program twice a year. There is no pre-employment physical examination; however, employees receive a combined hepatitis A and B vaccination but no post-vaccination antibody titer check for immunity to hepatitis B. Employees expressed concern that they were at risk of acquiring hepatitis B virus from exposure to the potentially infected needles and syringes sometimes found in the sludge.

Five of the employees interviewed reported at least one episode of the following gastrointestinal problems: diarrhea, nausea, vomiting, loss of appetite, and indigestion occurring after working with the de-watered sludge (biosolids). The symptoms were self-limiting, and their frequency varied from daily to intermittent. Some workers took their morning and afternoon break inside the office area. Other workers reported they ate their lunch in the office.

All but one interviewed employee reported unusual fatigue and excessive sleepiness. Ten employees reported daily headaches and one reported an occasional headache while at work that resolved completely when he left work or took analgesics. Five employees reported occasional dizziness, three reported short-term memory loss and four reported difficulty concentrating.

Of the six employees who reported having a cough, two reported recurrent sinus problems. Five employees reported episodic shortness of breath, and four reported chest tightness and wheezing. One employee was diagnosed with asthma after he started working at the de-watering plant but he has not been evaluated to determine whether his asthma is related to work. There was an employee each with viral cardiomyopathy, Bell's Palsy, and non-viral hepatitis. Two employees reported elevated liver function tests of undetermined etiology. Two employees had herniated lumbar discs.

All employees who reported symptoms experienced the symptoms during work at the sludge de-watering plant. According to the employees, the symptoms subsided when they left the de-watering plant (either at the end of their shift, on weekends, or when they completed their 3- to 6-month duty rotation at the de-watering plant).

### ***Incident Reports:***

Three injuries and one fall were documented in the incident reports.

## **DISCUSSION CONCLUSION**

The results of the air samples for sulfur-containing compounds, H<sub>2</sub>S, and VOCs on the days of this evaluation were well below any occupational exposure limit. However, we sampled only a few of the many potential contaminants that may exist in the complex wastewater and sludge mixtures. The air contaminants of interest (organic sulfides and some VOCs) in this survey were previously identified in air samples collected by a contractor hired by the County. However, these samples were collected as general area air samples over a few days. The concentrations measured by the contractor provide a general sense of concentrations of contaminants in the general plant atmosphere, over a period of a few days, but such measurements are not necessarily indicative of actual employee PBZ concentrations. Additionally, many odor-producing compounds are detectable by the human nose at concentrations well below the minimum detectable concentration of various air sampling techniques (e.g., the human nose detects H<sub>2</sub>S at a concentration of 0.002 ppm, however, the lowest detectable concentration for the air sampling method used in this survey is 0.05 ppm). This appears to be the case at this de-watering plant. Odors were very noticeable but air sampling revealed extremely low concentrations well below any occupational exposure limit. Because the waste stream changes constantly, the usefulness of additional

air sampling is limited. No employees wore respiratory protection at the de-watering plant, but those that work at other plants within the County reported they use a nuisance dust respirator when cleaning open tanks. This style of respirator is offered on a voluntary basis, therefore there is no need for management to implement a respiratory protection program.

The ventilation system used for odor control within the de-watering process area appeared to operate properly. However, to continue to adequately control odors, all doors within the plant process building must remain closed. The ventilation system in the office area should be improved by introducing outdoor air and keeping the office under positive pressure to minimize the infiltration of odors from the de-watering area during plant operating hours.

Wastewater and sludge is a complex mixture of microbial agents and chemicals, and employees in this industry have a potential exposure to these hazards through oral, respiratory, dermal, and mucosal routes. These hazards, particularly chemical hazards, may vary depending on the source of the wastewater. Some of the microbial agents that have been associated with sewage include bacteria such as *Shigella*, *Salmonella*, *E. Coli* and *Clostridium perfringens*; viruses such as *Poliovirus*, *Echovirus*, *Coxsackievirus*, hepatitis A and E; protozoans like *E. histolytica* and *Giardia*; and helminths like *Ascaris*, *Taenia* and *Strongyloides*.<sup>7</sup> However, the presence of these agents does not necessarily translate into disease. In order to develop an infectious disease, there must be a route of exposure that provides a sufficient dose of the microorganism via inhalation or ingestion. The risk of acquiring a disease could be reduced even further if the de-watering process was operated from a remote location. Epidemiological studies have shown that wastewater and sewage plants employees have an increased risk of certain symptoms such as fatigue, headaches, diarrhea, nausea, vomiting, loss of appetite, cough, shortness of breath, and mucosal irritation.<sup>6,8,9,10,11,12,13</sup> Although the cause of these symptoms is not fully understood, they are generally thought to be related to exposure to chemicals, microbes,

