

Chemical Implications Of Metal Toxicity Of Meat Processed Through Tire Fire.

BEETSEH C. I. AND ONUM D. E.

Department of Chemistry University of Agriculture Makurdi

Abstract

Abattoir roasts in two locations Katsina ala and Makurdi Benue Nigeria (where tires were used as fuel) were analysed with Buck Scientific Atomic Absorption Spectrophotometer (AAS) VGP 2110 and the presence among others were heavy metals specifically Zinc average value of 0.0475mg/l, Copper 0.0323mg/l, lead 0.0267mg/l and Cadmium 0.0173mg/l. This is apart from releasing of pollutants through its thick smoke into the local rivers of Katsina ala and Benue -compromising the immediate atmosphere and water life. Zinc and Copper have values below the WHO standards, Lead and Cadmium are toxic when they are above certain limits and can implicate the meat products by direct absorption by the meat flesh and the food chain that leads to man. Heavy metal poisoning affects all the organs of the body leading to various ailments like cough, dryness, irritation of the nose and throat headache, dizziness, weakness, fever, chills, chest pain, respiratory tract and kidney problems which can be sometimes fatal.

Key Words: Complication, Toxic, Smoke, Roast and Analysis.

Introduction

Records of general research and the estimated quantity of scrap tires in Nigeria are scarce but their uses on old vehicles, burning in order to obtain iron and steel frames as well as use as fuel for different purposes including roasting of animal skin as a form of dressing it for further use is encountered in various parts of the country. U.S. EPA (October 1997) "Air Emissions from Scrap Tire Combustion" shows that every year in the United States, 250 million automobile tires are discarded, presenting a serious disposal problem. Scrap tires take up large amounts of space and are difficult to destroy, are flammable, release toxic fumes when burned. are a serious threat to human health. Specifically, emissions from burning tires are highly mutagenic (more mutagenic than emissions from the burning of all other bulk materials that researchers have tested). A controlled simulation test program designed to identify and quantify organic and inorganic emission products during the simulated open combustion of scrap tires was conducted by EPA (Ryan, 1989) and further documented in an Air and Waste Management Association Paper [(AWMA) Lemieux and Ryan, 1993]. Emissions from burning tires contains significant amounts of the following known human carcinogens: benzene, 1,3-butadiene, and benz[a]pyrene. If tires are burned, small particles containing zinc oxide produces inflammation in the lungs. Lung damage has been documented in animal studies at levels lower than OSHA and EPA standards. They also include metals such as arsenic, cadmium, nickel, zinc, mercury, chromium, and vanadium. Both criteria and HAP emissions from an open tire fire can represent significant acute (short-term) and chronic (long-term) health hazards to firefighters and nearby residents. Both Katsina Ala and Makurdi have residences by the river and around abattoirs where scrap tires are used.

Their recommendations are that tires are not designed to be burned as a fuel and contain hazardous ingredients (the rubber in tires contains 25% extender oils derived from benzene, 25% styrene, a derivative of benzene, and 25% 1,3 butadiene. - both benzene and 1,3 butadiene are suspected human carcinogens). Tire-derived fuel (TDF) also contains remnants of wire that is difficult to totally remove.

1.0 Cow Skin Roasting

The abattoirs in the two locations Makurdi and Katsina Ala have six furnaces each locally made from mud, metal wires and clay. The major source of fuel used in the furnace includes firewood, rubber tires and charcoal. Each furnace has at least six employees involved in roasting and cleaning the animals. Outside the abattoir are sales men. Each has a table used to butcher the animals which are sold immediately to buyers or packaged and ready to be distributed to retailers. The animals' skin is first cut in to three parts before roasting. The roasting procedure consists of two different stages. The first which is also called "retouching"; here, the animals' skin are roasted evenly the inside skins is turned outward and then roasted. This process is meant to touch those parts that were hidden from the flames at the first stage the skin is rolled and tied with wire string gotten from rubber tire. This measure is aimed at indicating that the skin is to ensure completeness of roasting.

2.0 Tires

The main source of fuel used is the rubber tyre used to bring the furnace rapidly to very high temperature.

