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G.T. JONES TIRE & BATTERY DISTRIBUTING INC.
BIRMINGHAM, ALABAMA

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I. SUMMARY

On May 21, 1991, a Health Hazard Evaluation (HHE) was conducted by the National Institute for Occupational Safety and Health at the Gene T. Jones Tire and Battery Distributing, Inc., in Birmingham, Alabama. This visit was made in response to a request for technical assistance by the OSHA Region 4 Office, in Birmingham. OSHA had received a referral from the Alabama Health Department's blood lead surveillance activity. NIOSH representatives were accompanied by representatives from the Jefferson County Health Department on the site visit and evaluation.

The NIOSH technical assistance study at the G.T. Jones Tire and Battery Distributing Inc. Company found that 12 of the 15 workers had blood lead levels (BLL) >60 µg/dl and that the average of the last 3 blood levels exceeded 50 µg/dl for 13 of 15 employees. In this study, blood lead levels greater than 60 were associated with biochemical evidence of impaired heme synthesis and impaired renal function. Fourteen of 15 workers had elevated zinc protoporphyrin (ZPP) >100 µg/dl consistent with moderate lead poisoning while 3 of fifteen had ZPPs over 600 µg/dl, which is consistent with severe lead poisoning.[15]

The OSHA criteria for medical removal for overexposure to lead are as follows: 1) a single BLL of 60 µg/dl or greater, or; 2) the average of the last 3 BLLs or BLLs during the previous 6 months is 50 µg/dl or greater, or; 3) any medical condition which places the employee at increased risk of material impairment from lead exposure. Despite previous recommendations made by OSHA, continued increases in BLL have taken place (Figure 1.).

On the basis of the environmental and medical data the investigators determined that a health hazard existed from the over-exposures to lead during the breakdown processing of automobile and industrial batteries. Creatinine, a measure of renal function, is normally between 0.8-1.3 mg/dl. In six individuals serum creatinine was found to be elevated. Calculated creatinine clearance based on serum creatinine levels, adjusted for age and weight, was below normal (90 ml/minute) in seven tested and indicated mild renal function impairment in two of these individuals. These same individuals had average BLL's >60 µg/dl (range 63-79) for the last three determinations. All workers with Blls >60 µg/dl should be immediately removed from further lead exposure. Recommendations are provided in section IX of this report that may assist in reducing these adverse health effects.

Keywords: SIC 5093, battery, battery recycling, lead, blood lead levels, ZPP

II. INTRODUCTION

On May 21, 1991, a health hazard evaluation (HHE) was conducted by the National Institute for Occupational Safety and Health at Gene T. Jones Tire and Battery Distributing, Inc., in Birmingham, Alabama. This visit was made in response to a request for technical assistance by the OSHA Region 4 Office. OSHA had received a referral from the Alabama Health Department's blood lead surveillance activity. NIOSH representatives were accompanied by Alabama Department of Public Health representatives on the site visit and evaluation.

Preliminary data collected by the employer and provided by OSHA indicated elevated blood lead levels in 12 of the 15 employees (eleven employees had blood lead levels greater than 60 µg/dl). The NIOSH follow-up included medical tests (blood leads, complete blood counts, zinc protoporphyrin, blood urea nitrogen (BUN), creatinine, uric acid) and medical history, information on symptoms associated with exposure to lead, and family status information. In addition, aerosol measurements were made in the plant using a Real-Time Aerosol Monitor (RAM) to identify and prioritize potential sources of lead exposure in the battery breaking operation.

An opening conference was held with all the workers at the facility to explain the purpose of the evaluation and to answer questions. One hundred percent of the workforce volunteered to participate in the three phases of the site evaluation on May 21, 1991--questionnaire, physical examination, and blood specimen collection. At the end of the day a preliminary assessment of the survey responses was provided to both the workers and management. Information was also provided about the health effects of lead exposure. Workers were told they would receive a confidential letter informing them of their blood specimen results and that a report on the health status of the group as a whole would soon follow. Workers were notified of their blood specimen test results on June 26, 1991.

III. BACKGROUND

The G.T. Jones Tire and Battery Distributing Inc., employs fifteen individuals including the owner. Most of the workers are involved in all the jobs at the site depending on the availability of personnel. A list of the seventeen jobs performed at the facility is included in Appendix A.

Process Description

This battery breaking and recycling business has been in operation since 1979. Both automobile and industrial batteries are recycled for their lead and plastic. Automobile batteries consist of a plastic or rubber case and contain lead plates and sulfuric acid. Spent batteries contain lead oxide and lead sulfate.

Automotive Batteries

Automobile batteries are loaded by hand directly from a truck onto a roller conveyor; once on the roller conveyor batteries enter a short enclosure (about 2 feet long) which is open on both ends. A rotary saw is located in the floor of the enclosure with about one half to one inch of blade exposed. The enclosure is vented through the roof. This saw cut allows the batteries to drain free of acid mixture. An operator manually pushes the drained battery into the guillotine cutter. This cutter is hydraulically powered, and activated by the operator. The cut batteries exit onto a belt conveyor. A second operator separates the top from the case and drops it into a chute. The case continues up the belt conveyor and drops into the automatic battery dumper. The dumper consists of a rotary screen of about six inch mesh, about four feet in diameter, and twelve feet long. The tumbling action of the dumper causes the plates to fall through the screen to the floor below, and the cases are retained. The battery tops fall through the chute into an auger, and then onto a conveyor, where they are joined by battery cases exiting the dumper. An operator is stationed at the dumper exit to inspect cases for retained plates. A second operator watches the pile of plates. An elevated belt (about 20 feet high) conveyor transports the cases and tops across the width of the building to a hammer mill.

The mill grinds the tops and cases, discharging its product onto a moving screen, and passing lead-containing sludge into a liquid tank. A great deal of mist and metal projectiles escape from the mill. The liquid is then recirculated into the hammer mill. Plastic, paper, rubber, and lead chunks (from battery posts) exit via the screen. A series of augers and tanks separate these materials by flotation. Rubber and lead chunks are deposited in open bins. Paper is deposited in a liquid tank. Plastic chips are air-conveyed into an enclosed trailer. All materials are transported by front-end loader to trucks for shipment to other plants.

