Hazards of Exposure to Petrol Products in Gasoline Filling Workers

By

Elanood Falih Elmotieri

Supervisor
Dr. Shazalia Mahmoud Ali

Department of Chemistry
College of Science and Humanities-Hawtat Sudair

Majmaah University
DEDICATION
TO
MY FAMILY
Acknowledgements

After thanking Allah, who made all things possible and granted me the power to finish this work, I would like to express my deep appreciation to my supervisor Dr. Shazalia Mahmoud Ali who gave me a chance to work with her, extended all facilities, sustained interest in me and provided inspiring guidance for the successful completion of my work. I ever remain grateful to her.

I would like to thank all who helped me during the course of my work and the preparation of this research in chemistry department and all staff of Majmaah University for their support and constant encouragement, most especially to the president of the university and the dean of the college and the Mawheba centre staff.
## Table of contents

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dedication</td>
<td>2</td>
</tr>
<tr>
<td>Acknowledgement</td>
<td>3</td>
</tr>
<tr>
<td>Table of contents</td>
<td>4</td>
</tr>
<tr>
<td>Abstract (English)</td>
<td>5</td>
</tr>
<tr>
<td>Abstract (Arabic)</td>
<td>6</td>
</tr>
<tr>
<td>Introduction</td>
<td>7</td>
</tr>
<tr>
<td>Definition of Petroleum (Crude oil)</td>
<td>7</td>
</tr>
<tr>
<td>Exposure to benzene</td>
<td>8</td>
</tr>
<tr>
<td>Effects of chronic exposure to benzene</td>
<td>9</td>
</tr>
<tr>
<td>Health problems associated with petrol</td>
<td>10</td>
</tr>
<tr>
<td>Toxicity of lead</td>
<td>11</td>
</tr>
<tr>
<td>Rationale</td>
<td>12</td>
</tr>
<tr>
<td>Objective of the study</td>
<td>12</td>
</tr>
<tr>
<td>Results and discussions</td>
<td>12</td>
</tr>
<tr>
<td>conclusion</td>
<td>15</td>
</tr>
<tr>
<td>Recommendations</td>
<td>15</td>
</tr>
<tr>
<td>References</td>
<td>17</td>
</tr>
</tbody>
</table>
Abstract

Petrol and its derivatives are of the most important sources of energy in the entire world and they have many benefits, but there are downsides due to the risk of contamination of the environment as a result of excessive use of energy. Fuel station workers have many health risks due to their long exposure to gasoline and benzene and the inhalation of the fuel smell for a long time lead to many respiratory problems.

In this research we have collected results of a number of studies conducted in this area in different countries of the world, these studies showed that exposed to petrol and its derivatives as benzene and gasoline leads to negative effects and causes many pectoral diseases such as chronic cough also leads to the lack of production of white blood cells and red blood cells also leads to increase in urea and creatine level in the blood serum and injury myeloid leukemia.

The risk of exposure to these chemicals with the longtime of exposure and if the ventilation is not good.

In these studies very sensitive devises were used to detect the health problems resulting from exposure to petrol and its derivatives.
المستخلص

البترول ومشتقاته من أهم وأكثر مصادر الطاقة المستخدمة في العالم ولها فوائد كثيرة حيث ابتك البشرية تعتمد عليها كمصدر أساسي للطاقة ولكن هناك سلبيات ناتجة من مخاطر تلوث البيئة نتيجة للاستخدام المفرط للطاقة.

يتعرض عمال محطات الوقود إلى مخاطر صحية ناتجة إلى تعرضهم لساعات طويلة للغازولين ويودي استنشاقهم رائحة الوقود إلى اصابتهم بأمراض صدرية ومشاكل في الجهاز التنفسي.

وقد جمعنا في هذا البحث نتائج عدد من الدراسات التي أجريت في هذا المجال في بلدان مختلفة من العالم وقد أظهرت هذه الدراسات أن التعرض للبترول ومشتقاته كالبنزين والغازولين يؤدي إلى أثر سلبي ويسبب العديد من الأمراض مثل السعال المزمن ومنص في انتاج كرومات الدم البيضاء والحمراء ويوثر على وظائف الرئة ووجد أيضا ارتفاع في مستوى البوريا والكرياتين في مصل الدم بل ويودي أيضا إلى الإصابة بسرطان الدم النخاعي.

