U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45226

ADDENDUM TO HEALTH HAZARD EVALUATION
FINAL REPORT #77-87-440 (November, 1977)

ST. JOE MINERAL CORPORATION
HERCULANEUM, MISSOURI

Representatives of the International Brotherhood of Teamsters, Chauffeurs, Warehousemen and Helpers of America have pointed out several statements in the NIOSH Hazard Evaluation Report No. 77-87-440 that could be misinterpreted. This addendum serves to correct and clarify that NIOSH report.

1. NIOSH does not wish to give the impression that the work environment at St. Joe Mineral Corporation is ideal. Very high air levels of lead have been recorded in some areas, and many employees have shown elevated blood lead levels. Since the plant is under an abatement order by OSHA, NIOSH assumed that the presence of a lead problem at the plant was well-established.

2. The NIOSH report comments in several places on the "current" or "present" medical monitoring program at St. Joe Mineral Corporation. NIOSH should probably have indicated that the reported frequency of blood lead measurements was "proposed". At the time of the NIOSH visit, there had not yet been a follow-up period to determine whether or not blood lead determinations are actually being done with the proposed frequency.

3. The NIOSH report mentions that removal to the "Yard" area constitutes removal to a "low exposure" area for lead. Testimony by St. Joe officials to OSHA indicates that air lead levels in the yard area are in the 70-130 ug/m^3 range. This is below the current maximal occupational exposure limits, but there is still substantial lead exposure. Ideally, workers with elevated blood lead levels should be completely removed from lead exposure to allow the shortest possible time for return of blood lead levels to normal. The yard area has low lead levels compared to many areas of the plant, and it is below the maximal allowable occupational exposure levels; but the yard is not a "low exposure" area in the sense that lead exposure is minimal or absent.

4. The NIOSH report was in error concerning the number of workers transferred because of high blood levels. Based on testimony by St. Joe to OSHA, the number of men transferred appears to be closer to 40 men per quarter, rather than the 20-25 per year reported earlier.

5. The NIOSH report was also in error in stating that the respirator program at St. Joe was completely adequate as seen in practice. For air lead levels of over 1,000 ug/m^3, full-face respirators with air-line supply or appropriate filters should be used. The OSHA air lead data quoted in the NIOSH report showed several areas of the plant to be over 1,000 ug/m^3 of lead. Workers in high exposure areas were wearing half-face respirators at the time of the NIOSH visit.

6. NIOSH supports the principles of full access of individual employees to their medical records; of full disclosure of the reasons for and risks of medical treatment; and of education of the individual employees as to hazards in the workplace. NIOSH also supports the principle that economic considerations should be secondary to maintaining the health and safety of the workforce. Nothing in the NIOSH report should be interpreted as going counter to these principles.

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45226

HEALTH HAZARD EVALUATION DETERMINATION
REPORT NO. 77-87-440

LEAD SMELTING DIVISION
ST. JOE MINERAL CORPORATION
HERCULANEUM, MISSOURI

NOVEMBER 1977

I. TOXICITY DETERMINATION

NIOSH has investigated the medical surveillance and treatment program for lead exposed workers at St. Joe Mineral Corporation in Herculaneum, Missouri and has found that the present program is generally consistent with currently accepted medical practice:

1. Blood lead analyses are done on all workers in the plant every 2-3 months. A program of periodic medical examinations has been instituted.

2. Workers who have blood lead levels of 80 ug% or greater are transferred to the "Yard" and are monitored monthly. (The number of new blood lead elevations over 80 ug% ranged from 13 for the first quarter of 1977 to 37 for the second quarter of 1977.)

3. The Company's policy of chelation has recently changed. Chelation therapy is now given only to a worker who has significant symptoms (the Company reports that this has never occurred), or very high blood lead without symptoms, or if high blood lead levels persist despite several months removal from exposure to lead. Current chelation practice is to admit the worker to the local hospital. There is no evidence that any employee has suffered a serious side affect from chelation therapy at the company.

NIOSH recommends the following changes in the chelation therapy for lead exposed workers: 1) oral chelation should not be given simply at the request of an employee; 2) asymptomatic individuals should generally not be treated by chelation, and; 3) repeated use of chelating agents in any one individual should be avoided; 4) the decision to use chelation therapy should rest entirely with a physician.

Review of the available air sampling records shows that air concentrations of lead at many operations of this lead smelter have exceeded Federal OSHA Standards. Ventilation and other engineering control measures will be used ultimately to prevent excessive employee exposures. Respirators are being used as a temporary measure to control inhalation exposures to lead.