Industrial Batteries

Industrial batteries are much larger than automotive batteries, and consist of a metal container holding several cells. Each cell consists of a plastic case holding lead plates. Batteries are typically dismantled by using a torch to cut through the steel case. Cells are removed by dumping with a front-end loader. Individual plates are removed by cutting the plastic cases with an axe, then manually dumping the contents. Cases are manually transported to a second hammer mill for recovery. Case recovery was not observed during this site visit.

A schematic of the layout of the battery decasing operations is included in Appendix B.

IV. BUILDING INFORMATION

A concrete block structure contains the plant office, a small locker room and the automotive battery loading and cutting area. A separate concrete block structure contains a washroom, lockers, lunch area, and the plant laundry. All other operations are conducted under a single large metal roof with one side enclosed to minimize wind-generated dust. A waste water treatment system, no longer in use, was housed under a separate metal roof (with no walls).

V. EVALUATION CRITERIA

Inhalation (breathing) of lead dust and fumes is the major route of lead exposure in industry. A secondary source of exposure may be from ingestion (swallowing) of lead dust deposited on food, cigarettes, or clothing. Once absorbed, lead is excreted from the body very slowly. Absorbed lead can damage the kidneys, peripheral and central nervous systems, and blood-forming organs (bone marrow). These effects may be felt as weakness, tiredness, irritability, digestive disturbances, high blood pressure, kidney damage, mental deficiency, or slowed reaction times. Chronic lead exposure is associated with infertility and with fetal damage in pregnant women.[1,2]

Lead is a trace element in foods and beverages. Adults consume approximately 300 µg of lead each day of which only approximately 10% is absorbed, while children absorb nearly 50% of ingested lead. The daily respiratory intake for adults living in the United States is 20 µg.[1,2] Although an effective barrier to inorganic lead, the skin may allow for substantial absorption of fat soluble organic lead such as tetraethyl lead found in leaded gasoline, and may allow absorption of inorganic lead if broken secondary to disruption from trauma or dermatitis.

Previous studies report that overt symptoms of lead poisoning in adults generally begin at blood lead levels between 60 and 120 µg/dl.[1] Lead-acid battery workers, who may be heavily exposed to lead, have been shown to be at higher risk of dying from cerebrovascular and renal disease.[1,2] Neurologic, hematologic, and reproductive effects, however, may be detectable at much lower levels, and the World Health Organization has recommended an upper limit of 40 µg/dl for adult males.[3] Recent studies suggest that exposure of the developing fetus to blood lead levels far below these occupational exposure limits is associated with subtle neurologic impairment in early life and that there may not be a safe threshold for this effect.[4,5]

The U.S. OSHA permissible Exposure Limit (PEL) for lead in air is 50 $\mu g/m^3$ calculated as an 8-hour time weighted average (TWA) for daily exposure.[6] Employees whose blood lead level is 40 µg/dl or greater, must be retested every two months, and be removed from a lead-exposed job if their average blood lead level is 50 µg/dl or more over a 6-month period.

A blood lead level of 60 µg/dl or greater, confirmed by retesting within two weeks, is an indication for immediate medical removal. Workers on medical removal should not be returned to a lead-exposed job until their blood lead level is confirmed to be below 40 µg/dl.[6] Removed workers in the U.S. have protection for wage, benefits, and seniority for up to 18 months until their blood lead levels decline to below 40 µg/dl and they can return to lead exposure areas. This provides an incentive for employers to correct excessive exposures and avoids a disincentive for employee participation.

The blood lead test is one measure of the amount of lead in the body and is the best available measure of recent lead absorption. Adults not exposed to lead at work usually have a blood lead concentration well below 30 µg/dl.[7,8] Blood lead levels higher than 30 µg/dl have harmful effects on the mental development of young children. Since the blood lead concentration of a fetus is similar to that of its mother, and since the fetus's brain is presumed to be at least as sensitive to the effects of lead as a child's, the CDC advises that a pregnant women's blood lead be below 25 µg/dl.[9]

One of the earliest adverse health effects of lead is interference with the production of hemoglobin, the oxygen-carrying molecule in red blood cells. One of the steps in hemoglobin synthesis that is blocked by lead causes zinc protoporphyrin to accumulate in red blood cells before they are released from the bone marrow (where they are made) into the blood. Initially after lead exposure begins, affected red blood cells will be in the minority, but with continued lead exposure the proportion of red blood cells with increased amounts of ZPP increases. Red blood cells containing elevated amounts of ZPP can still be circulating three to four months after lead has exerted it adverse effects on them. Therefore, blood lead and ZPP levels will not rise and fall at the same time or rate.[10] Furthermore, people who have been exposed to different levels of lead for different periods of time may have different "body burdens" of lead stored in their bones and other tissues; this can affect their ZPP levels.[11,12] Finally, certain medical conditions can affect protoporphyrin metabolism; iron deficiency is the most common cause of an elevated ZPP in people without occupational lead exposure.

The blood lead level at which ZPP becomes elevated varies from person to person. At a blood lead level of 35-40 µg/dl about half of adult males will have an elevated ZPP, and at a blood lead levels of 25-30 µg/dl about half of adult women will have an elevated ZPP.[13]

The OSHA lead standard requires exposed workers to have periodic ZPP determinations, but it specifies no level at which any action should be taken. A WHO study group recognized that in countries where blood lead monitoring is impractical, it may be necessary to use ZPP to assess lead exposure. The group recommended that if ZPP is used for this purpose, a worker's ZPP should not exceed the upper limit of the laboratory's "normal" range by more than 50%.[13]

The zinc protoporphyrin (ZPP) level is a measure of lead interference with hemoglobin production. Heme synthetase, is the last enzyme in heme synthesis. Although some diseases and iron deficiency anemia can cause a rise in ZPP, in a healthy individual working with lead, lead absorption is the most likely cause for such an increase. ZPP levels begin to increase as blood lead levels reach 14-17 µg/dl and tend to stay elevated for 3-4 months (the average life span of a red cell). Normal values are below 50 µg/dl (79 µg/dl at the laboratory used for this study).[14] Several other laboratory measures of the adverse health effects of lead are reported including; blood urea nitrogen (BUN), creatinine, hemoglobin and hematocrit, and uric acid. These measures are reported in the results section of this report.