Tires are found on automobiles, trucks buses, air landing gears tractors and other farm equipment's, industrial vehicles such as baby carriage, are pneumatic, air is held under pressure inside the tire. Waste tires account about 2% of the global solid waste. Tires are almost not biodegradable. According to **Dmitri Kopeliovich** (2013) more than 1 billion of scrap tires are generated every year in the world. Most of them are dumped into landfills contaminating the environment, providing breeding sites for mosquitoes and presenting a fire risk. However the environmental aspect is not the only reason to recycle the scrap tires. Dumped tires store a large amount of energy, which may be recovered from them in form of solid, liquid and gaseous fuel. The energy may be recovered from scrap tires directly by using them as a fuel in incinerators. This technique is called **combustion**. It allows to recover maximum amount of the energy: 12,000-16,000 BTU/lb (27,900-37,200 kJ/kg). However the direct tire combustion produces black contaminated smoke, which should be cleaned. The alternative approach of scrap tires energy recycling is a decomposition of the tire material by a thermal conversion process. There are two types of thermal conversion of carbon containing materials: pyrolysis and gasification.

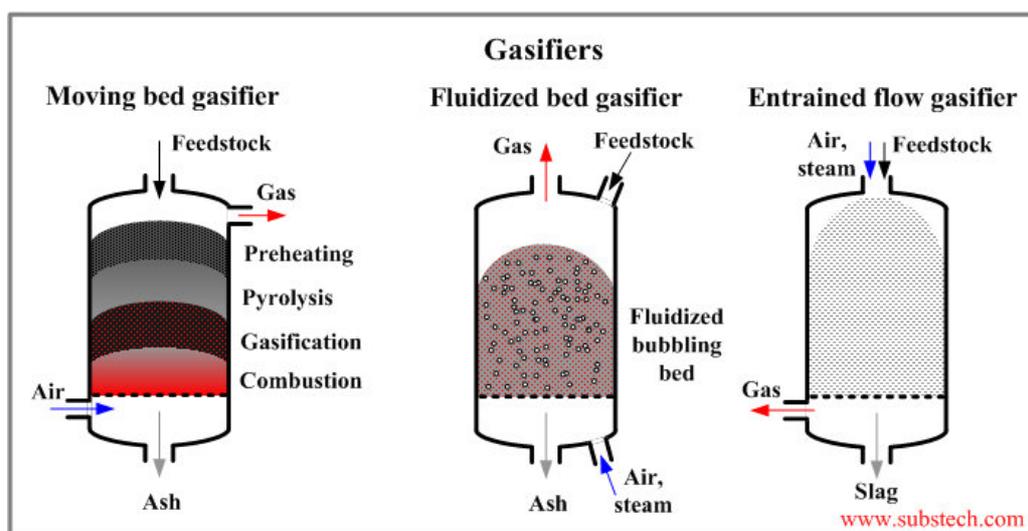
Pyrolysis is the thermal decomposition of an organic substance in the absence of Oxygen (inert atmosphere). In pyrolysis large hydrocarbon molecules of the substance break down into smaller molecules. Generally three products form as a result of pyrolysis: a fuel gas, liquid (pyrolytic oil)- up to 60% and solid residue (char)- 35-40%.

The solid char is composed of carbon black, which may be used for manufacturing tires and other rubber products, as a pigment in inks, paints and toners, as active carbon and for fabrication electrodes and cell batteries cores.

The liquid fraction consists of a mixture of oils, which may serve as a fuel or a raw material in oil refinery process. The combustion heat of the liquid fraction is 18,000 BTU/lb (42,000 kJ/kg). The gaseous product is composed of the gases: **CO**, **CO₂**, **H₂**, **C_nH_m**. The liquid/gas ratio depends on the temperature. The higher the temperature, the lower the liquid/gas ratio. The typical temperature range of pyrolysis is 750-1800°F (399-982°C). Another type of the thermal decomposition is gasification. **Gasification** is the thermal conversion of an organic substance into a combustible gas in the presence of an oxidant (air, steam). The oxidant (gasification agent) is supplied to the feedstock (e.g. shredded tires) where a series of heterogeneous reactions takes place:

Pyrolysis:	Feedstock	→	C	(carbon black)	+	volatile fraction
C	+		$1/2O_2$		→	CO
C	+		O_2		→	CO_2
C	+		CO_2		→	$2CO$
C	+	H_2O			→	CO + H_2
C	+		$2H_2$		→	CH_4
nC	+		$m/2H_2$		→	C_nH_m