and endotoxins released by microbes in the sewage.<sup>7</sup> Our decision not to sample for microbes and endotoxins was based on a review of studies presented in peer-reviewed journals that have suggested that microbes and endotoxins are frequently associated with sewage sludge.<sup>6,7</sup> Appropriate engineering controls and good work practices may reduce the risks associated with these hazards as highlighted in the recommendations section of this report. Additional studies have also suggested that exposure to odors may result in symptoms such as fatigue, confusion, and depression.<sup>14,15</sup> Identifying the source of these symptoms is further complicated because some of these symptoms are common in people without exposure to waste products. Environmental sampling for bioaerosols provides an indication of potential exposures on the day the sampling is conducted and would not provide information concerning past exposures that might be related to reported health symptoms.<sup>16</sup>

Wastewater and sewage employees are not considered to be at higher risk for contracting hepatitis B when compared to the general population.<sup>17</sup> This risk is further reduced by the hepatitis B vaccine plant employees are required to receive. The risk of contracting hepatitis A virus by the plant employees remains low because they have been vaccinated.<sup>18</sup>

Although the HHE request indicated that employees were concerned about viral cardiomyopathy, liver and neurological disorders, the interview revealed that only one of the concerns (viral cardiomyopathy) was reportedly diagnosed as work-related by the employee's physician. Our investigation and a review of medical and scientific literature do not support an association between work at the de-watering plant and reported liver and neurological disorders.

## RECOMMENDATIONS

- Improve the ventilation in the office area by introducing outside air and

maintaining positive pressure in relation to the de-watering area to minimize the infiltration of odors.

- Keep all doors in the de-watering process building closed.
- Wash hands thoroughly with soap and water after contact with sludge handling equipment or the sludge itself.
- Prohibit eating, drinking, or smoking in work areas. In addition, workers should always wash their hands before engaging in these activities or after using the restroom.
- Do not wear work clothes or boots home or outside the work environment. Use laundry services for washing work clothes.
- Encourage individuals who are concerned that their symptoms may be work-related to seek medical attention with a physician trained in occupational medicine.
- A post-vaccination antibody titer for hepatitis B should be considered for each worker who completed the hepatitis B series to confirm immunity or to aid in determining appropriate post-exposure treatment.
- Remind residents in the community served by this plant, in writing, of appropriate sharp disposal techniques to further reduce the risk to workers.
- Minimize workers' potential for exposure by remotely operating the de-watering system. Prior to implementing this engineering control measure, workers should attempt to reduce the amount of time spent in the de-watering area.
- Periodic training on standard hygiene practices for sewage-treatment workers should be conducted by qualified health and safety professionals.
- Encourage workers to quit smoking. Many adverse health effects have been associated with tobacco use, including but not limited to various forms of cancer and respiratory diseases. Smoking may also act synergistically with some of the hazards present at work places. Additional information on smoking cessation is available at <http://www.cdc.gov/tobacco>

[/how2quit.htm](#) or by calling 1-800-QUIT NOW (1-800-784-8669).

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**Table 1**  
**Indian River County Regional Sludge Facility**  
**Personal Breathing Zone and General Area Air Sample Results (ppm)**  
**Sulfur-Containing Compounds**  
**HETA 2004-0402-2975**  
**February 7–9, 2005**

Sample Type	Date	n-butyl Mercaptan	t-butyl Mercaptan	Carbon Disulfide	Carbonyl Sulfide	Diethyl Sulfide	Dimethyl Sulfide	Ethyl Mercaptan
Operator #1-PBZ	2-7-05	ND	ND	ND	ND	ND	ND	ND
Operator #2-PBZ	2-7-05	ND	ND	ND	ND	ND	<b>0.05</b>	ND
Operator #3-PBZ	2-8-05	ND	ND	ND	ND	ND	ND	ND
Operator #4-PBZ	2-8-05	ND	ND	ND	ND	ND	ND	ND
Operator #5-PBZ	2-9-05	ND	ND	ND	ND	ND	ND	ND
Area #1 (inside office)	2-7-05	ND	ND	ND	ND	ND	ND	ND
Area #2 (catwalk next to press)	2-8-05	ND	ND	ND	ND	ND	ND	ND
NIOSH REL		0.5	N/A	1.0	N/A	N/A	N/A	0.5