VI. EVALUATION DESIGN

A. Environmental

Aerosol measurements were made in the plant using a Real-Time Aerosol Monitor (RAM) to identify and prioritize potential sources of lead exposure in the battery breaking operation. This instrument samples the workroom air and instantaneously measures the concentration of airborne dusts and mists by measuring the amount of light scattered by these materials. Although the results of these measurements are reported in $\mu g/m^3$, these numbers should be considered as estimates of the true concentration of dust and mist, as the amount of light scattered depends on the characteristics of the specific aerosol in addition to its concentration.

The optical characteristics of the RAM are such that it is most sensitive to respirable aerosols (dusts and mists well below about 10 um in diameter). These measurements are short (about 1 minute) and may not reflect actual exposures measured by long-term sampling methods. The RAM measurements performed at this site visit are best judged as they relate to differences by location. Thus, outside the lunch room is considered "normal" or background aerosol associated with no activity for purposes of this analysis.

Wipe Samples

Wipe samples for lead were taken from a third of the employees' personal automobiles at the plant. These samples were collected to determine whether workers carried residual lead home on their bodies and clothes after removing their coveralls. Wipe samples were taken using Whatman Smear tabs and analyzed for the presence or absence of lead. Wipe samples were collected from the following locations: steering wheel, seat, dash, and floor between driver and passenger seat.

B. Medical

Occupational health history questionnaires, blood lead levels, (BLL), zinc protoporphyrin levels (ZPP), blood urea nitrogen (BUN), hemoglobin, hematocrit, creatinine, and uric acid, were measured for all 15 G.T. Jones employees. There was 100% participation by all current employees (15) in all phases of the medical evaluation. The blood specimens were sent to Metpath Clinical Laboratory, in Teterboro N.J., for analysis.

VII. RESULTS

A. Environmental

Employee exposures to airborne dust and mist from the battery breaking operations were monitored during this site visit at work stations locations throughout the facility. Workplace dust and mist measurements ranged from 40 to 400 $\mu g/m^3$. The levels of dust and mist were greatest at the trailer door, hammer mill, and in association with the process of dumping industrial batteries out of metal cases with a front-end loader (Table 1).

Wipe Sample data collected by OSHA, revealed the presence of lead in all of the five workers' automobiles sampled. Wipe samples indicated the presence of lead was highest at the drivers seat (3.00 mg), floor (1.90 mg) and dash (1.7 mg) locations. These data are not consistent with the reports that most of the workforce showers before leaving work to remove residual lead, and maintain proper hand washing procedures. This information also suggests a potential source of possible exposure through ingestion after contact with automobile surfaces.

B. Medical

On May 21, 1991, a work history and symptom questionnaire was administered, physical examinations were conducted, and blood specimens were collected for analysis of the G.T. Jones employees. All participants in the evaluation signed a consent form indicating their understanding of the study protocol and their willingness to participate. Workers were notified they would receive their individual blood test results and interpretation of the results several weeks following the evaluation.

The evaluation questionnaires consisted of information on demographics, work history, medical history, work practices, personal habits, non-occupational exposures to lead, and health and safety training. Physical exams, included blood pressure measurements, height and weight, presence or absence of lead lines, fundoscopic exam, biceps, tendon reflexes and/or brachioradialis reflexes, tremor, wrist strength, and ankle strength assessments. Finally, blood specimens were collected from each individual to assess blood lead levels, zinc protoporphyrin levels (ZPP), blood urea nitrogen (BUN), hemoglobin, hematocrit, creatinine, and uric acid. Results of each of the three phases of the study are presented in the following sections.

Questionnaire Results

Demographics and Work History

Demographic information for the G.T. Jones employees are summarized in Table 2. Employees ranged in age from 22 years to 49 years. The average age of employees was 33.4 years (SD=7.8 years). Ninety-three percent of the employees were males (n=14) and one employee was female. Sixty-seven percent were black (n=10) and 33% white (n=5). Sixty-seven percent (n=10) of the workers had either high school education or some college. Seventy-three percent were married (n=11), 13 percent were single or never married (n=2), and 13 percent (n=2) were divorced.

Among the fifteen employees there was a total of 31 children, averaging 2 children per adult. Thirty-three percent of the employees shared a household with individuals other than family members, and this variable was examined as a potential source of external exposure to lead.

The data indicate the G.T. Jones workforce turnover is low. Twenty-seven percent of the workforce has been employed for over eight years, 27% from 5-7 years, and the rest from 1-4 years. Workers averaged 10.6 hours per day (SD=2.3), and most worked 5.6 days per week.

Medical History

Workers were asked to report whether they had experienced any symptoms known to be associated with lead exposure over the last two weeks. Painful joints was the most frequently reported response (27%) followed by trouble sleeping (13%), poor memory or confusion (13%), and muscle weakness (13%). Only four workers reported conditions diagnosed by a physician, one reported a kidney condition, another anemia, and two reported hearing loss. Only two workers reported potential non-occupational exposures to lead, one attended a firing range and the other reported working with stained glass. None of the workers gave a medical history of medical conditions such as diabetes or gout which could account for the observed decrements in renal function.

Work Practices

Information on respirator usage, personal habits, and health and safety training are summarized in Table 3.

Ninety-three percent of the workers reported they wore a half-face cartridge respirator, however, one individual, did not wear his respirator during the entire site visit. It was observed that 8 of the 14 males had some evidence of facial hair, and thus called into question the fit and proper usage of respirators at the site. There was no indication of a fit testing program for the workers to ensure their respirators were properly sized for their faces. Over half of the employees (n=8) reported they only had their respirator changed when they asked their supervisor. One employee reported he changed his respirator cartridge everyday, and one reported less than once a week. Three employees (20%) changed cartridges less often than once a month, suggesting an inconsistent program among employees.

There appeared to be no designated program of zones for respirator usage. One third (n=5) of the employees reported wearing their respirators less than half the time while on the job; the rest stated they wore respirators 50-100% of the time. Eighty-six percent of the workers reported cleaning their respirators daily, and the majority (80%) also reported wearing safety glasses while on the job.