ويزداد خطر التعرض لهذه الكيمياويات كلما زادت ساعات التعرض وأيضا يزداد خطرها إذا كانت التهوية غير جيدة.

استخدمت في هذه الدراسات اجهزة في غاية الدقة لتحديد الآثار الصحية الناتجة من التعرض للبترول ومشتقاته.
1. Introduction

Petrol (or gasoline) is a volatile and inflammable petroleum-derived liquid mixture primarily used for internal combustion of machines. \cite{1}

It consists of hydrocarbons (table 1) (aromatic, saturated and unsaturated) and non-hydrocarbons (N, S, O2, vanadium and nickel) (table 2). \cite{2}

The word Petroleum (Petra + Oleum) means Rock Oil. Petroleum is often called crude oil, fossil fuel or oil. It is called a fossil fuel because it was formed from the remains of tiny sea plants and animals that died millions of years ago. When the plants and animals died, they sank to the bottom of the oceans.\cite{3}

Here, they were buried by thousands of kms of sand and sediment, which turned into sedimentary rock. As the layers increased, they pressed harder and harder on the decayed remains at the bottom. The heat and pressure changed the remains and, eventually, petroleum was formed. \cite{4}

1.1 Definition of Petroleum (Crude oil)

Petroleum can be broadly defined as a complex mixture of hydrocarbons that occurs in the earth in liquid, gaseous, or solid forms. It is a naturally-occurring brown to black flammable liquid. Crude oils are principally found in oil reservoirs associated with sedimentary rocks beneath the earth’s surface. Crude oil as it is found in nature consists of complex mixtures of compounds containing hydrogen and carbon (hydrocarbons). In addition to the hydrocarbons, compounds of sulphur, nitrogen and oxygen are present in small amounts. Furthermore, there are usually traces of vanadium, nickel, chlorine and arsenic. These compounds are harmful unless they are removed from crude oil by refining. \cite{5}
Table (1) Percent of hydrocarbons

<table>
<thead>
<tr>
<th>hydrocarbon</th>
<th>average</th>
<th>range</th>
</tr>
</thead>
<tbody>
<tr>
<td>paraffins</td>
<td>30%</td>
<td>15-60%</td>
</tr>
<tr>
<td>naphthene</td>
<td>49%</td>
<td>30-60%</td>
</tr>
<tr>
<td>aromatics</td>
<td>15%</td>
<td>3-30%</td>
</tr>
<tr>
<td>asphaltics</td>
<td>6%</td>
<td>remainder</td>
</tr>
</tbody>
</table>

Table (2) Percent of elements

<table>
<thead>
<tr>
<th>element</th>
<th>Percent range</th>
</tr>
</thead>
<tbody>
<tr>
<td>carbon</td>
<td>83-87%</td>
</tr>
<tr>
<td>hydrogen</td>
<td>10-14%</td>
</tr>
<tr>
<td>nitrogen</td>
<td>0.1-2%</td>
</tr>
<tr>
<td>oxygen</td>
<td>0.05-1.5</td>
</tr>
<tr>
<td>sulfur</td>
<td>0.05-6%</td>
</tr>
<tr>
<td>metals</td>
<td>&lt;0.1%</td>
</tr>
</tbody>
</table>

1.2 Exposure to benzene
Human exposure to benzene has been associated with a range of acute and long-term adverse health effects and diseases, including cancer and aplastic anemia. Exposure can occur occupationally and domestically as a result of the ubiquitous use of benzene-containing petroleum products, including motor fuels and solvents. Active and passive exposure to tobacco smoke is also a significant source of exposure. Benzene is highly volatile, and exposure occurs mostly
through inhalation. Public health actions are needed to reduce the exposure of both workers and the general population to benzene. [6]

Certain peoples have a greater risk of exposure to gasoline vapors; these include filling-station workers, service station attendants, drivers of gasoline trucks and refinery workers. [3] The volatile nature of petrol products makes them readily available in the atmosphere any time it is dispensed, especially at petrol filling stations and depots. People are exposed to gasoline fumes during fuelling and refuelling at gas stations, but the filling station workers are more at risk by virtue of their occupational exposure. [4]

1.3 Effects of chronic exposure to benzene

Benzene is a well-established cause of cancer in humans. .. Benzene causes acute myeloid leukemia (acute non-lymphocytic leukemia), and there is limited evidence that benzene may also cause acute and chronic lymphocytic leukemia, non-Hodgkin's lymphoma and multiple myeloma. