HEALTH HAZARDS OF LEAD EXPOSURE TO WORKERS AT GREATER KHARTOUM INDUSTRY AREA

Case Study: Printing House Press and Batteries Industry

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A Thesis Submitted for M.Sc. Degree

2005

Dedication

I dedicate this works to:

My parent, whom they

Support us, & waited in high

Patient to see us reaching

this level of acknowledge also

I dedicate this work to:

Dr. Ahmed El Tegani El Merdi.

Nahla

Acknowledgment

I am grateful and thanks for my former supervisor Dr. Ahmed El Tegani El Merdi and gratitude to all who made this work available and come to reality. Also I thanks the occupational Health Department, Sudan Atomic Energy Commission Laboratory and post-lab activities, university of Khartoum printing press, another printing press and Batteries industry.

Abstract

This study was carried out at printing press and batteries industry to assess the magnitude of inorganic lead poisoning and the degree of exposure among workers.

Blood, urine and hair samples were collected from workers at the working site and out site of Area-lead content in air samples exceeded the average allowable concentration at all locations which is an indication that the workers are exposed to high lead concentrations.

Workers at printing press and batteries industry had showed a low Red Blood Cell Count which may be an indication of lead poisoning. Lead in blood and samples exceeded the biological standard at both sites showing on occupational over exposure.

According to physical and biological parameters, workers both sites were found to be exposed to the risk of lead poisoning which needs to be controlled treated and the environmental factors should be modified for a cleaner and healthier environment.

الخلاصـــــة

أجريت هذه الدراسة على العاملين بالمطابع ومصانع البطاريات لمعرفة مدى تعرض العاملين لمادة الرصاص وآثارها الصحية عليهم.

تم أخذ عينات للهواء ، الدم، البول والشعر.

إن معدل الرصاص في الهواء يفوق الحد المسموح به مبيناً استنشاف العاملين لنسبة عالية من الرصاص يجعلهم عرضة للإصابة بالتسمم.

هناك ظهور تدني في كريات الدم الحمراء يؤكد حدوث تسمم نسبة لزيادة معدل الرصاص في الدم والبوم.

إذن نسبةً لكل هذه النتائج التي توصلت لها الدراسة فهي تؤكد وجود كل العوامل التي تشير للتسمم بالرصاص رغم الظروف البيئية المختلفة مما يستوجب القيام بالإجراءات الوقائية والعلاجية للعاملين المعرضين والمتأثرين صحياً بمادة الرصاص والتي تشمل الإجراءات الهندسية والإدارية للتقليل والتحكم في التعرض لمادة الرصاص وتحسين بيئة العمل.

Chapter (1)

1. Introduction:

Heavy metals constitute an ever growing menace to Urban societies. Industrial activities released and continue to release huge amounts of those toxic substances.

Printing press industry and batteries industry has evolved into a gigantic investment.

The printing press operations involve processes that may emit toxic element in the surrounding areas. Therefore house printing and other printings press in Omdurman, Khartoum and Khartoum north (Wafa, Horria, ElAmal printing). press Corporation was chosen to illustrate the possible exposure to heavy metals in working environments.

The printing press is located in Khartoum North Town within Kober industrial region, the main printing press beside the Khartoum University and the other printing press are located in the middle of the town and near the printing press surrounded by a residential area. It was established primarily to serve the needs of the university and concurrently render services to other organizations.

The printing press utilize relatively old equipment's which depended on manual collection of letters. The printing letters are made from lead which undergoes melting and casting within the printing press premises. The printing press operations involve the following steps:

a. The casting section:

Where the raw material (solid lead bars) is transformed into letters.

b. Manual collection section:

Lead letters are collected and arranged into words according to the text.

c. Printing Section:

Application of ink, colours and then printing the text.

d. Furnace section:

Used letters and waste lead chips are melted in a furnace to form new lead rods that can be used in the casting section.

It is envisaged that high amounts of lead can be emitted into the surrounding during those operations. To verify this line of thought the present study was conducted to assess and evaluate lead concentrations in the air within around the printing press area. Furthermore to check and determine lead concentrations in blood, hair and urine samples from workers in the printing press industry.

We believe that the outcome of this study will illucidate this problem and will render suggestions which may help to minimize the health hazards connected with that profession.

Lead poisoning is an environmental and public health hazard of global proportions.

Lead poisoning is intensely in nature, as the causes of poisoning vary widely from country to country and from community to community. (Landingan, PJ&Total Ac 1994)

Industrial lead emissions:

Another important influence ambient air level is the presence of an industrial source, lead inevitably released into the atmosphere during chemical processes in which it is used.

Industrial sources of lead are typically point of emission such sources give rise to narrow plume of pollution and hence considerable temporal and spatial uaniations in pollutant levels are encountered depending upon the wind direction and velocity.

The Printing press which utilizes old machinery depend on manual collection of letters produced from lead which is casted and melted within the printing press premises.

As a result of using lead in the printing press operations a high amount can be emitted into the surroundings which can pollute the air and contaminate objects in the vicinity.

This can make the working environment unhealthy for the workers. (Lippman, M(1995))

Lead is found widely in the environment as a natural substance and a contaminate.

Lead is used in many types of industry. The air contaminate with lead.

The pattern of increase in the lead contamination of the atmosphere has been revealed by studies of the lead content of the greenland ice cap. The lead load of the ice cap increased about times between 1750 and 1940, and it rose another 300% between 1940 and 1967. the similar patterns of lead contamination are not found in Antarctic snows lands strong support to thesis that atmospheric lead pollution originated first with lead smelting and then more recently with the combustion of gasoline. Both sources of contamination are concentrated in the northern hemisphere, and the spread of pollution to Antarctica and the southern hemisphere in general is largely blocked by atmospheric circulation patterns. (Gheis, G, 1985)

A small amount of lead invading the body is deposited and stored in the bones and other tissues, and the remainder excreted, having no harmful effects upon the body. However, as the amount of lead invading the body is increased, lead in blood is increased, developing its harmful effect upon the body. At this time, the symptoms known for long are as follows; anemia, occurrence of abnormal erythrocytes, an increase in urinary coproprophyrin excretion due to disturbance of hemoglobin (O.(1988).

In another study in Japan and developing countries was made on the change of the physiological conditions, and on the development of clinical symptoms, due to lead, using the same method as in poison tests. The symptoms were surveyed with reference to the concentration of lead in the air, on the basis of a statistical analysis. It is considered that, for the Japanese male adults who engage in lead work requiring moderate physical exertion for 8 to 8.5 hours a day for more than one year, the safety limit for the average lead concentration in the air, in order to protect them from any significant harm, is approximately 0.05 mg/m^3.

1) A measure to counter the source of hazard, experiments have been made in cooperation with engineers. At the same time, industrial hygienical education for the engineers has been performed.
2) A measure to counter hazardous condition of working environment. Improvement of protecting mask and closing etc. has been studied. Reports have been made on the prophylactic effects of several medicines.

    For the past 16 years, medical examination have been undergone every year by about 800 lead workers in so-called experimental factories. John Lenihan & Willian 1999.

The workers who are exposed to lead in any of its forms should wear personal protective equipment which should be washed or renewed at least once a week. Protective clothing made of certain man-made fibers retains much less dust than cotton overalls and should be used where the conditions of work render it possible; turn-ups, pleats and pockets in which lead dust may collect, should be avoided. Cloakroom accommodation should be provided for this personal protective equipment with separate accommodation for clothing taken off during working hours. Washing accommodation including bath accommodation with warm water should be provided and used. Time should be allowed for washing before eating. Arrangements should be made prohibit eating and smoking in the vicinity of lead processes and suitable mess rooms should be provided.

It is essential that the rooms and the plant associated with lead processes should be kept clean by continuous cleaning either by a wet process or by vacuum cleaners. Where, in spite of these precautions, workers may still be exposed to lead, respiratory protective equipment should be provided and properly maintained supervision should ensure that equipment is maintained in a clean and efficient and that it is used when necessary. John Lenihan & Willian 1999.

1.2. The lead consists of two types in Battaries making:-

1- Soft lead.

2- Ultimatum lead.

In Sudan the first company had made batteries is Al-robi company in 1956.

This company specialized in batteries that could be charge again.

Labours in batteries making use preventive substances to save themselves from danger of attacking with diseases, these substances represent in:

1- Gloves 2- Gumboots 3- Lab-coats.

Which usually made of leather emelrubber, after end of making process, labours take quantity of milk to enriched body in a case of vitamin shortage.

company ensures labours completely in work – injury if found and supply them with cure.

There are three methods of work. Injuries:

1- Breathing through smoking.

2- Wounds & Blood.

3- Smelling.

Lead is an important metal in electricity generating inside battery and can not replace any other metal instead of lead.

Lead get into liquid chemical reactions in battery to do many electrical functions and multi Purposes, so it could not quit from liquid battery and lead. So lead is very important metal in our life even it remains healthy damages, so it get into our daily life, such as petroleum remains contain lead and fuel remains from cars also contain lead which breathed by human in daily life. (Personal observations, 2003)

Then totally had been depended an lead in liquid battery any making.

Lead Industry in Sudan:-

A first dry battery (dry cell) had made in Sudan in 1972.

The dry cell produces from (zine chloride), it's dry matter.

There is no injury during dry cell producing

There is no danger on labours from that matter (zine chloride) except in on care, if it had been taken orally.

lead can not be used in dry cells because the voltage of dry cell (1.5V), but lead its voltage (2.2-2.6V), So lead dosen't use in dry cells. (Nile power industry 2004).

The industrial work environment imposes on the workers chemical, physical, biological, mechanical and /or ergonomically hazards. Chemical hazards may be in forms of residue, poisonous gases…etc. (website, 2003)

Lead (Pb) is one of the widely used metals. Due to the adverse health effects of its compounds e.g. tetraethyl – tetra methyl (TEL /TNL) if inhaled or ingested, it attracted the attention of environmentalists and health authorities more than any other industrially and /or biologically significant element (Abdul Azeem, 1996). A well illustrated multigrain impact of Pb on the human body was given by (EPA, 1986).

Its accumulation in the blood may affect the central nervous system of children and generates kidney disease. When its rate of absorption by the body exceeds that of its excretion, symptoms of Pb poisoning appear. For this reason many countries adopted safety measures with respect to the use of Pb.

The concentrations of Pb in ambient air usually increase as the population density increases. It falls progressively from an average value of 1 microg/m3 in cities to 0.02 microg/m3 in remote areas. During peak traffic hours Pb concentration shoots up to 20 microg/m3 (WHO, 1977 a). In industries that utilize Pb, its concentration becomes very high, but in the absence of Pb sources, indoor levels are usually lower than outdoor levels (WHO, 1977a).

1.3.Toxic effects in man:-

Lead induces a variety of biological effects of which the best recognized refer to derangement of haemsynthesis, includes in hibition of the porphyrin syntheis enzyme, Critical concentration of lead in blood and urine for various effects. Castillo (1993)

1.4.Epideomiology of lead poisoning:-

For many years, lead poisoning was one of the most requent. Occupational diseases and most frequent symptoms were anemia, lead palsy and gastic disorders.

The situation gas improved in many countries during the past 30 years as a result of more adequate preventive measures in industry and improved diagnostic and the tapeutic procedures. Castillo (1993).

1.5. Absorption and excretion of lead:

Lead burdens in humans: the main hazard in exposure to small amounts of lead lies in the gradual accumulation of lead in the bodies of exposed persons in the course of life time.

Therefore, there is very great interest in the absorption and excretion of lead. (Caprio, R 1994)

(I) Lead in Blood:-

In the report of the California public health Dept. (1976) It is stated the blood lead is often taken as a rough indication of total body burden and of the amount to which exposure has occurred in a general way.

Nevertheless, repeated samples from the same individual may show substantial shifts over a period of time when it does not seem likely that total body burden has undergone much change.

Further, it is reported to lead is continuous at a given level, there does not seem to be a steady increase in blood lead, Rather it seems are though the body slowly increase its capacity to excrete to excess to which it is exposed.

(II) Lead in Urine:

The lead content of urine is more variable than that of blood according to the California public health Dept. 1976.

When changes of lead exposure occur over a relatively short period of time, they are likely to show themselves in increased urinary lead, earlier than in blood level. Organic lead does not tend to be reflected in blood levels but is reflected in urine lead levels. (Caprio, R 1994)

1.6.Health:

In order to assess the total cost to the community from diseases such as chronic bronchitis and emphysema leading to morbidity and mortability, bates has suggested the acquisition of the following information:

A. An assessment of loss of productive working hours in industry in workers with chronic bronchitis competed to workers without this disease.
B. An assessment crippling power of emphysema and bronchitis.
C. An assessment of the welfare compensation caused by these diseases. (Allegri T.H 1998)

Health effects of lead:

The data available on the subject of lead in the environment suggest that people living in about one – third of the world's cities are likely to be exposed to lead level that are either only just within the safe guidelines or are unacceptably high.

The problem is likely to be worst in cities in developing countries with dense traffic and environmental problems industry. (Website, 2003)

1.7. Air Pollution:-

Air pollution by lead and other heavy metals may be either natural or man-made. Man-made air pollution there are three types, namely personal, occupational and community air pollution. (Bach 1972).

A. Personal: This comprises all gases and particles from cigarette, Cigar and Pipe smoking and use household sprays.
B. Occupational: Ambient or out door air pollution which no body can escape.
C. Largely unpredictable human and meteorological factors set the levels of community pollution, when people think of pollution, which can strike in the form of short term disasters causing thousands of deaths or as long-term influences changing the climate of the planet.

Air pollution in the Sudan resulting from the various activities of the Sudanese people is expected to be in general terms appreciably negligible and if any at all may limited to the major towns within the country – compared to other towns in the Sudan, however, Khartoum is expected to have the worst problem.

Here the industrial areas of Khartoum North, Khartoum South and the new petroleum areas are main areas producing poisoning gaseous wastes which are discharged into the air.

Producers of the wastes a part from engine exhausted waste.The increase in lead concentration in ambient air during the past 20 years has been attributed primary to industrial emissions and infusion of lead alkyls in gasoline.

The concentration of lead in air, soil and human body near major high ways in large urban communities in industrial area and traffic density can vary from 4 micro-gram to 50 micro – gram per cubic.meter (stringer 1974).

1.8. Occupational Sources of Lead:-

The final important source of exposure to lead for Cairo residents is occupational. Workers can be exposed to lead on the job site, then bring the lead home on their bodies, clothes, or possessions and expose others. There are inadequate data to assess the importance to the general population of such secondary occupational exposures. We do not know the number of workers significantly occupationally exposed to lead, nor their degree of exposure, nor the extent to which their activities away from the job site are likely to expose others. We expect, though, that this route of exposure would be significant only for the workers themselves and their families.

(Report of the Lead exposure for environment workers,Cairo 2001)

1.9. Measurements of exposure To Lead:-

Because of the large uncertainties in estimating the amount of lead to which people are exposed through each individual pathway, many investigations of human exposure to lead have focused on the total amount of lead in an individual's body without regard to the pathways by which the exposure occurred.

Only a fraction of the lead that is ingested or inhaled is actually absorbed into body tissues. The fraction absorbed depends on the mode of exposure, the chemical species of lead, the degree of previous and recent exposure to lead, the age of the subject, nutritional status, diet, and numerous other factors. Absorbed lead is transported rapidly through the body in blood, and can then accumulate in many other body tissues.

Eventually much of the absorbed lead moves into the bone, where it can accumulate over a lifetime. Lead in blood and soft tissues (e.g., liver, brain, kidneys) can be eliminated fairly rapidly in urine or feces, with a half-life of about one month. Lead in bone, though, is released extremely slowly, and bone can serve as a source of lead to the rest of the body long after exogenous exposure to lead has ceased. Transfer of lead occurs easily to a fetus during pregnancy. (Report of the Lead exposure for environment workers, Cairo 2001)

An individual's total exposure to lead can be gauged by sampling any several biological tissues, including blood, urine, semen, hair, tooth, or bone. Sampling teeth or bone will indicate the individual's long-term exposure to lead; the soft tissues will indicate more recent exposure. As a matter of convenience in obtaining samples, blood has been the tissue most frequently chosen for investigation. (Khera, Ak-1995)

1.10 Objectives:

- To highlight the health effect of the workers in the printing press and batteries industries.
- To raise the awareness of the workers about the hazards.
- To find applicable solutions for the workers in the local environment.

Chapter (2)

2. Literature Review:

A harmful agent exerts its toxic effect when it is in contact with body cell. To make that contact, entry into the body must be made in one of three ways: inhalation-skin absorption-ingestion. Chemical compounds in the form of liquids, gases, mists, dusts, fumes, and vapours may cause problems by inhalation, by absorption (through direct contact with the skin) or by ingestion (eating or drinking). (Schoreder, 1974)

Inhalation: involves those airborne contaminates that can be inhaled directly into the lungs and can be physically classified as gases, vapours and particulates. Inhalation as a route of entry is particularly important because of the rapidity with which toxic material can be absorbed in the lungs, pass into the blood stream and reach the brain.

Absorption: through the skin can occur quite rapidly if the skin is cut or abraded. Intact skin, however, offers reasonably good barrier to chemicals. Unfortunately there are some compounds (such as organic Pb, N, and phosphates) that dissolve in the fats and oils of the skin and readily absorbed through the openings for hair follicles. (Schoreder, 1974)

Ingestion: in the work place people may unknowingly, eat or drink harmful chemicals. Toxic compounds are capable of being absorbed from the gastrointestinal tract into the blood. Lead oxide can cause serious problems if people working with this material are allowed to eat or smoke in the working place.

Inhaled toxic dust can also be ingested in amounts that may cause trouble. If the toxic dust swallowed with food or saliva is not soluble in digestive fluids, it is eliminated directly through the intestinal tract. Toxic. Materials that are readily soluble in digestive fluids can be absorbed into the blood from digestive system. (Dugger, 1973).

In the absence of safe handling methods, workers in smelting, refineries, mains, acid storage batteries, cable sheeting and docks have the greatest potential for inhaling Pb particles, (WHO, 1977a). Contaminated clothes may act as a potential source of hazard (WHO, 1977a).

Other hazardous industries include ceramics, glassware, automobile radiators production and repair, manufacture of electronic components, lithography, x-ray protection and insulation for nuclear industry (Abdul Azeem, 1996).

Cosmetics have caused Pb poisoning, particularly a mascara- like cosmetic which may contain as much as 88% Pb sulfide (WHO, 1977a). Colored printing ink and magazine illustrations have hazardous Pb levels ranging from 1140 microg/Kg to 3170 microg/Kg (WHO, 1977a).

Most of Pb compound are laminated in the faces. The rest is trapped by the liver and excreted, in part, in the bile (Sax, 1963). Therefore, larger amounts of Pb compounds and a longer period of exposure are usually necessary to cause poisoning. However, inhalation of Pb compounds, even in small doses, leads to rapid development of toxicity levels (Olishifski, 1999).

2.1. Other sources of lead:-

Lead-glazed ceramics used in the home may also contribute to lead in the Ceramics diet. Release of lead from both packing and pottery will be facilitated when they are used to hold acidic content. Cooking food in lead-contaminated water can elevate lead concentration in food. Sherlock (1987) reported that every 10 ug/L in water increase the lead concentration in cooked vegetables by about 6 ug/kg.

The concentration of Pb in food is rather variable. In human and cow's milk, it has been found to range between 10 to 40 microg/L, while higher values were found in powdered milk (WHO, 1977a)

Plants do not readily absorb Pb from the soil, but probably get contaminated in areas exposed to smelter emissions.

The major source of children's Pb intake is Pb –based paints and/or contaminated street dust due to the addition of TEL to petrol. This may increase Pb intake by children, depending on their playing habits. (WHO, 1977a).

2.2 chemical contaminations:-

(Allegri T.H, 1998) mentioned that heavy metals such as lead, mercury, cadmium, zinc and chromium are natural components in the environment. They become potentially lethal hazards, however, when their concentrations build up to higher than normal levels. The major source of heavy metals pollution are, primarily, metallurgical activities, the petrochemical industries and the large scale exploitation of coal. The most disastrous incident involving, mercury occurred in 1950 in Japan know as the Minamata Bay Poisoning. This incident happened when a Japanese plastic manufacturing company kept dumping methyl mercury into the Bay as an effluent of its production processes.

The fish of course ingested the methyl mercury and since fish is the stable diet of the Japanese people the Minamata communities were afflicted. (Olishi Fski, 1999)

Benzene: which is a common component of gasoline is widely used in industrial processing operations, has been thought to cause leukemia and disorders of the central nervous system. Also chromosome damage is known to occur in workers exposed to very low levels of benzene compounds. (Blokker, P. 1972)

2.3. Lead Hazards:-

The most frequent symptoms of lead poisoning are anemia, gastric disorders, and lead palsy (Gheis. A. 1988).

Many lead compounds, are very insoluble, a phenomenon that results in their deposition in the bone.

The real problem is the poisoning with organic lead (Tetraethyl lead) compounds which are absorbed from the respiratory tract, gastrointestinal tract, and skin. The major portion of volatile organic lead accumulates in the brain due to a special affinity between organic lead and the liquid of nerve tissues. Tetraethyl lead is hundred times as toxic as inorganic lead . (Schroeder , H .A . 1997).

The lung retention of airborne lead depends the size of aerosol particles . In average conditions retention is about 30 percent of the amount exposure to lead is reflected in blood . At two levels of exposure an increase of 1 gm Pgm^{-3} in air for eight hours exposure a day is reflected by an increase of roughly Ipg $^{-1}$ of blood, with 24 hours a day the increase is probably twice as high. (Mark & Gems, 1990).

The most reliable test for excess of lead in the body is blood lead test. Lead poisoning is treated by administering chemical substances that allow lead to be excreted more easily from the body. (John, L & William 1999)

Because treatment takes a long time and always not satisfactory, prevention is especially important. Although extremely server cases of lead poisoning are rare in industry today, lead exposure must be controlled to prevent even the moderate symptoms, which can still be troublesome. The body can handle and eliminate small amount of lead without harm. When intake rates exceed the normal excretion level, an accumulation occurs in the body. (John, L. & William 1976).

It's estimated that 40 – 50 percent of atmospheric lead, 5 – 10 percent of lead in food and 10 percent of lead in water are absorbed in the body.(Blocker, 1970).

However the above investigator mentioned that the largest amount of lead in human body is stored in bones, and small concentrations are recorded in soft tissues especially in liver and kidneys. Content of lead in urine is more variable than that of blood according to the California public health department publication.

2.4. Lead in the Printing and Batteries Industry:

Printing, an essential tool of knowledge, is carried out by three fundamental methods: Letter press, lithography and gravure. Lead is used in this industry in manufacturing printing letters. The process involved Pb melting, shaping and later on composing of printing letters.

There are few health hazards in hand composing of printing letters. To minimize hazards removal of dust from type cases which are made of an alloy of Pb, tin and antimony, should be by suction but not blowing (Purkis, 1983). Cleaning of casting machines should be performed under good ventilation using safe solvents.

During mechanical composing exposure to Pb should be minimized by effective thermostatic control of the pot of molten type metal and during remitting (Purkis, 1983) is cast from Pb alloy, there is an increased health hazard specially if eating, drinking and smoking are not avoided. In hot metal areas good ventilation may contribute significantly in reducing Pb and other fumes (Purkis, 1983).

2.5. Health Effects:

Studies in Sudan comprise of a study by Hassan, (1984) who investigated lead pollution from automobile emission in Khartoum. It was found that Pb concentrations in the air and soil were directly proportional to traffic density.

Mohamed, (1986) studied the air and noise pollution produced by traffic automobile emissions, namely Pb were used as a pollution monitor.

Salah, (1988) studied the risk of Pb poisoning among exposed workers as a function of ambient thermal conditions in a Pb accumulator plant in Khartoum North.

Ahmed, (1996) studied the occupational exposure in the work environment in a dry cell battery factory. She found a significant difference ($p< 0.05$) in manganese and Pb levels but not in hemoglobin (Hb%) and white blood cells count between the workers and control group.

The haematopoietic system shows effects at lower Pb B levels than any other system. A decrease in Hb% level has been detected starting at PbB level of 50 microg/ 100 ml (WHO, 1977a) are widely employed methods for detection of Pb poisoning.

Yaffe et al (1983) reported that the isotopic rations of Pb of children were close to the average Pb rations of paint from exterior walls and of surface solid in adjacent areas where children play. From their epidemiological investigation Al Saleh et al (1994) found that the mean Pb concentration, in man, increases during the first five years of life, after which it begins to decrease reaching a non-poisonous level at 16 years of age. Factors such as socioeconomic status and culture may contribute to the results.

Anemia is probably an early and the only clinical feature of toxicological effects of Pb on the industrial worker (Stokinger, 1981). It results from shortened life span, and impairment of theme synthesis of the RBC. The RBC count in cases of moderate severity is 4 to 4.5 million/cm3, with a Hb% level between 70% and 80%. PbB constitutes 2% of the total boy Pb. Of this, 90% is bound to RBC and 10% is to plasma (Stokinger, 1981).

Persons with high calcium consumption have both decreased blood pressure and reduced PbB due to the competition of both Pb and Ca for the same binding sites (EPA, 1986).

Castillo et'al (1983) found that the levels of immunoglobulin inmmuno globulin is inversely related to Pb concentration in blood in the exposed group than in the non-exposed control group of similar age and sex.

Cory (1990) evaluated the kinetic and biochemical responses of young (21 day old), adult (8 months), and old rats (16 months) exposed to 0.2, or 10 microg Pb acetate/Kg/day for a period of 9.5 months. His results indicated that an enhanced vulnerability to Pb in older rates may be due to increased Pb exposure and to a greater sensitivity to the biochemical effects of Pb. Differences in the tissue distribution of Pb with age included lower bone levels, but increased concentrations in the brain, liver and kidneys.

Nikolova et'al (1991) studied two groups of workers without clinical manifestations of intoxications. He found that the metabolic process in the erythrocytes were more pronounced in workers occupationally exposed to Pb than those exposed to manganese.

Ivanova and Nachev (1993) investigated an experimental model of Pb encephalopathy and confirmed the direct toxic of Pb and its penetration into the nervous system.

Payton et'al (1994) studied a population of 744 men and concluded that exposure to low-level environmental Pb correlates with a significant decrement in renal function.

Tesink (1994) pointed that Pb may be toxic if ingested in large quantities less than 44 microg of Pb/Kg of dry weight of feed is considered safe for cattle. He also pointed out that Benelux, regulations give acceptable concentrations of meat, kidneys, liver (between 0.3 and 0.1 microg Pb/Kg, and milk (0.05 microg Pb/kg) destined for human consumption.

Berlin et'al (1995) pointed out that over 90% of the body load of Pb is harboured by the skeleton. If this is rapidly mobilized it may constitute a health risk. They also examined a healthy 36 – year – old man with 10 years of work related to Pb exposure. They found that the patient had high skeletal turnover, reduced bone density, and signs of tubular dysfunction.

Lead compounds produce a brittleness of red blood cells (RBCs) which hemolyze with a slight trauma, and tend to destroy more rapidly due to their increased fragility. This may produce anemia which is rarely severe. Newly formed RBCs may be acted upon by Pb on entering the blood stream with a resultant coagulation of their basophilic material. The effect of Pb on white blood cells is controversial (Sax. 1993).

Lead compounds produce a damaging effect with all the tissues and organs with which it comes into contact, with no lesion produced (Sax, 1993).

Toxicity by Pb compounds depends upon it solubility, particle size, chemical and physical from. If a Pb compound is used as a powder, contamination of the atmosphere will be much less than when the powder is kept damp, (Sax, 1993). The clinical types of Pb poisoning are alimentary, encephalic and neuromotor.

According to stokinger (1995) age, seasonality, alcohol level, Fe deficiency, vitamin, calcium and protein content are the major factors affecting toxicity and its magnitude. Children are more liable to be poisoned than adults.

Stokinger (1995) demonstrated that lower cacium and protein concentrations increases Pb retention in soft tissues (kidney) where as high levels tend to mobilize Pb from the body. Alcohol was found to interfere with urinary coproporphyrin test for response to Pb exposure.

The Environmental protection agency (EPA, 1986) in the proposed national ambient air quality guide, has suggested that mean Pb B levels in excess of 15 kg/100 ml of blood in children aged 1-5 years could be accompanied by biological effects.

Infants are liable to exposure to Pb in-utero of working mothers (Wang et al, 1989), or mothers living in the vicinity of Pb smelters McMichael et al (1988). An additional source of exposure is probably contaminated clothing of family members with occupational exposures (Baker et' al 1977, Kaye et' al 1987, Wang et' al 1989).

A study by bellinger et' al (1994) suggested that measures of classroom performance may show long-term effects of early Pb exposure. Silva et' al (1986) reported similar results in 4-year-old children.

Needleman et' al (1995), Winneke et' al (1993); Bhatacharya et' al (1988) found that behavioural and attentional deficits and disability in maintaining physical balance in children were significantly associated with children's tooth and PbB levels. The 1986 EPA document adopted 30 microg/dl as the critical value responsible for neurobehavioural deficits as suggested by the study of Winneke et' al (1993).

Lead in cans. Additional exposure to lead in food may come from packing. Until the mid-1980's, most cans used throughout the world for food packing were constructed in three pieces joined by lead solder. Such cans were phased out in most OECD countries beginning in the mid or late 1980's, but they are still used in Egypt. U.S. findings in the mid-1980's were that foods packed in lead soldered cans often had lead levels from 100 to 400 ug/kg, or from five to thirty times the lead content of frozen or fresh foods. Forty-two percent of the lead in food in the U.S. was estimated to come from lead solder cans (OECD, 1993). Data on a variety of canned foods in four OECD countries showed that the lead content of foods in soldered cans was about three to twenty times higher than the lead content of the same food in a modern one-piece, non-soldered can (UNEP, 1988). Sampling for lead in Egyptian canned tomatoes and oranges during 1977-80 showed levels between 390 and 3.600 ug/kg, far above the levels found for the same canned produce in other countries at this time (UNEP, 1992/1993).

2.6. Lead-Based Paint:

In the U.S., one of the most significant current remaining sources of exposure to lead is consumption of peeling or flaking lead-based paint. Although lead-based paint was essentially banned in the U.S. in 1977, in 1991 over 20 million older housing units still contained lead paint (OECD, 1993). As such paint deteriorates; it can flake off and be eaten directly by children, or be ground into dust on floors and be ingested by several means.

Chapter (3)

3. Methodology

To investigate the probability of Lead and heavy metals contamination in the batteries making and printing press work environment the following materials and methods were utilized:

a- Blood, hair and urine samples were collected from the old workers in Al ROBI company, Nile power industry, house printing press Corporation and other printing press. (Wafa, Horria, ElAmal printing).

b- Air samples were obtained from the different sections in alrobi, Nile power industry and in the printing press premises and from the surrounding areas.

c- Control samples from persons and areas not related to the in alrobi and Nile power industry and printing and press environment were also collected.

d- Personal observations.

3.1. Methods:

a- Informal discussion and conversation with the employees of the printing press.

b- Visit to the various sections of the industry of batteries and of printing press and photo documentation were performed.

c- Laboratory investigations:

Atomic Absorption spectrometer (AAS) and X-Ray fluorescence (XRF) analytical techniques were utilized to determine heavy metal concentrations in the collected samples.

3.2. Sampling Techniques:-

Air samples:

Air samples were collected using a sucking pump apparatus which sucks two liters of air per/minute. 13 air samples were collected from the various sections in the, Nile power industry and printing press building (Wafa, Horria, ElAmal printing) and from surrounding areas.

Air control samples were collected from ElSarha twon in North Omdurman and Khartoum Bariy (Shmbat) province. Sucking time has been deliberately varied in some section to investigate the quality of obtained results.

3.3. Urine Samples:-

10 urine samples were obtained from different persons working at the printing press and a similar number of samples were collected from persons outside the printing press assumed to be un-exposed to direct heavy metals contamination.

3.4. Hair samples:-

Twenty six samples were collected from two testing groups: 13 persons in the first group exemplify the (exposed persons, printing press employees) who are suspected to be affected by lead contamination while the second group is selected from outside the printing press (as control samples).

Two grams of head's hair were taken from each subject.

3.5. Blood samples:-

Blood samples were taken from 20 subjects, 10 from exposed persons (employees) and 10 from persons not related to the printing press environment. 5 ml of vein blood were taken from each person using a syringe.

3.6. Analytical techniques:-

For air, hair and urine samples analysis were performed using Atomic Absorption spectrophotometer (AAS) while for the blood samples analysis an X-ray Fluorescence device (XRF) was used to detect lead concentration levels (for detailed information see appendix)

3.7. Analysis of air samples:

Air samples were placed in a 100 ml beaker, 20 ml of 30% HNO_3 and 4 ml-concentrated HCL were added.

The samples were digested on hot plate and reduced to a volume of approx. 5 ml. the beaker content were diluted by adding 5 ml deionized water-then the solution was filtered and made up to 25 ml in volumetric flask. Lead concentrations in each sample were determined by (AAS).

3.8. Analysis of urine samples:

Sample of 40 ml urine put in atube then 30% HNO_3 is added to adjust the PH to 4 or 5. then 1 ml of 10% Trixton and 1 ml of Ammonium pyrollidin Ditho Carbomate (APDC) were added to the tube content. After that 3 ml of methyle Isobutyl ketone (MIK) were added and the mixture was shaken for 10 minutes and then the content centrifuged to separate the methyle layer. Heavy metal concentrations were obtained by (AAS).

Analysis of blood sample was dried in the freeze dryer. The dried blood samples were pressed to form pellets for measuring Pb, Zn, Cu and Fe concentrations in the blood by X-ray fluorescence technique.

Chapter (4)

4.Results

Visits to the printing press premises, alrobi and Nile power disclosed that the probability of lead and heavy metals contamination especially lead is very high. In the various section of the printing press buildings contaminates are released which directly affect persons in the working site and indirectly persons in the vicinity. Photographs displayed in plates (1, 2, 3, 4, 5, 6, 7, 8) demonstrate our observations. Large amounts of lead fumes were observed in the furnace and casting sections. (see plate 1, 6).

The performed analytical investigations on the various sampling materials provided the following:

Lead concentrations in air samples.

Lead concentrations in air samples is displayed in table (1) samples from certain sites were duplicated using different sampling time 30 and 60 minutes), show that samples collected from the furnace section has a higher lead concentration compared to other sections. This could be attributed to the fumes during the melting process (see plate 7). Also air samples taken from air conditioner have got high lead concentrations due to its proximity to the furnace section. Apparently lead fumes accumulate in the air conditioner during the night.

Lead concentrations in air from the other sections range from (0.1 ppm-0.53 ppm) which is clearly higher than the concentrations displayed by the samples taken from the nearby residential area which range from 0.11 ppm to 0.38 ppm which are considerably higher than those in the sample from the control area (ElSarha). This difference in lead fumes and lead dust released from the printing press.

It is evident from table (1) that lead concentrations in air from the control area. Moreover samples taken in 60 minutes show higher lead concentrations than those taken in 30 minutes. This suggests that the determination of lead concentrations in air samples is more reliable when sampling time is increased.

4.1. Lead concentrations in urine samples

Lead concentrations in urine samples analysed by (AAS) did not show any significant difference in Pb content between the exposed and non exposed persons. This meaningless result could be attributed to sampling error (samples were taken in the afternoon by then lead in the human body has already been excreted). Urine results are displayed in table (2).

4.2. Lead concentrations in hair samples:

Although the elemental content of hair samples displayed in table (3) and fig (II) conveys some irregularities in Pb distribution between the exposed and non-exposed groups the overall signal confirms the fact that lead concentrations in the employees of the printing press is generally higher than in other persons. Some high values of lead (0.64, 0.75, 0.40 ppm) in samples 11, 12 and 13 belong to persons whose working environment is related to chemicals (Omdurman Ahlia University/Nuclear Science Laboratories (NCR)).

Zn and Fe values did not show any pattern between the two groups. Generally hair samples are not a good indicator for the source of contamination since hair can attract contaminations from sources other than the printing press environment.

4.3. Lead concentrations in blood samples:

(XRF) results of lead concentrations in blood samples displayed in table (5) show lead content among the printing press workers. Samples 5,6,7 and 9 in the exposed group yielded high lead concentrations. The mentioned blood samples are collected from labourers who work at the furnace and caster sections. Blood sample no (8) is taken from a labourer who lives in the printing press near the furnace section. Sample No (10) disclosed very high values of lead this sample belongs to a worker who has been working since the establishment of the printing press in 1961.

Fig (III) which displays the average content in blood samples emphasizes high Pb concentrations in the exposed group compared with the control. Exposed persons are directly subjected to lead contaminated air in their working environment. Lead concentrations vary according to the place or section of work because in some places workers are directly exposed to lead fumes e.g. caster and furnace sections while in others workers are indirectly exposed to lead such as office employees. Moreover ventilation of the offices and freedom of movement diminish the effects of lead contamination.

It is noticeable from fig (III) that concentrations of Fe, Zn, and Cu, in the analyzed samples are higher in the non-exposed persons compared to the exposed. This phenomenon suggests that lead in the exposed persons hampers and partially inhibits the absorption of other trace elements, thus curtailing their participation in the normal metabolic processes.

TABLE (1)

Lead concentrations (ppm) in Air samples from the printing Press and control area

No	Site	Concentration sampling duration 30m	Concentration in sampling duration 60m
1	Caster	0.1	0.4
2	Manual collection	0.53	0.53
3	Furnace	0.28	3.7
4	Air conditioner	0.45	1.4
5	Furnace (after working hours)	0.31	No sample
6	Printing press yard	0.2	No sample
7	Residential area	0.11	No sample
8	Residential area	0.38	No sample
9	El Sarha (control)	No sample	0.02
10	Shmbat	0.03	0.08
Total		2.39	6.13

PPM = part per million

TABLE (2)

Lead concentrations in Urine samples

Samples No	**Lead Concentrations in urine samples**	
	Exposed persons	non exposed (control samples)
1	0.16	0.25
2	0.089	0.124
3	0.25	0.06
4	0.153	0.174
5	0.045	0.185
6	0.18	0.28
7	0.153	0.14
8	0.02	0.14
9	0.15	0.25
10	0	0.045
Total	1.2	1.46

PPM = part per million

(The world standard of urine is 90 mg/g)

TABLE (3)

Pb, Fe and Zn concentrations in hair samples

Exposed Group

Sample	Concentrations in ppm		
	Pb	**Fe**	**Zn**
1	0.030	1.18	0.1
2	1.04	37.8	2.2
3	0.09	10.3	0.6
4	0.15	86.1	0.6
5	0.20	3.8	2.69
6	0.48	15.1	2.07
7	0.44	13.1	2.86
8	0.14	7.0	3.25
9	0.35	9.5	1.03
10	0.19	41.5	2.68
11	0.82	18.0	1.94
12	0.43	9.0	1.02
13	0.18	15.2	1. 71
Total	4.54	267.58	22.75

PPM = part per million

TABLE (4)

Control Group

Sample	Concentrations in ppm		
	Pb	**Fe**	**Zn**
1	0.07	0.8	
2	0.04	1.73	0.41
3	0.03	3.24	0.78
4	0.11	10.97	0.40
5	0.01	7.95	0.23
6	0.02	8.4	0.82
7	0.19	15.1	1.88
8	0.28	41.5	2.8
9	0.08	2.7	1.0
10	0.06	1.4	0.7
11	0.64	4.5	1.7
12	0.75	29.5	2.5
13	0.40	10.2	0.7
Total	2.68	137.99	13.92

PPM = part per million

TABLE (5)

Pb, Fe and Zn concentrations in blood samples

(Exposed Group)

Sample No	**Working Site**	**Employment years**	**Concentration in (PPM)**			
			Pb	**Fe**	**Zn**	**Cu**
1	Director	31	23	1852.3	31.16	2.55
2	Manual Collection	14	23	179.4	23.15	11.82
3	Manual Collection	23	22	2074.1	31.70	4.43
4	Delivery	9	34	2128.2	18.16	6.58
5	Casting	10	53	2180.9	17.99	5.77
6	Binding	16	74	2190.4	24.75	3.09
7	Furnace	5	97	1695.5	31.8	7.12
8	Clinic	1	61	1753.6	27.9	10.8
9	Casting	16	80	1773.9	25.8	9.9
10	Costing Offices	34	154	1596.8	16.2	2.6
Total		159	621	17425.1	248.61	64.66

PPM = part per million

(The world standard of blood is 40 mg/100 ml)

TABLE (6)

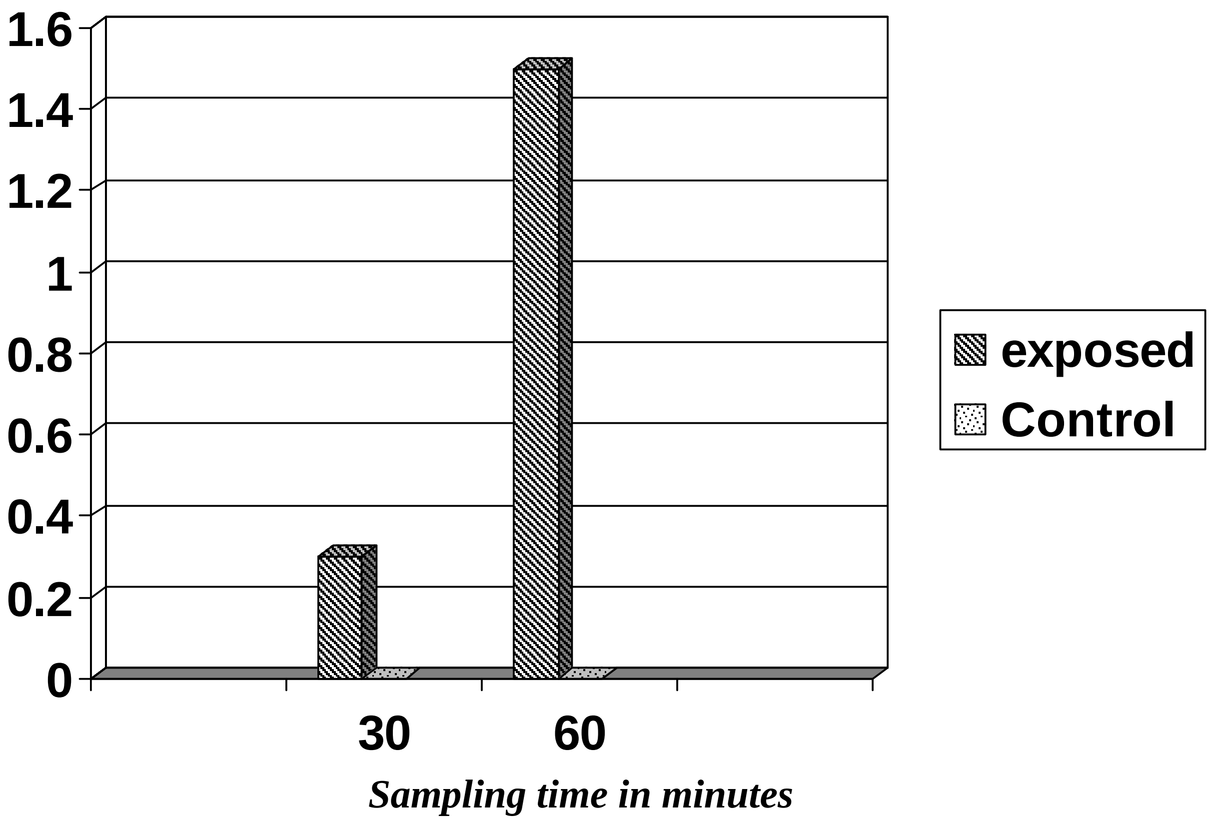
Pb, Fe, Zn and Cu concentrations in blood sample

(Control Group)

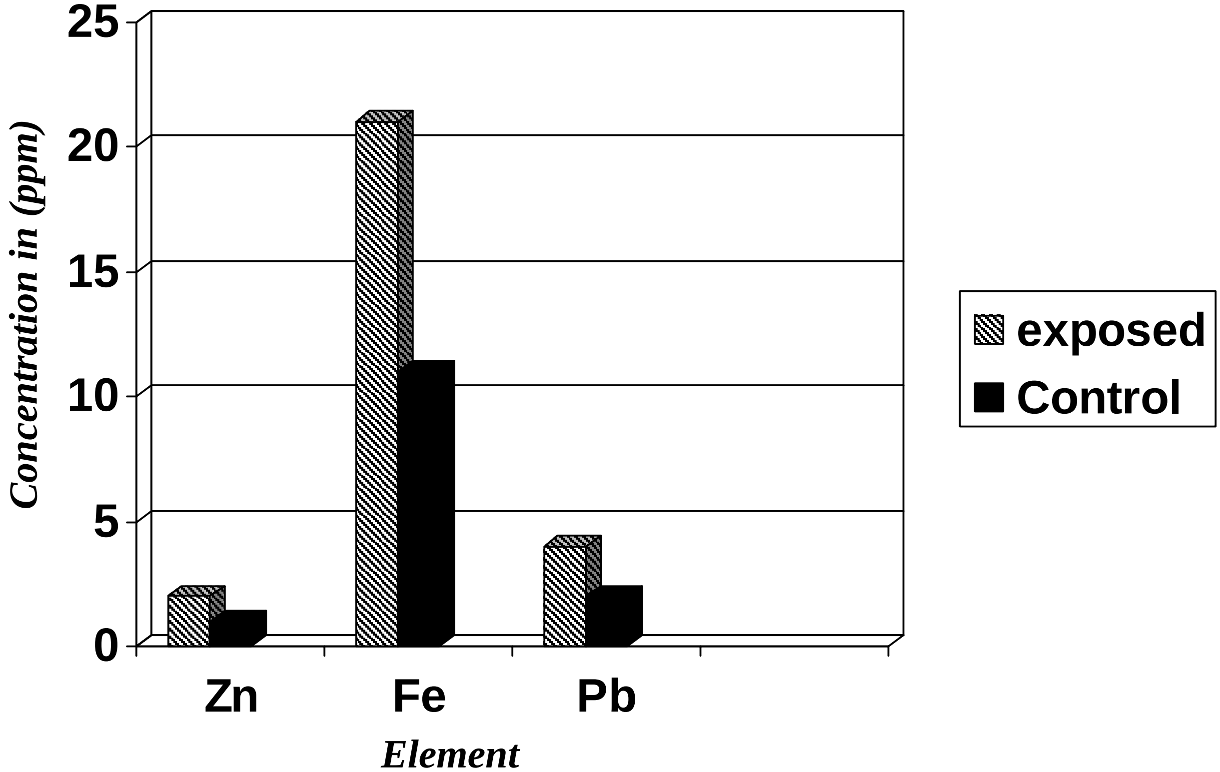
Sample No	Working Site	Employment years	Concentration in (PPM)			
			Pb	Fe	Zn	Cu
1	Worker in SSMO	4	37	2299.7	28.85	6.71
2	Worker in SSMO	2	18	2305.3	27.96	6.58
3	Worker in SSMO	1	37	2098.4	26.00	3.89
4	Worker in SSMO	3	44	2144.4	34.55	5..64
5	Worker in SSMO	5	19	2187.7	30.45	5.91
6	Worker in O.A.U	1	44	2118.7	20.3	6.85
7	Worker in O.A.U	5	62	2220.1	27.78	6.45
8	Worker in O.A.U	4	36	1295.3	39.36	6.18
9	Worker in O.A.U	2	27	2171.4	23.15	3.49
10	Worker in O.A.U	4	24	1868.6	27.42	4.97
Total		31	348	20709.6	3000.4	62.67