There are three general types of gasification process: fixed bed, fluidized bed and entrained flow (see the picture):



Fixed (moving) bed gasifier is the simplest type of gasification reactor. The process takes place in a shaft-type reactor. The coarse pieces of tires are loaded from the top. They move downwards. The reactive gas (air, steam, oxygen) comes from the bottom and goes upward in the direction opposite to the direction of the descending feedstock. The feedstock material reacts with the gasification agent producing the product gas, which leaves the gasifier through the top. In its way downwards the feedstock passes in series several zones: the drying zone, the pyrolysis zone where the organic substance converts into carbon black, the reduction (gasification) zone where the oxidizing gases are reduced in the reaction with carbon, the combustion (oxidizing) zone where the residual carbon is oxidized by the oxygen of the gasification agent. The temperature in the combustion zone may reach 2192°F (1200°C). The disadvantages of fixed bed gasifiers are relatively low efficiency and the possibility of the oxidant to break through forming channels in the feedstock and reacting with the gaseous product in form of explosion.

Fluidized bed gasifier does not have different zones (in contrast to the fixed bed type). The chemical reactions occur in the isothermal dispersion of the fine feedstock particles in the gas. The feedstock particles are mixed

with the gas introduced from the bottom of the reactor. The mixture is in a liquid-like form. The gaseous product goes upwards passing through the fluidized bed and leaves the gasifier through the top. Some of the ash particles are taken by the gas and they are separated from it in a cyclone or filters. The temperature of the fluidized bed process is lower than that of the fixed bed: 1292-1652°F (700-900°C).

Entrained flow gasifier operates with the feedstock particles fed through the top of the reactor. The gasification agent (oxidizing gas) also enters the gasifier through the top. Entrained flow process occurs at high temperature and therefore it takes very short time (few seconds). High temperature also causes the ash to melt forming a slag, which is removed from the gasifier bottom. The gaseous product is clean and should not be additionally cleaned.

Rubber alone does not have all the properties required in a good Tyre. Most tires' today are made out of rubber compound made up of various chemical mixed in with the rubber while it is still in liquid form. The chemicals used helps give the tire's the temperature resistance strength and durability that they required.

A passenger car tyre is typically composed of: natural rubber, Synthetic rubber, sulfur and sulfur compounds, silica, phenolic, resins, oil; aromatic, naphthenic, black fatty acid, inert materials. (Kovac, F.T., Tire Technology 2008)

Chemical composition test on tire shows that it contains numerous toxic and hazardous air pollutants and once burnt those can become air borne. Various raw materials used in the manufacturing of tyres have been documented to pose adverse health and environmental effects. Natural rubber alone pose a dangerous fire and when heated to decomposition emits toxic fumes of SO₂ (dioxosulphate). Base materials used in polymer rubber production, such as butadiene and styrene are suspected human carcinogens and many of the polymer additives can cause systemic toxic effects. Isoprene is a mild toxic by the pathway of inhalation. It also reacts with air and ozone to form dangerous peroxides. Butadiene is a confirmed carcinogen and teratogen in animals and a suspected human carcinogen. Inhalation of high concentration of butadiene can cause unconsciousness and death Human systemic effects of butadiene by inhalation include coughing and hallucination. Styrene is suspected carcinogens; it has been found to be poisonous by ingestion, inhalation and intravenous routes.

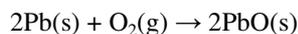
3.0 Toxic Metals

Toxic metals may enter the human body through food, water, air, or absorption through the skin when they come in contact with humans in agriculture and in manufacturing, pharmaceutical, industrial, or residential settings. Industrial exposure accounts for a common route of exposure for adults. Ingestion is the most common route of exposure in children (Roberts 1999). Children may develop toxic levels from the normal hand-to-mouth activity of small children who come in contact with contaminated soil or by actually eating objects that are not food (dirt or paint chips) (Dupler 2001). The Agency for Toxic Substances and Disease Registry (ATSDR) in Atlanta, Georgia, (a part of the U.S. Department of Health and Human Services) was established by congressional mandate to perform specific functions concerning adverse human health effects and diminished quality of life associated with exposure to hazardous substances. The ATSDR is responsible for assessment of waste sites and providing health information concerning hazardous substances, response to emergency release situations, and education and training concerning hazardous substances (ATSDR Mission Statement, November 7, 2001). Here in Nigeria we have the National Agency for Food Drug Administration and Control NAFDAC, working in collaboration with other national agencies like Federal Environmental Protection Agency- Retained as Cap 131 FEPA and National Guidelines and standards for Water Quality in Nigeria NGSWQN.

3 . 1. Lead (pb)

Reaction of lead with air

The surface of metallic lead is protected by a thin layer of lead oxide, PbO. Only upon heating lead to 600-800°C does lead react with oxygen in air to form lead oxide, PbO.



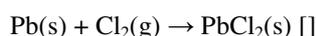
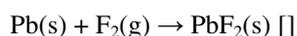
Finely divided lead powder is pyrophoric, however, meaning it is a fire risk.

Reaction of lead with water

The surface of metallic lead is protected by a thin layer of lead oxide, PbO. It does not react with water under normal conditions.

Reaction of lead with the halogens

Lead metal reacts vigorously with fluorine, F₂, at room temperature and chlorine, Cl₂, on warming to form the poisonous dihalides lead(II) fluoride, PbF₂, and lead(II) chloride, PbCl₂, respectively.



Reaction of lead with acids

The surface of metallic lead is protected by a thin layer of lead oxide, PbO. This renders the lead essentially insoluble in sulphuric acid, and so, in the past, a useful container of this acid. Lead reacts slowly with hydrochloric acid and nitric acid, HNO₃. In the latter case, nitrogen oxides are formed together with lead(II) nitrate, Pb(NO₃)₂.

Reaction of lead with bases

Lead dissolves slowly in cold alkalis to form plumbites.

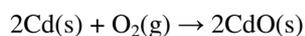
Lead and lead compounds are generally toxic pollutants. Lead(II)salts and organic lead compounds are most harmful ecotoxicologically. Lead salts are attributed to water hazard class 2, and consequently are harmful. The same applies to lead compounds such as lead acetate, lead oxide, lead nitrate, and lead carbonate. Lead limits plant chlorophyll synthesis. Nevertheless, plants can take up high levels of lead up to 500 ppm from soils. Higher concentrations negatively influence plant growth. Through plant uptake, lead enters food chains. Consequently, lead pesticide application is prohibited in most countries. Lead accumulates in organisms, sediments and sludge. Lead in wastewater mostly stems from streets and roofs. Lead exists as four stable isotopes, and no less than 26 instable isotopes.

The toxicity of lead compounds increases as their solubility increases. In children the accumulation of lead may result in cognitive deficits; in adults it may produce progressive renal disease. Symptoms of lead poisoning include abdominal pain and diarrhea followed by constipation, nausea, vomiting, dizziness, headache, and general weakness. In the environment Lead arises from both natural and anthropogenic sources. Exposure can occur through drinking water, food, air, soil, and dust from old paints containing lead. Lead interferes with a variety of body processes and is toxic to many organs and tissues including the heart, bones, intestines, kidneys, and reproductive and nervous system. It interferes with the development of the nervous system and is therefore particularly toxic to children, causing potentially permanent learning and behaviour disorders. Symptoms include abdominal pain, confusion, headache, anaemia, irritability and in severe cases, seizures, coma and death. (Blood lead level testing, department of ecology, state of Washington. 2011)

3.2 Cadmium (Cd)

Reaction of cadmium with air

Cadmium metal burns in air to form cadmium(II) oxide. This material is coloured variously, depending upon how it was made.

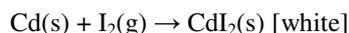
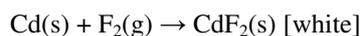


Reaction of cadmium with water

Cadmium metal does not react with water.

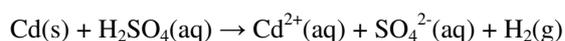
Reaction of cadmium with the halogens

Cadmium difluoride, cadmium(II) difluoride, CdF_2 , cadmium dibromide, cadmium(II) dibromide, CdBr_2 , and cadmium diiodide, cadmium(II) diiodide, CdI_2 , are formed in the reactions of cadmium metal and fluorine, F_2 , bromine, Br_2 , or iodine, I_2 .



Reaction of cadmium with acids

Cadmium metal dissolves slowly in dilute sulphuric acid to form solutions containing the aquated Cd(II) ion together with hydrogen gas, H_2 . In practice, the Cd(II) is present as the complex ion $[\text{Cd}(\text{OH}_2)_6]^{2+}$.



The reacts of cadmium with oxidizing acids such as nitric acid, HNO_3 , are complex and depend upon precise conditions.

Reaction of cadmium with bases

Cadmium metal does not dissolve in aqueous alkalis such as potassium hydroxide, KOH.

Cadmium is an extremely toxic metal commonly found in industrial workplaces. Due to its low permissible exposure limit, overexposures may occur even in situations where trace quantities of cadmium are found.

Acute exposure to cadmium fumes may cause flu like symptoms including chills, fever and muscle ache sometimes referred to as “the cadmium blues” More severe exposures can cause trachea-bronchitis, pneumonitis and pulmonary edema. Symptoms of inflammation may start hours after the exposure and include cough, dryness, and irritation of the nose and throat headache, dizziness, weakness, fever, chills, and chest pain. Inhaling cadmiumladen dust quickly leads to respiratory tract and kidney problems which can be fatal.

“cadmium and you”. Health and safety executive, (2010.) Cadmium is not essential for plant growth but under certain conditions can accumulate in some plant to levels that are hazardous to animals and human beings. At extreme levels, it causes an illness called -itai disease characterized by brittle bones and intense pain .

Eating food or drinking water with very high cadmium levels severely irritate the stomach, leading to vomiting and diarrhea, and sometimes death. Eating lower levels of cadmium over a long period of time can lead to build up of cadmium in the kidneys.

If the levels reach a high enough level, the cadmium in the kidney can cause damage, and also cause bones to become fragile and break easily.

3.3 Zinc (Zn)

Reaction of zinc with air

Zinc metal tarnishes in moist air. Zinc metal burns in air to form the white zinc(II) oxide, a material that turns yellow on prolonged heating.

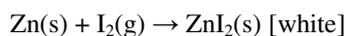
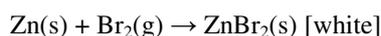


Reaction of zinc with water

Zinc does not react with water.

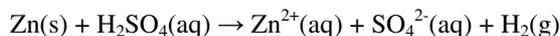
Reaction of zinc with the halogens

Zinc dibromide, zinc(II) dibromide, ZnBr_2 , and zinc diiodide, zinc(II) diiodide, ZnI_2 , are formed in the reactions of zinc metal and bromine, Br_2 , or iodine, I_2 .



Reaction of zinc with acids

Zinc metal dissolves slowly in dilute sulphuric acid to form solutions containing the aquated Zn(II) ion together with hydrogen gas, H_2 . In practice, the Zn(II) is present as the complex ion $[\text{Zn}(\text{OH}_2)_6]^{2+}$.



The reacts of zinc with oxidizing acids such as nitric acid, HNO_3 , are complex and depend upon precise conditions.

Reaction of zinc with bases

Zinc metal dissolves in aqueous alkalis such as potassium hydroxide, KOH, to form zincates such as $[\text{Zn}(\text{OH})_4]^{2-}$. The resulting solutions contain other species as well.

Zinc is a metal that is normally found in small amount in nature. It is used in many commercial industries and can be released into the environment during mining and smelting activities. People living near smelters or industries using zinc could be drinking water, breathing air and touching soil that contains the metal. Exposure to high levels of zinc over long periods of time may cause adverse health effects. Zinc is a trace element that is essential for the human health .when people absorb too little they can experience a loss of appetite, decreased sense of taste and smell, slow wound healing and skin sore. Zinc shortage can even cause birth defects.

Although humans can handle proportionally large concentration of zinc, too much Zinc can still cause eminent health problems such as stomach cramps, skin irritation, vomiting, nausea and anaemia.

Very high levels of zinc can damage the pancreas and disturb the protein metabolism and cause arteriosclerosis .Extensive exposure to zinc chloride can cause respiratory disorders. Zinc can be danger to unborn and new born children when their mothers have absorbed large concentration of time the children may be exposed to through blood or milk of their mothers.

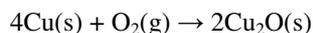
A short-term illness called metal fume fever can result if workers breathe very high levels of zinc dust or fumes. This condition, which usually lasts from 24 to 28 hours, causes chills, fever, excessive sweating and

weakness. Long-term effects of breathing zinc dust or fumes are not known.
zinc .com)

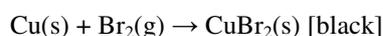
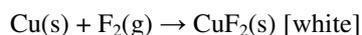
([http://www. lenntech-zinc .com](http://www.lenntech-zinc.com))

3.4 Copper Cu

Copper metal is stable in air under normal conditions. At red heat, copper metal and oxygen react to form Cu_2O .

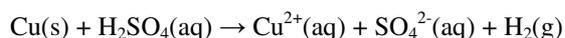


The reaction between copper metal and the halogens fluorine, F_2 , chlorine, Cl_2 , or bromine, Br_2 , affords the corresponding dihalides copper(II) fluoride, CuF_2 , copper(II) chloride, CuCl_2 , or copper(II) bromide, CuBr_2 respectively.



Reaction of copper with acids

Copper metal dissolves in hot concentrated sulphuric acid to form solutions containing the aquated Cu(II) ion together with hydrogen gas, H_2 . In practice, the Cu(II) is present as the complex ion $[\text{Cu}(\text{OH}_2)_6]^{2+}$.



Copper metal also dissolves in dilute or concentrated nitric acid, HNO_3 .

Copperiedus –excess copper in the body- can occur from eating acid foods cooked in uncoated copper cookware, or from exposure to excess copper in drinking water or other environmental sources. Copper in the blood exist in two forms: bound to ceruloplasmin (85–95%) and the rest "free" loosely bound to albumin and small molecules. Free copper causes toxicity, as it generates reactive oxygen species such as superoxide, hydrogen peroxide, and the hydroxyl radical. These damage proteins, lipids and DNA. Symptoms of copper poisoning by ingestion include vomiting, hematemesis (vomiting of blood), hypotension (low blood pressure), melena (black "tarry" feces), coma, jaundice (yellowish pigmentation of the skin), and gastrointestinal distress . Copper is a component of several enzymes necessary for normal metabolic functions .food sources rich in copper includes shellfish, organ meat, nuts, dried legumes and cocoa.

Effect of copper deficiency can include anaemia, low numbers of white blood cells, osteoporosis, in infants and children, and defects in connective tissue leading to skeletal problems.

Acute poisoning from ingestion of excessive copper can cause temporary gastrointestinal distress, with symptoms such as nausea, vomiting and abdominal pain .High levels of exposure to copper can cause destruction of red blood cells, possibly resulting in anaemia .Mammals have efficient mechanisms to regulate copper stores such that they are generally protected from excess dietary copper can damage the liver and kidney.

Chronic (long-term) effects of copper exposure can damage the liver and kidneys. Mammals have efficient mechanisms to regulate copper stores such that they are generally protected from excess dietary copper levels. ARD-EHP-9 2005,

4.0 Tire roast analysis

4.1 Apparatus Pipette, volumetric flask , measuring cylinder, beaker, erlenmeyer flask, weighing balance, filter paper.

4.2 Reagents Concentrated nitric acid HNO_3 , concentrated sulphuric acid H_2SO_4 , concentrated perchloric acid HClO_3 , distilled water dilute hydrochloric acid.

4.3 Procedure

For samples obtained from each station 1.0g of the abattoir roast was transferred into a 125ml Erlenmeyer flask which had been previously washed with dilute HCl acid and distilled water. 4ml of perchloric acid, 25ml concentrated HNO₃ and 2ml concentrate H₂SO₄ was added to the Erlenmeyer flask containing the roast samples under a fume hood. The contents were mixed and then heated gently to medium heat on hot plate under perchloric acid fume hood.

The content was heated continually until a dense white fume appeared. The flask was allowed to cool and then 1-2 ml of concentrated HNO₃ was added for extra digestion of undigested material.

Finally, the content was heated strongly for half a minute and allowed to cool. 40-50ml of distilled water was added to the content and boiled for half a minute on the same plate at medium heat. The mixture was then cooled and the solution filtered completely into a 100ml Pyrex volumetric flask and made up to mark with distilled water. The solution was stored for Zinc, lead, Copper and Cadmium determination using atomic absorption spectroscopy.