Personal Habits

While only one third of the employees smoked at work, 20% reported smoking at their work station, or in the lunch room. In addition, 93% reported they ate their lunch at work, another possible route of ingestion of lead. Sixty percent (n=9) of the workers reported they showered at work before leaving, consequently, 40% did not. The information reported on showering behavior was not consistent with the behavior we observed while on site. Only 20% of the employees were observed to have showered. Moreover, a third of the workers did not change their clothes when leaving the work site at the end of the day.

Potential Non-Occupational Exposure to Lead

Thirteen percent of the workers reported they had removed lead based paint during the past six months and only one worker had worked with stained glass. One worker also reported he spent time at an indoor firing range.

Health and Safety Training

All employees reported they received training about the health effects of lead exposure and information about protective equipment. Employees also responded correctly to questions about symptoms associated with lead exposure and recommended protection measures.

Laboratory Analysis of Blood Specimens

Results from the laboratory analysis of blood specimens are summarized in Table 4. The following information is a brief description of the laboratory results.

Blood lead Levels (BLL) and Zinc Protoporphyrin (ZPP)

Blood lead level test results showed that 93% of the G.T. Jones employees had blood lead levels elevated above 40 μg/dl ranging from 52-86 μg/dl at the time of our site visit. The mean blood lead level for the group was 65 μg/dl (SD=18), clearly above the OSHA lead standard level requiring medical removal. In fact, 12 of the 15 employees had blood lead levels above 60 μg/dl. Figure 1 illustrates the increasing trend in blood lead levels for the entire workforce between January of 1989 and May of 1991.

ZPP was elevated above normal for 93% of the workers, ranging from 27-616 μg/dl and a mean ZPP for the group of 268 μg/dl (the "normal" range for ZPP is 0-79 μg/dl). Only one employee had BLL and ZPP in the normal range.

Hemoglobin

Hemoglobin was below normal in 46% of the workers (the normal range from 13-17 gm/dl). The average for the group was at the low end of normal 13, and ranged from 11-16 gm/dl (SD=1).

Blood Urea Nitrogen (BUN) and Creatinine Levels

Six percent of the workers had Blood Urea Nitrogen above normal (8-22 mg/dl) with an average BUN of 16.7 mg/dl for the group (SD=4.5).

Serum creatinine was elevated in six workers. The formula of Gault and Cockcroft was used to predict creatinine clearance for men based on serum creatinine level.[15] Using a creatinine clearance of 90 ml/min as a generally accepted lower limit of normal for young men, seven of the 14 men (50%) had a calculated clearance below normal. Two individuals had clearances below 80% of normal suggesting mild renal function impairment.

Physical Exam Results

Systolic and Diastolic Blood Pressure Levels (PRE EXAM)

Systolic blood pressure averaged 122.8 with a SD=9.221 for the group. Diastolic blood pressure levels, which are measured in mm Hg, averaged 74 mm Hg with a SD=10.17 for the group. Only one of the workers had diastolic blood pressure over 90 (normal mm Hg).

Gums

Upon physical examination 33% of the workforce (n=5) was observed to have lead lines.

Fundoscopic, Biceps, Tremor, Wrist Strength, Ankle Strength Exams

Fundoscopic exams were normal in all but one employee who showed evidence of A/V nicking (a visible change in the arteriovenous crossing where the vein appears to stop abruptly on either side of the arteriole).[16] Other physical indicators of lead exposure (biceps, tremor, wrist strength and ankle strength) were normal in all of the employees.

Statistical Analysis Methods

Statistical analysis of the questionnaire data were performed to explore associations among the behaviors of G.T. Jones employees and medical, and physical exam data. Correlation coefficients were estimated using the Statview Statistical program (v. 512+). Categorical variables with dichotomous response outcomes (e.g. work with lead at home: yes, no) and all continuous variables (e.g. age, number of days per week, duration of employment, and medical test data -- BLL, ZPP, BUN etc.) were examined. BUN and ZPP were positively associated with one another (r=.729), while Hemoglobin and ZPP were found to be negatively associated (r=-.594). BUN which increases with renal dysfunction was positively associated with ZPP. Hemoglobin, decreases with the anemia caused by lead. BLL and Creatinine were positively associated r=.668, as was BUN and Creatinine r=.755. Uric Acid was positively associated with BLL, ZPP, BUN, and Creatinine, with the following r values of .676, .638, .727, and .656 respectively. Other associations between medical test data, clinical outcomes, and survey responses showed no meaningful significant differences (t-tests) between risk factors (i.e. duration of employment, clinical outcomes, and survey responses). These results are likely due to the limitations of small numbers in many of the response categories.

VIII. DISCUSSION AND CONCLUSIONS

A. Environmental

This evaluation of lead exposed workers involved minimal environmental sampling, since OSHA had made personal air sampling and job-specific area sampling measurements in a previous site visit. The data from our RAM measurements suggests three locations with high levels of dust and mist, these areas included the door of the scrap plastic trailer, the hammer mill, and in the area where dumping of industrial batteries takes place. Differences in health outcomes associated with the various work stations were not examined since employees perform all jobs depending on the availability of personnel. At present there appear to be no effective engineering controls in place to contain this dust and mist.

Wipe samples taken by OSHA from workers' automobiles indicated the presence of lead in all of the cars sampled. Lead was present in the greatest quantities at the drivers seat, floor, and dash locations of the automobiles. This finding suggests another potential source for contact with lead and a possible route for the ingestion of lead.

B. Medical

Work Practices

The questionnaire responses and physical examinations analysis indicate few symptoms, physical findings, or medical conditions diagnosed by physicians related to lead exposure. Physical examinations and symptoms are not, however, the most sensitive measures of lead-related health effects. Blood tests, currently the best indicator of over exposure to lead, revealed substantial elevations above the normal range. Responses to work practice questions revealed numerous opportunities for overexposure to lead.

Fifty seven percent of the workers showed some evidence of facial hair, and since there was no fit testing program at the facility it is probable that respiratory protection is inadequate. Usage and cleaning of respirators is inconsistent among employees, and 34% reported wearing their respirators less than half-time while on the job. The lack of use of respirators and personal protective clothing and equipment by key company personnel during the entire site visit indicated a lack of concern for personal safety and was a poor example for others.

Personal Hygiene

Only 60% of the workers reported showering at the end of their shift. Furthermore, a third of the workers reported no change of clothing at the completion of their shifts. It is likely that many of the workers take home residual lead on their bodies and street clothes (which are worn underneath coveralls) during work.