PPM = part per million

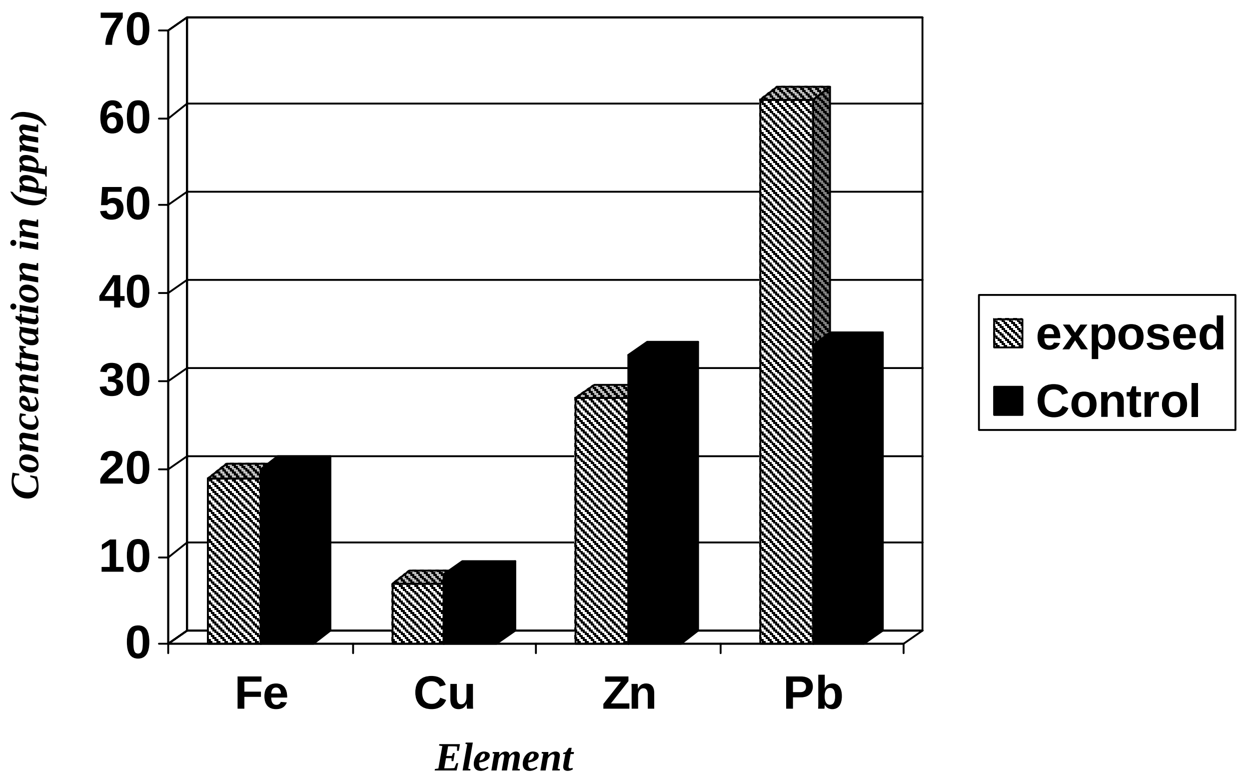
I): Lead Content in air samples from Fig (
The two areas as a function of time



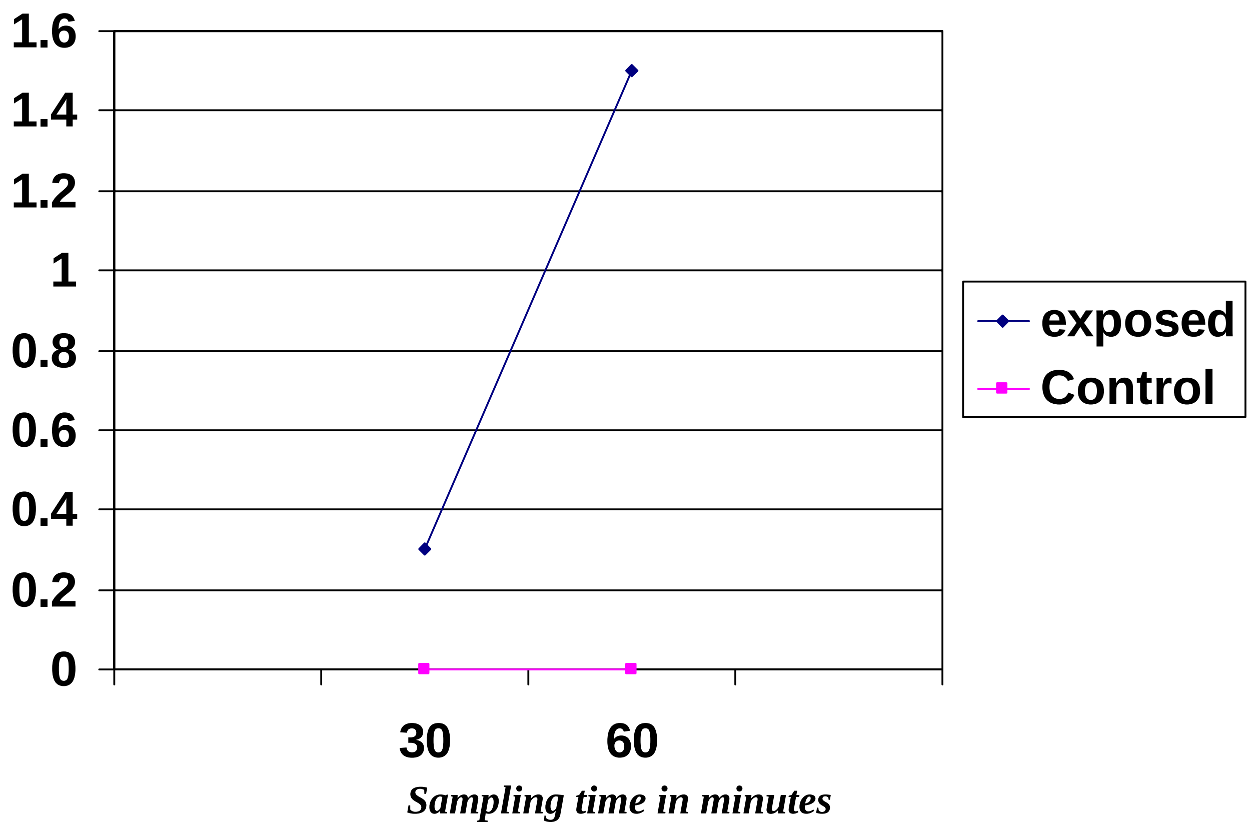
II): Concentration of Fe, Zn and Pb in Fig (
hair samples from the two groups.