Sections of this report include more detailed discussions on: NIOSH's medical and environmental investigation, the toxic effects of lead, and recommendations to both employees and the company for reducing exposures to lead.

II. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this Determination Report are currently available upon request from NIOSH, Division of Technical Services, Information and Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After ninety (90) days, the report will be available through the National Technical Information Service (NTIS), Springfield, Virginia. Information regarding its availability through NTIS can be obtained from NIOSH Publications office, at the Cincinnati, Ohio address. Copies have been sent to:

A) Lead Smelting Division, St. Joe Mineral Corporation, Herculaneum, Missouri
B) U.S. Department of Labor, Region VII
C) NIOSH, Region VII
D) Authorized Representative of Employee - (Teamsters Local Union No. 688)
E) Representative of International Brotherhood of Teamsters

For the purpose of informing the approximately 600 affected employees, the employers shall post the Determination Report for a period of 30 days in a prominent place(s) near where exposed employees work.

III. INTRODUCTION

Section 20 (a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669 (a)(6), authorizes the Secretary of Health, Education, and Welfare, following a written request by an 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.

NIOSH received such a request from an authorized representative of employees (Teamsters Local Union No. 688) at the Lead Smelting Division of St. Joe Mineral Corporation in Herculaneum, Missouri. NIOSH was requested to evaluate the Company's medical program for lead exposed workers.

IV. HEALTH HAZARD EVALUATION

A. Process Description and Conditions of Use

This Herculaneum, Missouri facility of the St. Joe Mineral Corporation is primarily involved in the production of lead metal ingots from lead ore (galena) concentrate. Sulfuric acid, zinc and silver are secondary products of this lead smelting process. Normal daily lead production is about 1-1.5 million pounds per day. Approximately 600 persons are employed daily for three shifts.

Lead sulfide concentrate (70-72% Pb) is brought to this facility from southeast Missouri. The concentrate is unloaded by a tilting car dumper (usually during the day shift) and conveyor transported to the mixing bins where lime rock, hematite, sand, and recirculated materials are added. This mixture is then sintered to convert the lead sulfide to lead oxide (the sulfur dioxide goes to the sulfuric acid plant). The sinter is conveyed to the blast furnace area where coke and flux are added. The molten lead metal and slag products are layer separated as they leave the blast furnace. The slag is either recirculated, or disposed of. Lead from the blast furnace then goes to the lead refinery operation where the dross, copper, silver, and zinc is removed. The lead is then cast as bars or pigs ranging in weight from 25 to 2,000 pounds.

B. Toxicity of Lead and Treatment of Lead Toxicity

Lead is a highly toxic metal, but long experience in industry has shown that good engineering controls in the workplace and good personal hygiene among employees can make lead a safe material to use.

There is a very large amount of information available on the toxic properties of lead. Any person who works with lead should be aware of the following facts:

1. Lead is a solid at room temperature. Chunks of lead at room temperature are not usually a hazard to health; but when lead is melted and heated to high temperature, lead fume comes off the molten lead. This fume can easily be breathed deep into the lung, where the lead can be readily absorbed into the bloodstream.

2. Lead can also be absorbed from the intestines after it is swallowed. Because of this, persons working with lead should be very careful to wash their hands carefully before picking up anything to put in their mouths. There should be no eating or drinking in a work area where lead is used.

3. Lead is not absorbed through the skin to any significant extent. It is very important, however, to shower and change clothes before going home to prevent contaminating the home with lead dust. There have been cases of lead workers' wives being poisoned by lead dust while laundering lead-contaminated work clothes. Young children who crawl on the floor and put things in their mouths are especially likely to be poisoned by lead dust which has been carried home by workmen.

4. Lead is a naturally-occurring material that is normally present in small quantities everywhere in our environment. There have always been small quantities of lead present in our air, water, and food. Lead has no known normal function in the human body; it is not essential for human growth. (Many metals, such as iron, copper, and zinc, are necessary for the proper functioning of the human body).

   All normal people have a small amount of lead in their bodies, and there is no known health problem caused by these "normal" levels of lead. The normal human body has ways of handling these small amounts of lead. Most of the lead eventually comes out in the urine, although small amounts can come out in feces, sweat, and saliva. Lead has a tendency to be deposited in the bones. Large amounts of lead can accumulate in the bones, where it tends to stay for a long time. For this reason, a long period of time away from a lead-exposure area may be needed for a person to eliminate most of the lead from his body.

5. Lead has many effects on the human body. When a lot of lead is absorbed into the body over a short period of time, the symptoms of "acute" lead poisoning occur. When lead is absorbed over a long period of time, "chronic" lead poisoning may occur. The symptoms of lead poisoning include: constipation, headache, loss of appetite, general weakness and fatigue, inability to sleep, abdominal pains, aches and pains in muscles and joints, and weakness or shakiness in the arms or legs.

   Large amounts of lead can damage several organs in the body. Nerves can be damaged, especially those in the arms and legs. This results in muscle weakness, usually first noticed in the hands and feet. Another result can be a tremor, or shakiness, that usually starts in the hands. The brain is rarely affected in adults exposed to lead. The kidney can be damaged by lead. This may result in abnormalities of blood tests used to check on kidney function, such as serum blood urea nitrogen (BUN) or serum creatinine. Gout can be a complication of damage to kidneys by lead, but is usually only seen in people who drink lead-contaminated moonshine liquor. Lead can also cause anemia, or low blood count, by impairing the ability of the bone marrow to make new red blood cells. This anemia usually improves rapidly after the lead is removed from the body.

Lead is not known to cause cancer in humans. Lead may be dangerous to unborn children, so pregnant women should not be exposed to lead.

6. There are large differences in the ability of individual human bodies to handle lead. Some people absorb lead better than others; some people get rid of lead in the urine better than others; and some people show symptoms of lead poisoning at lower blood lead levels than others. These differences among individuals depend on age, sex general health and nutrition, kidney function, and many other factors that are not well understood.

7. The Federal government has established permissable limits for the amounts of lead than can be present in the blood of a person who works with lead.

   In the past, NIOSH has recommended that 80 ug of lead per 100 ml of whole blood should be the maximum allowable level. This was based on evidence showing that normal persons are not harmed by levels up to 80 ug/100 ml blood. More recent evidence indicates that a maximum level of 60 ug/100 ml blood may give a more adequate margin of safety. OSHA has been conducting hearings in recent months to determine if the maximum permissable level of lead in the air, and possibly also in blood, should be lowered.

8. The recommended treatment of lead intoxication has been changing in recent years. The usual practice in industry now is as follows:

   a. Any person with substantial exposure to lead should have a periodic lead determination.

   b. If a worker's blood lead level reaches a level of 80 ug/100 ml or greater, the blood lead level should be rechecked if there is any reason to suspect lab error. If the lead level is correct, the worker should be removed from the lead-exposed area. He should not return to a lead-exposed area until a repeat blood lead determination is at least below 80 ug/100 ml, and preferably below 60 ug/100 ml to give an added margin of safety. (NIOSH currently recommends that workers should be removed from lead exposure at a blood lead of 60 ug/100 ml.)

   c. There should be no chelation agents used to treat a high blood lead level unless:

      i) The lead level is very high. (Exactly how high is a matter of medical judgment. There are no written standards for this.)

ii) The worker has symptoms suggestive of lead poisoning.

iii) The blood lead level has failed to drop after a prolonged period away from lead exposure. (This is also a matter of medical judgment. There are no written standards for this.)

Chelating agents should not be used on a worker who continues to work in an area of high lead exposure. There is some evidence that oral chelating agents can enhance the absorption of lead which has been swallowed; this could make lead intoxication worse.

9. Chelating agents have been used for many years to treat lead intoxication: Calcium Versenate (EDTA, ethylene-diamine-tetraacetic acid) is the compound most commonly used to help remove lead from the body. This compound binds lead very tightly, and then helps the lead to pass into the urine and out of the body. Versenate is not absorbed very well after being swallowed, which makes it relatively ineffective when given as a pill. For this reason, Versenate is usually given directly into a vein for maximum effectiveness. This can be done under medical supervision in a properly equipped plant medical facility, but now it is usually done in a hospital.

Versenate can have some side-effects. When given orally, it can cause diarrhea and abdominal upset. When injected into a muscle, it causes considerable pain. It can cause itching and allergic reactions in some individuals. There is some recent evidence that it might cause some kidney damage when given in large doses over a long period of time. There is also some evidence that it can bind other necessary metals from the blood, thus causing a deficiency of these essential trace metals in the body. This would usually only be a problem when versenate was used in large amounts.

For these reasons, there has been a trend away from using versenate in recent years. In 1976, NIOSH recommended that chelation should no longer be routinely used in asymptomatic workers who had a blood lead level over 80 ug/100 ml. Removal from lead exposure without chelation should be the first choice of therapy. Chelation should not be done while a worker is still exposed to significant amounts of lead; chelation should not be repeated very often; intravenous chelation should generally be used in preference to oral chelation.

C. Environmental Exposure Standards and Guidelines

The present occupational safety and health standard (OSHA) for lead is 200 ug/M^3 (as measured by an 8-hour air sample). OSHA has proposed a new standard with a permissible exposure limit of 100 ug/M^3 (there are many new provisions in this proposed standard). The permissible exposure limit is based on a correlation of airborne concentrations of lead with blood lead levels which have been associated with adverse effects and symptoms of lead exposure. The currently existing and proposed exposure limits are:

OSHA Current Legal Standard	200 ug/M^3
OSHA Proposed Standard	100 ug/M^3
ACGIH - TLV	150 ug/M^3
NIOSH Criteria*	(less than)150 ug/M^3

*In March of 1977 NIOSH recommended to OSHA that this level be reduced to below 150 ug/M^3 ... a recommendation consistent with the OSHA Proposed Standard of 100 ug/M^3.

D. Evaluation Methods

A NIOSH physician and a NIOSH industrial hygienist visited the Hurculaneum Missouri facility of St. Joe Mineral Corporation on July 26 and 27, 1977 to investigate the medical surveillance and treatment program and to review the company's program for controlling worker exposures. The NIOSH industrial hygienist met with St. Louis Area OSHA personnel before the site visit to discuss their past and present activities at this facility. The results of OSHA air sampling, citations issued, and abatement programs were reviewed.

The NIOSH physician conducted the following investigations during the site visit:

1. Review of blood lead data as reported quarterly to OSHA beginning in January, 1977.

2. Review of company medical records on all workers who received chelation therapy since July 1, 1976.

3. Review of reports of private medical consultants retained in the past few years to review the company medical program.

4. Discussion of medical problems and policies at St. Joe Mineral Corporation with the plant physician and medical technician, corporate safety personnel, corporate medical consultant, representatives of Teamsters Local 688, and several randomly selected employees encountered during the walk-through of the plant.

The NIOSH industrial hygienist discussed and reviewed various aspects of the company's employee exposure control program including:

1. Review of the process and materials flow.

2. Review of engineering exposure control measures for these operations.

3. Observation of work practices, employee personal hygiene, and other factors affecting employee lead exposures.

4. Review of the company's lead air sampling program and the results.

5. Review of the currently practiced respiratory protection program.

E. Evaluation Results

Medical Results

1. Demography:

The plant employs about 600 workers; about 500 of these work in lead-exposed areas of the plant. All production workers are male, and about 90% of them are Caucasian. The production workers are unionized, belonging to Teamsters Local #688.

2. OSHA Records:

The blood lead summary data supplied to OSHA by St. Joe Mineral Corporation in 1977 revealed that out of about 500 total workers in the lead-exposed areas of the plant, the following frequencies of blood lead levels had been found:

1st quarter 1977

Blood lead (ugPb/100 ml whole blood):	71-80	81-90	91-120	121-
Number of employees	110	10	3	0

2nd Quarter 1977

Blood lead (ugPb/100 ml whole blood):	70-79	80-89	90-99	100-
Number of employees	105	12	15	10

All remaining blood lead levels were below 70 ug%.

The number of workers who were kept in the "yard" area of the plant to avoid lead exposure during the first half of 1977 ranged from 33 to 38 out of the total yard crew of about 80.

The blast furnace, dross, and sinter areas of the plant account for 82% of the blood lead levels over 80 ug%.

3. Review of Medical Program

The current medical program at St. Joe Mineral Corporation consists of the following:

a. Blood leads are done on all workers in the plant every 2-3 months. St. Joe Minerals employees a full-time technician who does the blood lead determinations at the plant site using atomic absorption spectroscopy with a Delves cup method. Quality control is checked internally by sending samples to labs in other St. Joe plants; quality control is monitored externally by sending samples to an independent reference lab.

Blood lead determinations have been done at the plant for over 20 years. Polarigraphic methods of blood lead analysis and the analysis of urine for coproporphyrins were abandoned several years ago in favor of regular blood lead determinations by atomic absorption spectroscopy.

b. If a worker has a blood lead level of 80 ug% or greater, he is immediately transferred to the "yard", which has a documented low level of lead in the air. He also has a serum BUN determination made at this time. If the BUN is abnormal, a serum creatinine and routine urinalysis (including specific gravity, albumin, glucose, microscopic) are performed. This program of blood testing is continued monthly until the blood lead falls to below 80 ug%, and preferably to below 70 ug% because of the tendency of these workers to rapidly reaccumulate lead when returned to lead-exposed areas of the plant.

c. The general medical monitoring program includes a pre-employment history, physical, blood lead, BUN, and hemoglobin. A program of periodic re-examinations every three years has been instituted in the last 2 years. The medical unit at the plant has facilities for doing blood leads and chest x-rays. A certified emergency medical technician is on duty during the days for minor complaints; and a physician visits the plant daily in the morning to consult on more difficult problems. An emergency vehicle is available at all times, and the extensive medical resources of St. Louis are available for consultation only 30 miles away.

d. The policy towards chelation therapy has changed over the last year at St. Joe. Until about June, 1976, it was customary to give oral chelation to all workers who were transferred to the Yard because of a blood lead of 80 ug% or greater. Chelation was not given to a worker while he was in an area of high lead exposure. According to the company, an average of about 20-25 men a year required transfer to the yard, and most of these were chelated.