Physical Exams

Physical examination revealed one third of the workers had evidence of lead lines, indicating chronic lead exposure. The average number of years on the job for the five workers was 3.5 years ranging from 3-6 years. Blood pressure was normal for all but one employee, and three workers had hematocrit results indicative of anemia, although only one reported previous physician diagnosis of the condition. Tremor, wrist strength, and ankle strength were normal for all workers.

Laboratory Tests

Laboratory analysis of blood specimens showed that 14 of 15 employees had elevated blood lead levels above the action level of 40 µg/dl. Fourteen of the fifteen employees had blood lead levels above 60 µg/dl. ZPP levels were also elevated above normal in all but one employee. The ZPPs of 14 out of 15 workers exceeded the normal range. Elevated serum creatinine in 6 of the 15 workers may indicate renal impairment in 33% of the workforce.

IX. RECOMMENDATIONS

Environmental

As a result of this site visit NIOSH investigators made several recommendations regarding plant changes to reduce exposures to lead dust, fumes, and sulfuric acid mist. In general, engineering measures are the preferred means of controlling occupational exposures.

Examples of engineering controls include substitution of safer materials or equipment, isolation of hazardous processes from the workers in time or space, and ventilation and enclosure of processes to prevent contaminants from escaping into the workplace. Personal protective equipment and work practices represent a second line of defense against occupational exposure to toxic chemicals.

1. Respirator usage areas need to be defined by means of an area sampling program, or analysis of existing data. All workers in designated areas should be wearing a respirator. Establishing a fit testing program and high/low exposure zones may also be beneficial in placing employees who may need to be removed from exposure for high blood lead levels.[17]

2. Close the locker room by the battery saw; no showering should take place at that location. All workers should shower and change to clean clothes that have not been stored in lockers with work clothes.

3. Workers should wash thoroughly before eating or smoking, and should not do either activity while at their work station.

4. Separate the office from the rest of the plant. Personnel in lead contaminated clothes should not be permitted in the office area.

5. Truck drivers should not walk through the plant and be unnecessarily exposed to lead.

6. Several individuals (guillotine leader, separation, dump operator, and hammer mill operator) work in relatively fixed positions. For those workers either provide a fresh air supply directly overhead, and/or compressed air connection for a supplied air respirator.

7. Cutting industrial battery cases with a torch may result in extremely high lead exposure levels. Either an alternate means (mechanical) should be found to prepare those cases or local exhaust ventilation should be installed for this operation.

8. Seal the rear portion of the trailer receiving plastic chips to prevent escape of additional mist.

9. Enclose and ventilate the in-feed to the hammer mill to prevent escape of mist and metal projectiles.

10. Enclose and ventilate the liquid tanks to prevent mist from carrying throughout the plant.

11. To minimize the acid mist content of the air, a trough for acid collection should be fabricated for the bottom section of the roller conveyor which extends to the floor drain.

Medical Recommendations

1. All workers with elevated blood leads above 60 µg/dl should have a complete medical evaluation. Individuals with abnormal renal function studies should be evaluated by a physician qualified to assess kidney function or a nephrologist. The University of Alabama in Birmingham School of Public Health is a NIOSH Educational Resource Center with a staff of specialists trained in the diagnosis and evaluation of occupationally-related diseases.

2. Follow-up of children by the Jefferson County Department of Health should assist in determining whether children of G.T. Jones workers are exposed to lead as a result of contact with parents or from lead exposure from worker's vehicles.

3. Workers with blood lead levels over 50 µg/dl over the past six months, or over 60 µg/dl, should be immediately removed from lead exposure until their blood lead concentration is below 40 µg/dl per the medical removal protection provisions of the OSHA Lead Standard.

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XII. DISTRIBUTION AND AVAILABILITY OF REPORT

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1. Gene T. Jones Tire and Distributing Inc.
2. OSHA Regional Office, Atlanta, GA
3. OSHA Region 4 Office, Birmingham, AL
4. Alabama Department of Public Health, Montgomery, Al

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. Aerosol Monitor Measurements
G.T. Jones Inc., May 21, 1991

Operation or area	Concentration $\mu g/m^3$
Outside lunch room	40
Breaking ind. btty cases	40-70
Dumping ind.btty cases w/loader	~170 **
Auto btty dumper (not running)	~60
Auto btty dumper (running, exit)	~70
Auto btty dumper (running, plate side)	~80
Hammermill (not running)	~60
Hammermill (running, near tank)	90-120 **
Trailer door	~400 **
Battery saw	~80

** Denote areas of greatest dust and mist exposure

Table 2. Employee Demographics
G.T. Jones Inc., May 21, 1991

Age Mean= 33.4 SD=7.87 Range=27 Min.=22 Max.=49

Sex	93% Male n=14	7% Female n=1
Race	67% Black n=10	33% White n=5

Education		n	%
	1=Grade 1-8	1	7
	2=Some HS 9-12	4	27
	3=HS Grad	6	40
	4=Some College	4	27
	5=College +	0	0

Marital Status		n	%
	1=Single	2	13
	2=Married	11	73
	3=Separated	0	0
	4=Divorced	2	13
	5=Widowed	0	0

Table 3. Work Practices, Personal Habits, Training
G.T. Jones Inc., May 21, 1991

- 93 % of the workers reported wearing respirators
- Respirator changes

	n	%
1=only when I ask	8	53
2=daily	1	7
3=once a week	1	7
4=< once a month	3	20
5=don't know	0	0
6=no change	1	7

- % Time wearing respirator

%		
0=0	1	7
1= 1-25	3	20
2=26-50	1	7
3=51-75	4	27
4=76-100	6	40

- Repirator cleaning

0=not applicable	1	7
1=daily	13	87
2=weekly	1	7

• Eye protection	12	80
• Smoke at work		
0=not applicable	10	67
1=0-10 /day	4	27
2=11-20 /day	1	7