5.0 Results

Table 1 Average quantity mg/l of toxic metals in the roast

PARAMETER	MKD ROAST QUANTITY mg/l	K-ALA ROAST QUANTITYmg/l	AVERAGE QUANTITYmg/l
Zinc	0.049	0.046	0.0475
Cu	0.037	0.0276	0.0323
Pb	0.029	0.0244	0.0267
Cd	0.020	0.0146	0.0173

6.0 Observations

From the analysis carried out, the elements lead (Pb) copper (Cu), cadmium (Cd) and Zinc (Zn) were found to be present in the samples collected and their concentrations were in the order Zn > Cu > Pb > Cd. Zinc was detected as the highest, in all the samples analyzed.

Table 2 Health based guideline by the WHO concerning Zn Cu Cd and Pb

Element/ substance	Symbol/ formula	Normally found in fresh water/surface water/ground water	Health based guideline by the WHO
<u>Cadmium</u>	Cd	< 1 µg/l	0,003 mg/l
<u>Copper</u>	Cu		2 mg/l
<u>Lead</u>	Pb		0,01 mg/l
<u>Zinc</u>	Zn		3 mg/l

According to **Health based guideline by the WHO as shown above Table 2 the concentrations of zinc and copper in the roast** (average 0.0475mg/l and 0.0323mg/l respectively) was lower than WHO limits while that of cadmium and lead (average 0.0173mg/l and 0.026mg/l respectively) are higher.

7.0 Conclusion

People come in contact everyday with these toxic metals and yet are not aware of the threat they pose as a result of slow bioaccumulation. The presence of these heavy metals in the abattoir roast dumps is of a major health concern not just for those that work every day around the abattoir, but also for those who consume the meat processed from the abattoir. So also are the aquatic lives in rivers Katsina ala and Benue especially during the raining season as the rain washes these toxic metals in to the river.

Finally, the farm crops around these areas are also affected as the crops take up water from the river; the heavy metal present in the water body is also taken up by the crop causing bio-accumulation as well as heavy metal poisoning.

8.0 Recommendations

Tyre fires have severe impact on air, water and soil when burned in the open combust incompletely and emit both conventional air pollutants. The pollutants can cause short and long term health problems ranging from skin and eye irritation, depression and nervous system ailments to cancer..

Cleaning the site where there was an abattoir roasts dump is very expensive and many sites have to be declared as hazardous waste cleanup sites. When these roasts dump is washed away by rain water the heavy metals present either end up in the surrounding farms or lateral waters that may be also used for animal husbandry.

Abattoir roast dump should be buried and also that the use of tyre as fuel should be controlled to reduce the health risk associated with the toxic metals

Recycled rubber is used in asphalt overlays on highways. A reclaimed rubber modified asphalt mixture improves stability, durability, reflective crack reduction and oxidation resistance. All of this adds up to a mixture with an indicated service life outlasting our conventional mixes. Construction procedures are similar to typical lay-down operations.

Scrap tires are used as fuel because of their high heating value. Using scrap tires is not recycling, but is considered a beneficial use — it is better to recover the energy from a tire rather than landfill it. In 2003, 130 million scrap tires were used as fuel (about 45% of all generated) — up from 25.9 million (10.7% of all generated) in 1991. Tires can be used as fuel either in shredded form - known as tire-derived fuel (TDF) — or whole, depending on the type of combustion device. Scrap tires are typically used as a supplement to traditional fuels such as coal or wood. Generally, tires need to be reduced in size to fit in most combustion units. Besides size reduction, use of TDF may require additional physical processing, such as de-wiring. There are several advantages to using tires as fuel: Tires produce the same amount of energy as oil and 25% more energy than coal; The ash residues from TDF may contain a lower heavy metals content than some coals; Results in lower emissions when compared to many US coals, particularly the high-sulfur coals. EPA supports the highest and best practical use of scrap tires in accordance with the waste management hierarchy, in order of preference: reduce, reuse, recycle, waste-to-energy, and disposal in an appropriate facility. Disposal of scrap tires in tire piles is not an acceptable management practice because of the risks posed by tire fires, and because tire piles can provide habitats for disease vectors, such as mosquitoes. In 2003, more than 290 million scrap tires were generated in the US. Nearly 100 million of these tires were recycled into new products and 130 million were reused as tire-derived fuel (TDF) in various industrial facilities. TDF is one of several viable alternatives to prevent newly generated scrap tires from inappropriate disposal in tire piles, and for reducing or eliminating existing tire stockpiles. Based on over 15 years of experience with more than 80 individual facilities, EPA recognizes that the use of tire-derived fuels is a viable alternative to the use of fossil fuels. EPA testing shows that TDF has a higher BTU value than coal. The Agency supports the responsible use of tires in portland cement kilns and other industrial facilities, so long as the candidate facilities: (1) have a tire storage and handling plan; (2) have secured a permit for all applicable state and federal environmental programs; and (3) are in compliance with all the requirements of that permit.