Since about June, 1976, the practice of chelating asymptomatic workers with blood leads over 80 ug% was discontinued because of recommendations against prophylatic chelation made by NIOSH and by medical consultants retained by St. Joe.

Chelation has been carried out on selected individuals in the last year, primarily because of failure of the blood lead to decline after several months of removal from exposure.

Four men received Intravenous (IV) chelation in March, 1977 after a trial of removal from exposure combined with oral chelation. Before being given IV chelation therapy, some of these men were asked to take the chelating agent orally for a period of time in the presence of the doctor, a practice referred to at the plant as "handfeeding." Some of this IV chelation in March was done in the plant medical office under the supervision of the plant physician in order to minimize time lost from work. The blood leads of these men ranged from 81-191 ug% prior to chelation. Two of these men received a 5-day course of therapy; the other two men had therapy terminated after 3 days due to lack of adequate veins.

In June and July of 1977, three men were hospitalized for IV chelation therapy for blood lead levels ranging from 84 to 141 ug%. One man refused therapy because he could not get the company to give him his exact diagnosis or his blood lead level. Prior trials of oral chelation were tried on only one of these three men.

Oral chelation therapy was only being given to two men at the time of the NIOSH visit; this was apparently at the request of the individuals under treatment. In the period from July, 1976 - July, 1977, about 16 men were chelated orally for blood leads ranging from 80 to 129.

Chelation has had few reported side effects as practiced at St. Joe. One man on oral chelation had diarrhea necessitating termination of treatment. Two men on IV chelation had their treatment terminated early because of lack of adequate veins. Records of serial BUN determinations showed no consistent or significant changes during treatment.

Most of the men who were chelated had no symptoms of lead intoxication. Two of the seven men who were chelated reportedly had significant abdominal pain, however. Two of the sixteen men who were chelated orally in the last year also had some abdominal pain, and one had some loss of appetite.

The company policy is that the diagnosis of "lead intoxication" will only be applied to an individual who has symptoms of lead poisoning. An elevated blood lead level without accompanying symptoms is not labelled lead intoxication. This semantic distinction has no bearing on treatment, but it has acquired some importance in discussions between St. Joe Minerals and Teamsters Local No. 688. The union wants St. Joe Minerals to give an employee who requires chelation a written statement of his medical diagnosis, the need for treatment, the alternatives to treatment, and the risks of treatment. The company is not willing, at the moment, to provide written statements. As a result of this disagreement over the release of medical information to individual employees, at least one employee with symptoms of lead intoxication has refused treatment.

The current policy on chelation therapy at St. Joe is as follows:

a. No chelation is routinely given for a blood lead level of 80 ug% or greater without symptoms. The worker is transferred to the low-exposure "Yard" area and monitored monthly.

b. Chelation is given to workers who have significant symptoms, or who have a very high blood lead without symptoms, or who have persistently high blood lead despite several months removal from exposure to lead. There are no fixed criteria for using chelation; this is a matter of medical judgment by the plant physician, who believes that a high blood lead level over a long period of time is deleterious whether or not overt symptoms of lead intoxication are present.

c. Chelation is now generally only done by the IV route, which is much more effective than orally. Although some IV treatments have been given in the past in the plant first aid room, the current practice is to admit the worker to the local hospital for treatment.

The NIOSH medical officer feels that the current practice of chelation is generally consistent with prevailing medical practice in the U.S.A. today, except for the following:

1. Oral chelation should not be given simply because a worker requests it. The decision to treat should be entirely up to a physician. NIOSH believes that there are very few indications for oral chelation; there is almost always a better method of treatment.

2. Although there is considerable controversy in the medical community today about the dangers of a high blood lead level in an asymptomatic individual, the current trend is away from any use of chelation on asymptomatic persons because of the potential toxicity of the chelating agents themselves. Unless the need for returning a worker to a lead-exposed job becomes very urgent, NIOSH would prefer to leave workers in areas of low lead exposure until their blood lead level drops without treatment.