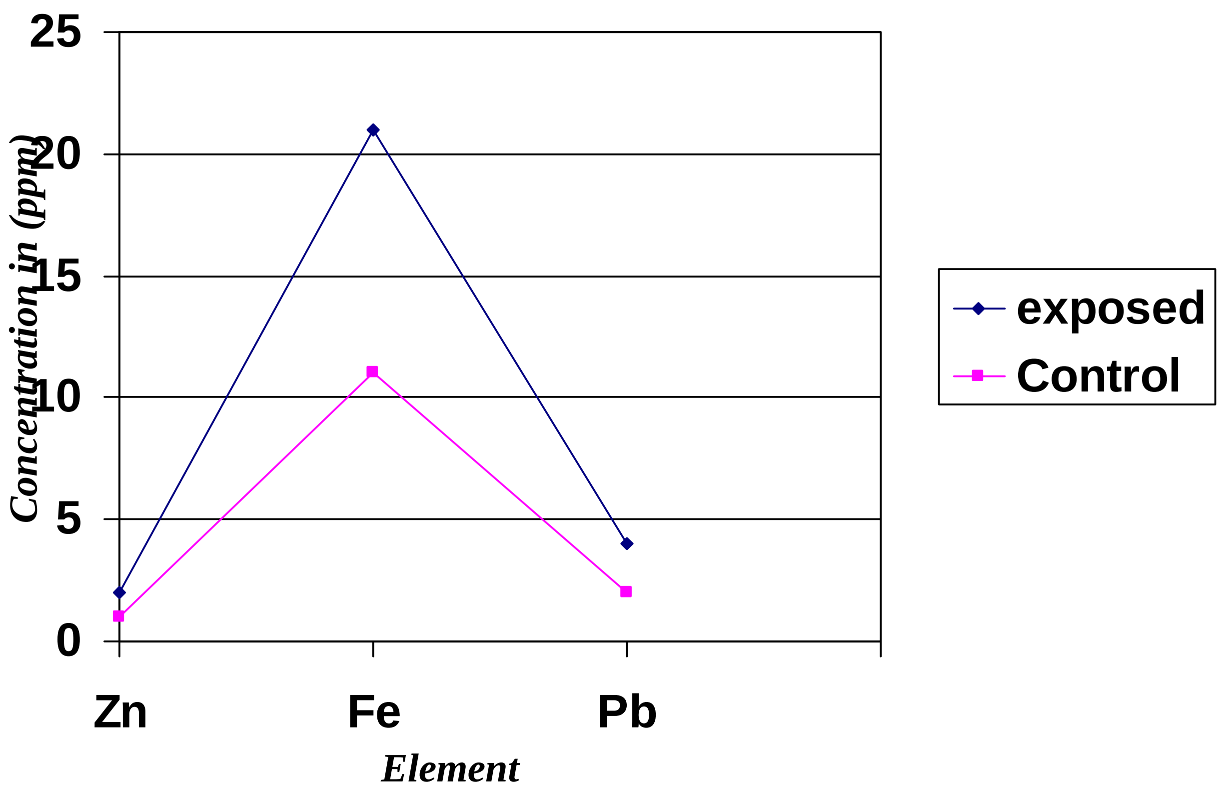
III): Average elemental concentration in Fig (
blood samples from the two groups.



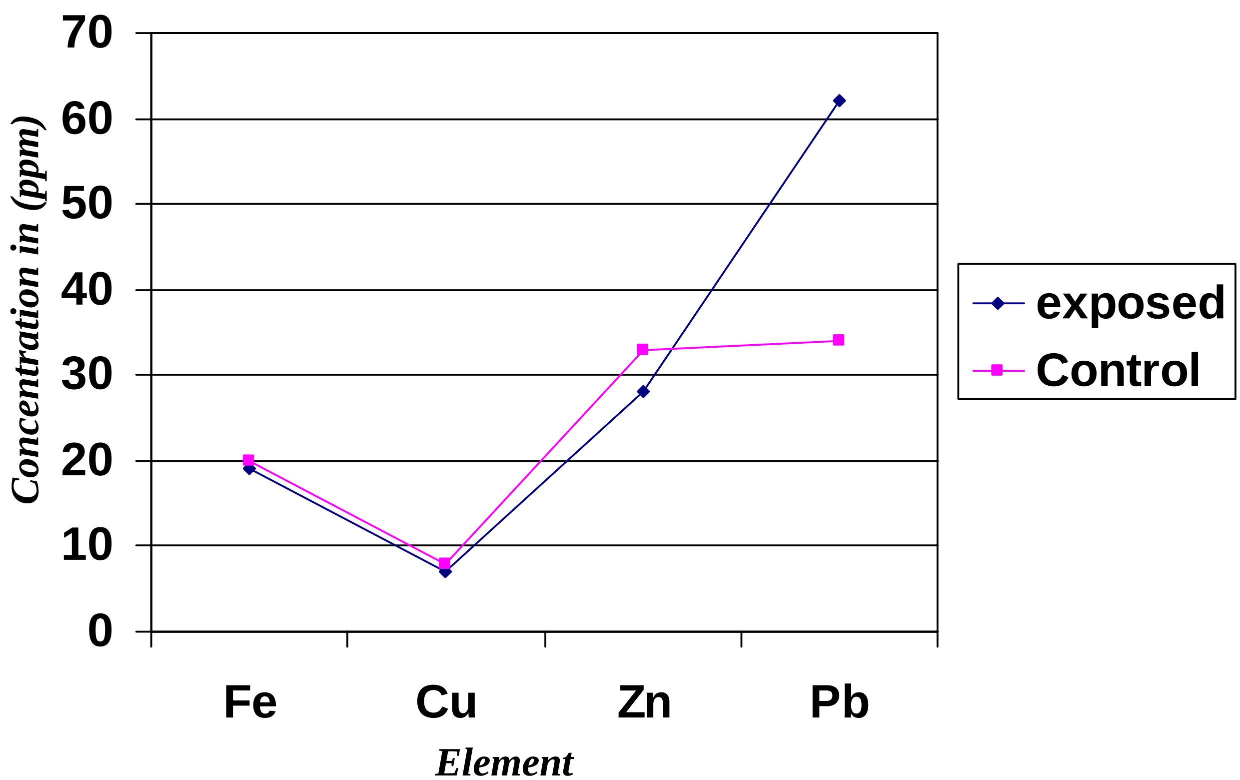
i): Lead Content in air samples from Fig (
The two areas as a function of time



ii): Concentration of Fe, Zn and Pb in Fig (
hair samples from the two groups.



iii): Average elemental concentration in Fig (
blood samples from the two groups.



Chapter (5)

5. Conclusions & Recommendations:

5.1. Conclusions

1. Lead concentrations in air samples from the printing press work environment is 10 times higher than in the air of the control area. (ElSarha, Shmbat)
2. Blood samples conveyed a clear signal that Pb concentrations in exposed persons are higher than in the no exposed.
3. Analytical results from hair samples can not be ascribed to definite source since hair is prone to attract contaminates from various sources.
4. Air and blood sample are the most suitable sampling materials for the detection of heavy metals pollution from industrial activities.
5. The results suggest that lead pollution could in habit the absorption of some vital to life trace elements eg. Fe, Zn and Cu.
6. Employees of the printing press industry are more susceptible to pb poisoning than others.

5.2 Recommendations:

1. Substitution of the present primitive equipments by new and modern. Laser printers may radically change the present working environment.
2. Maintenance of equipment and control of equipments emissions so as to minimize the workers exposure.
3. Ventilation facilities should be improved to minimize the intensity of contaminants.
4. Education and training of worker’s on the safe and hygienic work reference.
5. Workers should be provided with protective makes especially in the caster and furnace sectors and they should abide by the rules and wear those makes.
6. Regular environmental monitoring for the lead concentration is essential for control of workers.
7. Periodical medical checkups for workers should include investigation of the blood lead level for early dilation of the adverse health effects.

Further studies should be conducted to include more specific ways for workers about safety & health.

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Appendix

For air, hair and urine samples atomic absorption spectroscopy (AAS) was used for blood samples X-ray florescence a (XRF) analytical method was employed.

Atomic Absorption Spectroscopy:

(AAS) the samples in solution is atomized in a burner this ruptures chemical bonds and breaks down molecules into atoms. These atoms are not exited they exist mainly in their ground state. Atoms in this condition will absorb characteristic resonance radiation of precisely the same wave length that they would emit if they were excited. This property is utilized by allowing in a hollo cathode lamp source to pass through the flame vaporized sample. The extent of absorption, at a particular wave length characteristic of the metal, is proportional to the concentration of the element being aspirated in the flam.

X-ray Fluorescence (XRF):

XRF-consists of exciting inner electrons in atoms of an unknown material. In returning to the ground state, the electrons in atoms of an unknown material. In returning to the ground state, the electrons give up their energy in the form of X-rays. This characteristic X-ray energy identify the elements present in the material.

Some advantages of XRF:

1) It is non destructive, the original samples remains intact and it can be analyzed any number of times.
2) One analysis provides simultaneous detection of a number of elements. The method can be easily automated.

Contains