Table 4. Blood Specimen Analysis
G.T. Jones Inc., May 21, 1991

	Mean	(SD+/-)	Range	Normal	#>Normal	%
BLL (µg/dL)	65.8	18.6	9-86	0-40	14	93
ZPP (µg/dL)	268.7	185.7	27-616	0-79	14	93
BUN (MG/dL)	16.7	4.5	9-29	8-22	1	7
Hemoglobin (GM/dL)	13.6	1.3	1-16	13.5-17.7	4*	27
Hematocrit (%)	43.4	3.9	8-53	40-52	4	27
Creatinine (MG/dL)	1.3	.2	.8-1.6	.8-1.3	6	40
Uric Acid (MG/dL)	6.6	1.3	3.2-8.4	3.6-8.1	1	7

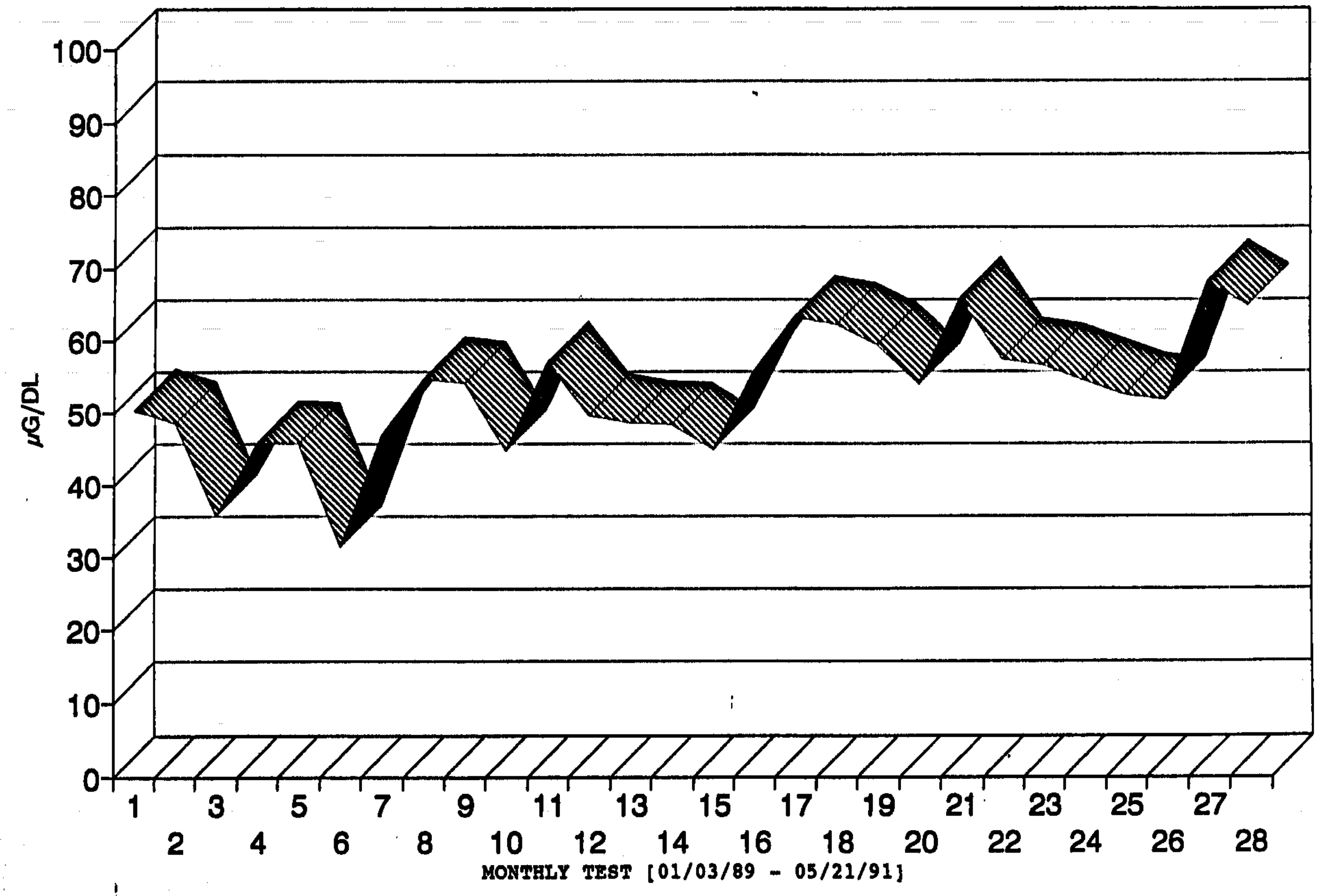
* indicates hemoglobin's below normal

FIGURE 1

G.T. JONES INC.
May 21, 1991
HETA 91-213

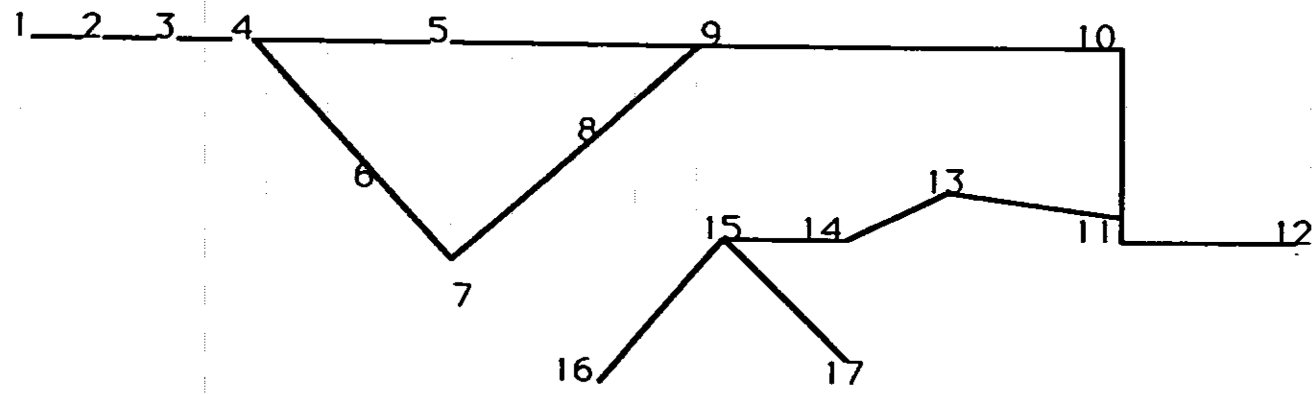
BLOOD LEAD LEVELS

MONTHLY GROUP AVERAGES



APPENDIX A

Flow Chart G. T. Jones Tire And Battery Breaking Operation



Legend :

1 Battery receiving

2 Roller conveyor to battery head cutter

3 Employee slides battery into guillotine head cutter

4 Manual separation of heads and casings

5 Auger conveyor for battery heads

6 Upwardly inclined conveyor to
7 automatic battery dumper. Employee observes process to ensure dumping

8 Empty casings conveyor

9 Junction of battery heads & casings for transport to 10

10 Hammermill for grinding of heads & casings

11 Dumper discharges to bins

12 Dumper discharges to bins

13 Bin for plates from automobile batteries

14 Bin for plates from industrial batteries

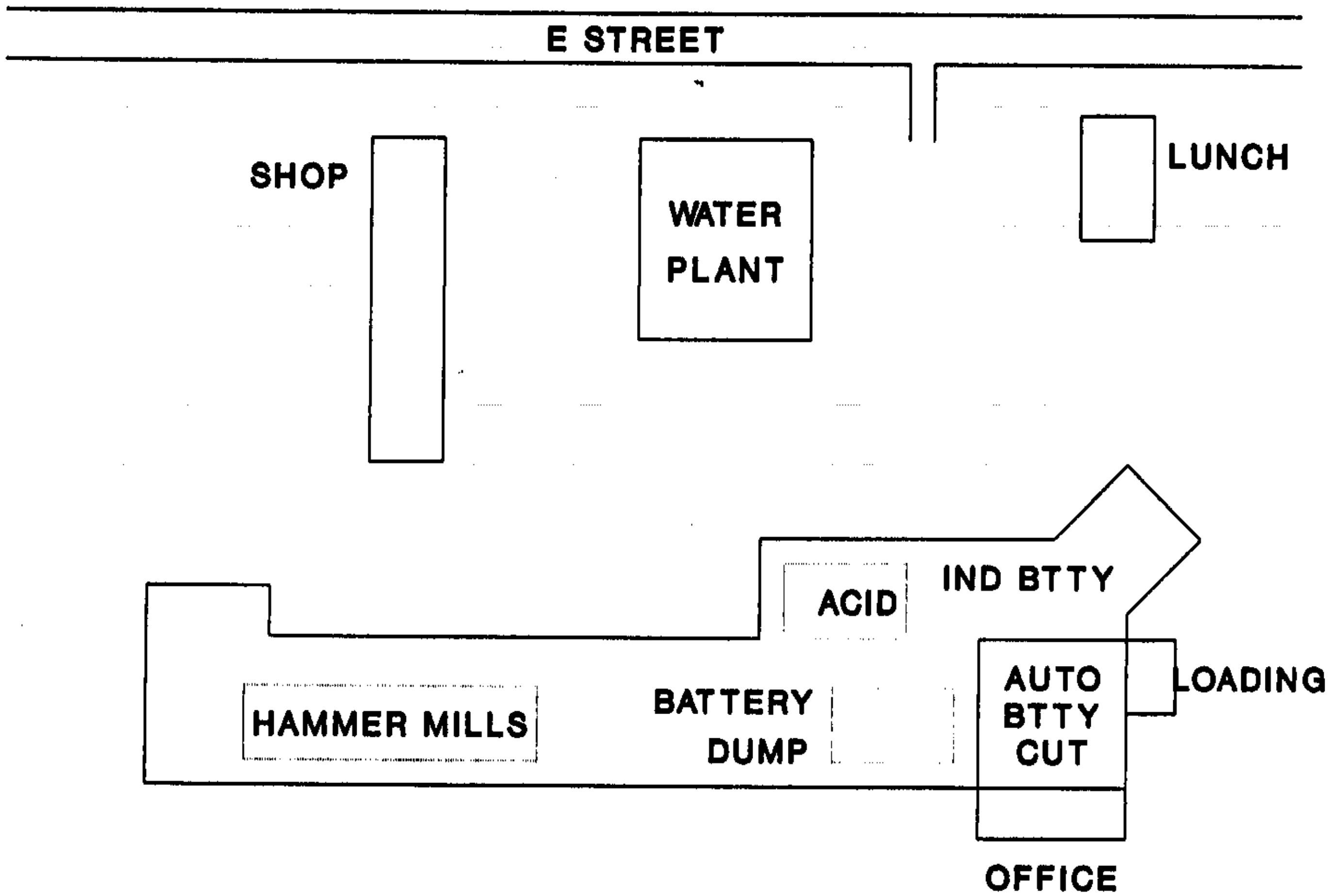
15 Sink float process

16 Under water auger transports lead to bin

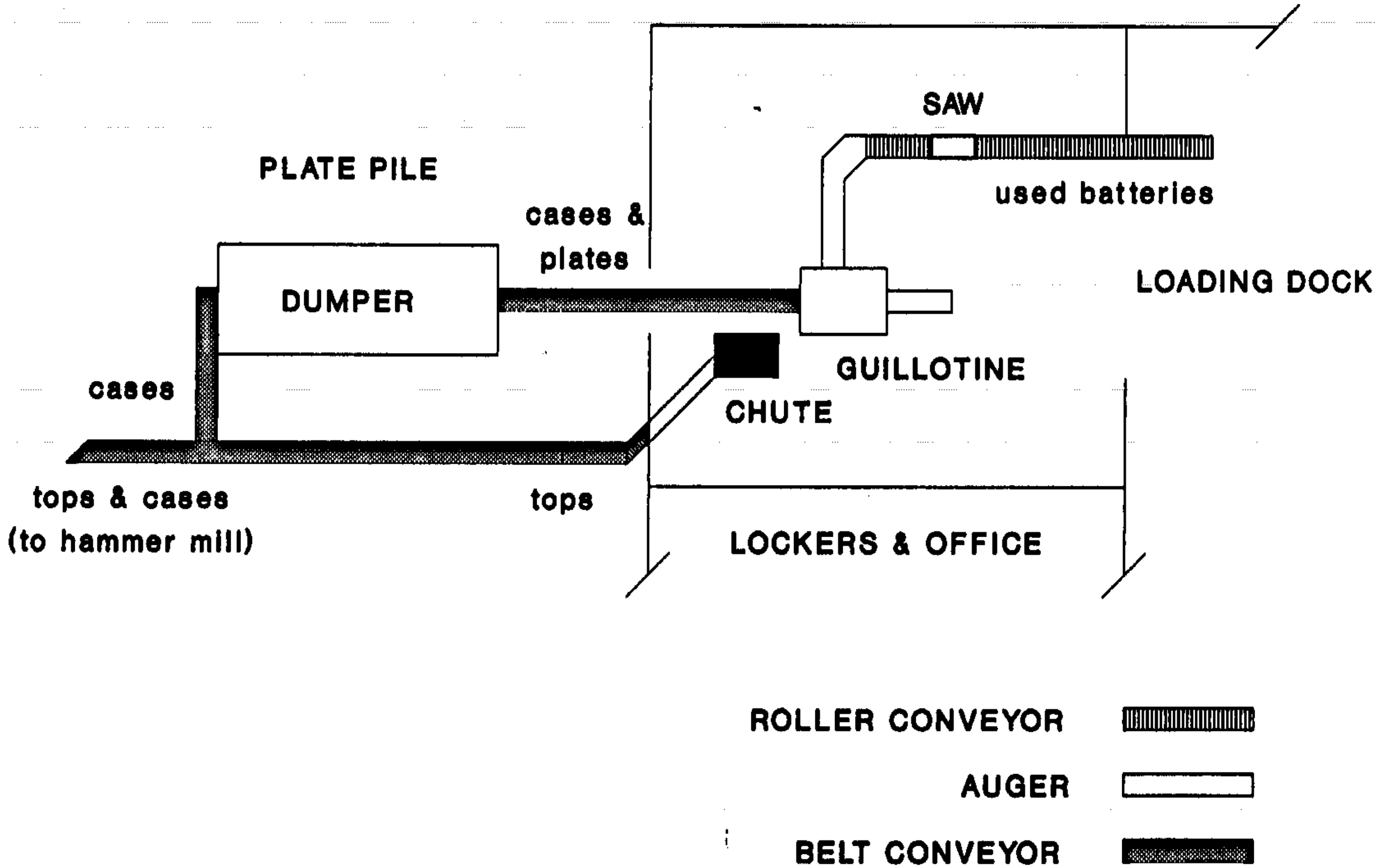
17 Under water auger transports head rubber to hazardous waste disposal bin

APPENDIX B

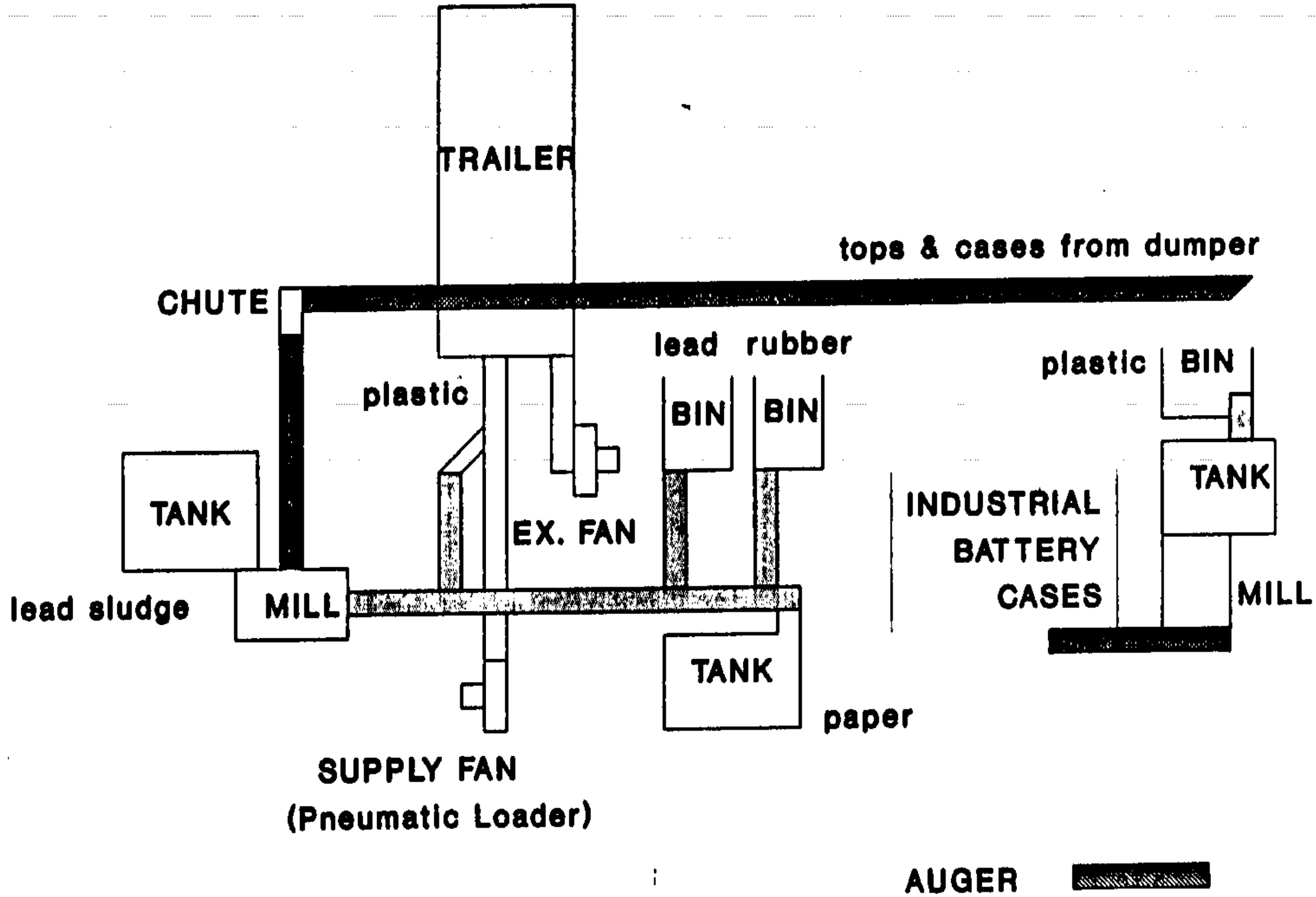
G. T. Jones - Battery Decasing



G. T. Jones - Automotive Battery Decasing



G. T. Jones - Automotive Battery Decasing



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