3. Repeated use of chelation in any one worker should be avoided. If improved engineering controls, safety equipment, and personal hygiene will not keep an employee's blood lead level down, alternative work areas should probably be found.

Environmental Results

1. OSHA

The Occupational Safety and Health Administration (OSHA) out of the St. Louis office has been monitoring employee exposures to lead and has been following the Company's exposure control program. Air sampling by OSHA in January of 1974 found excessive exposure levels to lead at the sinter plant, baghouses, blast furnaces, and dross plant. A citation was issued and an abatement program was established and included engineering control measures and a respiratory program. OSHA has extended the abatement or correction period and continues to monitor the Company's progress.

2. Walk-through

The walk-through survey of this facility allowed the investigators to only briefly observe working conditions. The sintering plant and blast furnace areas were observed to have large accumulations of lead dusts and process debris on the ground and equipment. The conditions observed were considered to be typical except for the acid plant which was down for repair. The large quantities of materials handled appears to make good housekeeping especially difficult. Equipment failure is apparently common and disrupts production schedules. Discussion with workers in various areas indicated that they were generally aware of

the potential hazards of lead and practiced available means of avoiding lead exposure. Numerous complaints were made about sulfur gases from the acid plant.

3. Engineering

There are continuing equipment and process changes being made to improve production as well as to reduce potential health and safety hazards. OSHA is monitoring the progress of these engineering controls (e.g. ventilation and machine guarding). Equipment problems such as "blow holes" in the blast furnaces will probably continue to create production disruptions.

4. Work Practices

The time spent on-site allowed NIOSH investigators to briefly observe work practices. Most workers who were interviewed seemed to realize that it was important to avoid exposure to lead during their job tasks. Workers appeared to avoid, whenever possible, areas where there were high levels of dust or fume. However, there are times when conditions require workers to enter areas which have high dust of fume levels. One such condition which was observed was at a blast furnace where the "pot hole" had frozen during a power failure: about five workers were involved in trying to loosen the lead metal/slag while visible fume and hot particles filled the work area (most workers were wearing respirators in this area). In many situations the potential safety hazards could far outweigh the potential health hazards.

Workers who are found to have high blood lead values are placed into the yard crew where there is (reportedly) low exposure potential.

5. Personal Hygiene

The personal hygiene of workers could be a large contributor to lead exposure at this facility. Most workers appeared to realize this and the Company has stressed the importance of this.

Eating and drinking is restricted to the cafeteria and certain control rooms (at the power house, acid plant, #5 baghouse, etc.) where the air is purified. The cafeteria has wash facilities and areas for storing box lunches.

During the walk-through survey, Company representatives explained that workers are provided with a clean change of pants, shirt and jacket each shift. At the end of a workshift, the workers turn in their contaminated clothes to the laundry and receive clean items. Discussion with various workers confirmed that these laundry procedures are practiced and generally acceptable. Change and shower facilities appeared clean. Workers wash and change on their own time. Some workers stated that the showers and change facilities were too crowded and that consequently some workers go home without showering.

Workers were observed to carry and smoke cigarrettes in work areas. Carrying and smoking cigarrettes in high lead areas will result in significant lead exposures unless special precautions are taken to prevent contamination of cigarrettes and hands are clean while smoking.

6. Air Sampling

Results of air sampling performed by OSHA and St. Joe Mineral Corporation were reviewed. Air sampling is performed by the Company on a regular basis to determine worker exposures and to evaluate the effectiveness of engineering controls. Review of air sampling results showed that air lead concentrations in many areas and operations exceeded the proposed OSHA standard of 100 ug/M^3. Based on available results, the highest exposure potentials have existed in the sinter plant, blast furnace and baghouse(s).

Table I summarizes approximate ranges of air lead concentrations measured in recent years. (There can be many variables affecting air lead levels. These ranges are approximations of the results made available to NIOSH).

This summary shows that there are many operations at which average air lead concentrations exceed the OSHA standard of 200 ug/M^3 of air (Proposed OSHA Standard - 100 ug/M^3). This means that without the use of a proper respirator, a worker could breath enough lead so as to contribute to the total lead accumulation in the body. Exposures to lead above 200 ug/M^3, when combined with exposures such as:

1. Smoking cigarrettes contaminated with lead,

2. Accidental ingestion from lead on the hands during eating food (contaminated with lead?) or chewing finger nails,

3. Swallowing saliva when working in dusty areas, licking ones lips, etc.,

4. Exposures at home because of lead brought home on shoes, clothes, and body,

5. Exposures at home from lead glazed ceramics, leaded gasoline, and other environmental contamination,

...could result in excessive absorptions and accumulations of lead in the body. Any area or operation which results in a visible accumulation of lead dust or fume should be entered only when necessary and with the proper respirator being used.