Approximately 17 million tires per year are consumed in industrial boilers.

According to a Rubber Manufacturers Association survey in 2004, 19 industrial facilities were using TDF in their boilers to supplement their fuel usage. Industrial boilers are smaller than utility boilers and typically use a variety of fuels. When utilizing TDF, tires are typically shredded. Not all boilers are compatible with TDF. Clumping and clogging are common and preclude the use of TDF in many facilities.

Another impediment is the metal in the tires — if not removed before combustion, it ends up in the ash and can create disposal problems. Each facility must evaluate the impact of TDF on their air emissions and ash disposal. Industrial facilities must apply for the appropriate permits from their state and/or local regulatory authorities before commencing operation.

Approximately 10 million tires per year are consumed as fuel at dedicated tire-to-energy facilities. A dedicated tire-to-energy facility is specifically designed to burn TDF as its only fuel to create energy.

According to a Rubber Manufacturers Association survey at the end of 2003, there was only one dedicated tire-to-energy facility operating in the US. The dedicated tire-to-energy facility, Exeter Energy Limited in Sterling, Connecticut burns mainly whole tires and consumes 10 million tires per year. This facility serves as a major scrap tire market for scrap tires in New York and northern New Jersey. The second dedicated tire-to-energy facility in the US is located in Ford Heights, Illinois and was not in operation at the end of 2003.

Even though dedicated tire-to-energy facilities have been demonstrated to achieve emission rates much lower than most solid fuel combustors, there are no known facilities under construction or consideration. The length of time and cost of construction, as well as the deregulation of the utility industry hinders further expansion of this industry.

REFERENCES

<http://muextension.missouri.edu/xplor/wasteman/wm0003.htm> elawus@elaw.org (Free full text). *JAMA* **295** (4): 398–402. doi:10.1001/jama.295.4.398. PMID 16434630.

^ Association of official Analytical chemist (A.O.A.C) (1970). Official methods of analysis Ed 11, Washington Dc.

^ Bates R G, Concept and Determination of Ph in 1. M Kokhoff and Elving,Ed, Treastise on Analytical Chemistry.

^ Chip, B (1998) other sources of lead;Heavy metal and health, world institute. website. [www. osha. gov](http://www.osha.gov).

^ David, J. (1982) Toxicity ,heavy metals. Department of emergency medicine magee -woman’s hospital to the university of Pittsburgh medical centre web site<[http:h20spare.Wq](http://h20spare.Wq)>.

^ Joseph, T.K (2002) Toxicity of heavy metals, Determination of heavy metals in Amaranthus Hybridus p. 17

^ Brewer GJ. (2010). Copper toxicity in the general population. *Clin Neurophysiol.* 2010 Apr;121(4):459-60. doi:10.1016/j.clinph.2009.12.015 PMID 20071223

^ Jump up to: ^a ^b ^c ^d Casarett & Doull's Toxicology, The Basic Science of Poisons, Fifth Edition, Edited by Curtis D. Klassen, Ph.D., McGraw-Hill, New York. pp 715.

^ *Copper: Health Information Summary, Environmental Fact Sheet. New Hampshire Department of Environmental Services,ARD-EHP-9 2005,*

^ *Lenntech (2010).*

Jonathan Levy, Harvard School of Public Health. Based on information provided by the Environmental Protection Agency.

^ Landrigan, PJ (1990). "Critical assessment of epidemiologic studies on the human carcinogenicity of 1,3-butadiene". *Environmental Health Perspectives* 86: 143–147. PMC 1567758.

^ Zumdahl,Steven S Chemical principles 6th Ed. 2009).

^ *Chisholm, Hugh, ed. (1911). Encyclopædia Britannica, vol. 26. Encyclopædia Britannica. p. 1007.*

^ A new use for old tires:A garden using tires

^M Nehdi, A Khan, (2001). Cementitious Composites Containing Recycled Tire Rubber: An Overview of Engineering Properties and Potential Applications.

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