Sample Type	Date	Hydrogen Sulfide	Isopropyl Mercaptan	Methyl Mercaptan	n-Propyl Mercaptan	Tetrahydrothiophene	Thiophene
Operator #1-PBZ	2-7-05	ND	ND	ND	ND	ND	ND
Operator #2-PBZ	2-7-05	ND	ND	ND	ND	ND	ND
Operator #3-PBZ	2-8-05	ND	ND	ND	ND	ND	ND
Operator #4-PBZ	2-8-05	ND	ND	ND	ND	ND	ND
Operator #5-PBZ	2-9-05	ND	ND	ND	ND	ND	ND
Area #1 (inside office)	2-7-05	ND	ND	ND	ND	ND	ND
Area #2 (catwalk next to press)	2-8-05	ND	ND	ND	ND	ND	ND
NIOSH REL		10*	N/A	0.5	N/A	N/A	N/A

N/A = Not available

ND = None Detected (Below the limit of detection = 0.05 parts per million [ppm])

PBZ = Personal breathing zone sample; Area = General area air sample collected at a fixed location

\* indicates NIOSH Recommended Exposure Limit (REL) for hydrogen sulfide = 10 ppm (Ceiling Limit)

**Table 2**  
**Indian River County Regional Sludge Facility**  
**Personal Breathing Zone and General Area Air Sample Results (mg/m<sup>3</sup>)**  
**Volatile Organic Compounds**  
**HETA 2004-0402-2975**  
**February 7–9, 2005**

Sample Type	Date	Benzene	Toluene	Dimethyl Disulfide	Xylenes	Ethyl Benzene	Hexa-chloroethane	p-Dichlorobenzene
Operator #1-PBZ	2-7-05	ND	ND	ND	ND	ND	ND	ND
Operator #2-PBZ	2-7-05	ND	ND	ND	ND	ND	ND	ND
Area #1 (inside office)	2-7-05	ND	ND	ND	ND	ND	ND	ND
Operator #3-PBZ	2-8-05	ND	ND	ND	ND	ND	ND	ND
Area #2 (catwalk next to press)	2-8-05	ND	ND	ND	ND	ND	ND	ND
Operator #4-PBZ	2-8-05	ND	ND	ND	ND	ND	ND	ND
Operator #5-PBZ	2-9-05	ND	ND	ND	ND	ND	ND	ND
MDC		0.01	0.01	0.02	0.01	0.01	0.02	0.01
NIOSH REL		3.2	375	N/A	435	435	10	902

ND = None Detected (Below the MDC)

MDC = Minimum Detectable Concentration - milligrams per cubic meter of air (mg/m<sup>3</sup>)

PBZ = Personal breathing zone sample

Area = General area air sample collected at a fixed location

NIOSH REL = NIOSH Recommended Exposure Limit

**Table 3**  
**Indian River County Regional Sludge Facility**  
**Personal Breathing Zone and General Area Air Sample Results (ppm)**  
**Hydrogen Sulfide – Toxilog Ultra® Sampling**  
**HETA 2004-0402-2975**  
**February 7–9, 2005**

<b>Sample Type</b>	<b>Date</b>	<b>TWA</b>	<b>Peak</b>	<b>Comments</b>
Operator #1-PBZ	2-7-05	0	2	Working in office
Area #1	2-7-05	0	0	On desktop in office
Operator #2-PBZ	2-7-05	0	2	Working in office
Operator #1-PBZ	2-8-05	0	2	Working in plant
Area #1	2-8-05	0	2	Above belt filter-press
Operator #1-PBZ	2-8-05	0	1	Working in plant
Operator #1-PBZ	2-9-05	0	4	Working in plant
Area #1	2-9-05	0	2	Above belt filter-press
Operator #1-PBZ	2-9-05	0	5	Working in plant

ppm = parts per million

TWA = Time-weighted average

Peak = Maximum concentration measured during the sampling period

NIOSH Recommended Exposure Limit (REL) = 10 ppm (Ceiling limit)

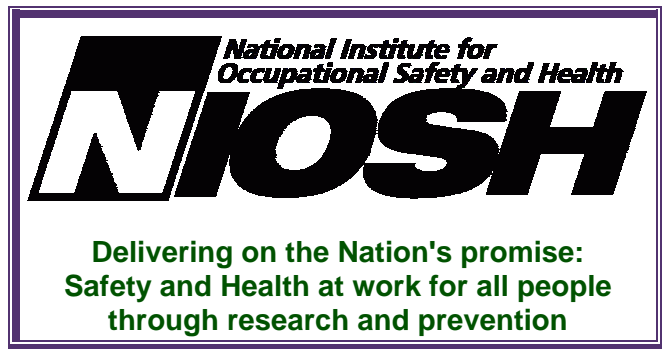
OSHA Permissible Exposure Limit (PEL) = 20 ppm (Ceiling Limit)

ACGIH Threshold Limit Value (TLV) = 10 ppm (TWA)



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Centers for Disease Control and Prevention  
National Institute for Occupational Safety and Health  
4676 Columbia Parkway  
Cincinnati, OH 45226-1998

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