7. Respirator Program

All employees have been issued respirators for use. Most workers were observed to be using their respirators in areas of heavy dust or fume. Each worker has been personally provided with two half-face respirators (MSA Comfo-II respirators with dust and fume cartridges are the most commonly used. These respirators are certified by NIOSH.) The respirators are cleaned, disinfected, and stored in a room by individuals whose only job is this. Review of the Company's written Respirator Program, inspection of the respirator cleaning room and practices, and individual discussion with various persons, indicated that the "Respirator Program" complies with OSHA requirements.

However, these respirators give protection from lead dust only when accepted and used properly by workers. When asked, most workers stated that they did work with the respirators but that they are difficult to breath through and are uncomfortable, especially in hot areas. This was an expected complaint since all respirators are uncomfortable and create a resistance to breathing. Fit testing by the banana oil-isoamyl acetate-technique has been performed for all users.

It was observed that when the respirators are not being breathed through, most workers carry them loosely around their necks. This could result in lead exposure if lead dust or debre were to fall into these hanging respirators. When asked, workers said they exchanged their respirator whenever it became visibly contaminated inside.

These half-face respirators will not give adequate protection when used in areas where air lead concentrations exceed ten times the permissible limit. In these situations, full-face or supplied air respirators must be used.

F. Discussion

Investigation of the workplace and various records shows that there is a very large potential for workers to be exposed to lead. It appears that the Company has identified the areas and operations which have high lead concentrations in the air. The Company is attempting to control worker exposures to lead by means of engineering changes (ventilation, etc.), encouraging good work practices and personal hygiene, and the use of respirators. The blood of workers is periodically tested to detect workers who have absorbed excessive quantities of lead.

It is significant that many workers have been exposed to quantities of lead which exceed the OSHA Standard (200 ug/M^3) but have not shown lead effects and high blood lead levels. This may be explained by the type of lead dust (for example, lead oxide is better absorbed and more toxic than lead sulfide or by individual susceptibility. Another explanation could be that some workers get more exposure because of poor personal hygiene. For example: not washing hands before eating, smoking lead contaminated tobacco, not showering at the end of work, or not wearing respirators consistently.

It is the responsibility of the Company to control the lead hazard primarily by engineering means, and by requiring workers to follow proper work practices and personal hygiene. While the Company has a responsibility to make good personal hygiene as practical and easy as possible, each individual employee has the final responsibility for his own personal hygiene.

V. RECOMMENDATIONS

1. The company should continue the present medical monitoring program. NIOSH commends St. Joe Minerals for recent improvements in their program.

2. The company should try to clear up some of the employees' confusion and fears concerning lead toxicity and chelation therapy. Probably this will require a policy of freer access to medical records by individual employees. A more open communication should exist concerning the indications for, alternatives to, and potential complications of chelation therapy. Employees should be educated as clearly as possible about the hazards of lead and the ways available to minimize those hazards. Personal physicians can obtain the results of a patient's medical tests if release authorization is made by the patient.

3. The company should strongly emphasize personal hygiene to the employees.

   a. Smoking in the workplace should be strongly discouraged; a separate smoking area could be created if necessary. (Smoking by itself is known to cause and contribute to many diseases.)

   b. Handwashing should be encouraged and enforced.

   c. Showering and changing clothes should be enforced. Additional facilities may be needed to make cleanliness as easy as possible for the workers.

   d. Eating in the workplace should continue to be prohibited.

   e. Respirators should be used in the prescribed areas of the plant.

4. The company should continue its efforts to find ways to screen out individuals who have unusual susceptibility to lead accumulation.

5. While the company has a responsibility to make good personal hygiene as practical and easy as possible in the workplace, each individual employee has the final responsibility for his own personal hygiene. Compensation for injury is a poor substitute for good health.

6. The current practice of chelation therapy is generally consistent with prevailing medical practice, and should be continued except for the following:

   a. Oral chelation should not be given simply at the request of an employee. Criteria for chelation should be consistently applied in all cases.

   b. Asymptomatic individuals should generally not be treated by chelation. There is no convincing evidence that the risks of a chronically-elevated blood lead level outweigh the risks of treatment with chelating agents.

   c. Repeated use of chelating agents in any one individual should be avoided.

7. The decision to use chelation therapy should rest entirely with a physician, not with what the employee thinks is the best therapy.

   The health of individual employees will surely suffer if the consent for treatment is used as a bargaining tool.

8. The Company should continue present engineering and other measures aimed at reducing worker exposures. Respirators are meant to be used if engineering controls are not feasible or until these controls can be made to work.

9. The Company should continue air sampling so that areas and operations with excessive levels of lead can be known. Workers should know what their potential exposures will be before entering an area or performing an operation. (It is more important to use a respirator in highly contaminated areas). Workers should know the consequences of their exposures. This will probably require more mutual openness and trust between individual employees, Union health and safety representatives, and the Company.

10. Respirators must be used in areas of excessive air lead levels. (However, respirators are meant to be used only as a temporary solution until engineering measures can be taken to control excessive levels of lead in the air.) Only NIOSH approved respirators should be used:

Airborne Concentration of Lead	Recommended Respirator
(i) Fume, dust, or mist not in excess of 100 mg/M^3.	(A) A powered air purifying respirator with a full facepiece and high efficiency particulate filter.*
(ii) Fume, dust, or mist not in excess of 5.0 mg/M^3.	(A) A high efficiency particulate filter* respirator with a full facepiece; or (B) A supplied-air respirator with a full facepiece, helmet, or hood; or (C) A self-contained breathing apparatus.

Airborne Concentration of Lead	Recommended Respirator
(iii) Fume or combined fume, dust and mist not in excess of 1.0 mg/M^3.	(A) An air purifying respirator (except single use types), with fume or high efficiency particulate filter*; (B) A supplied air respirator; or (C) A self-contained breathing apparatus.
(iv) Dust or mist not in excess of 1.0 mg/M^3.	(A) An air purifying respirator (except single use types), with dust or mist filter; or (B) A supplied-air respirator; or (C) A self-contained breathing apparatus.

*NOTE - High efficiency particulate filter means 99.97% efficient against 0.3 micron size particles.

Individual employees should personally inspect all parts of the respirator issued to them to insure that all parts are working properly and not damaged. (A warped valve or facepiece can make a respirator totally ineffective. The inside of the facepiece should be checked by the user for dust which may have fallen inside the facepiece. Workers should continue to get a clean and disinfected respirator each shift or when any visible dust has gotten inside the facepiece.

Employees with heart or respiratory problems should not use a respirator unless a physician is consulted. It is considered good practice for the company to give each respirator user a medical examination to insure that the user of the respirator will not aggravate or worsen a pre-existing health problem. A reasonable work pace must be set since respirators cause significant resistance to breathing.

11. The Administrator for the Respirator Program should attend NIOSH Course 593 (Industrial Hygiene Respiratory Protection) or equivalent training.

VI. REFERENCES

1. Lilis, R. and Fischbein, A. - Chelation Therapy in Workers Exposed to Lead. A Critical Review. JAMA June 28, 1976, Volume 235, No. 26.

2. Occupational Safety and Health Administration Proposed Standard for Occupational Exposure to Lead, 40 Federal Register 45934, October 3, 1975

3. OSHA Public Hearing on Occupational Lead Standard, Statement of Edward J. Baier, Deputy Director of NIOSH, March, 1977.

4. Physician's Desk Reference 1977, P. 1274-1275. Calcium Disodium Versenate.

5. Zenz, C. - Occupational Medicine - 1975. Yearbook Medical Publishers p. 715-769.

AUTHORSHIP AND ACKNOWLEDGEMENTS

Report Prepared By:

Charles L. Wisseman, MD
Medical Officer
Medical Section
Hazard Evaluation and
Technical Assistance Branch
Cincinnati, Ohio

Jack O. Geissert
Industrial Hygienist
Industrial Hygiene Section
Hazard Evaluation and
Technical Assistance Branch
Cincinnati, Ohio

Originating Office:

Jerome P. Flesch
Acting Chief
Hazard Evaluation and
Technical Assistance Branch
Cincinnati, Ohio

Table I

Summary of Air Sampling Results,
Made Available to NIOSH
At St. Joe Mineral Corporation
in Herculaneum, Missouri

Area/Operation	Exceed 1,000 ug/M^3	Exceed 200 ug/M^3	Exceed 100 ug/M^3	Less than 100 ug/M^3
Sinter Plant:				
Mix room	X	X	X	
General area	X	X	X	
Control room			X	X
Blast Furnace:				
Trestleman	X	X	X	
Charger		X	X	
Operator	X	X	X	
Baghouse:				
General air	X	X	X	
Dross Plant:				
Operator/Helper		X	X	
Refinery:				
Desilvering			X	
Lead Loader				X
Casting				X
Fireman/Helpers			X	X
Retort			X	X
Foreman				X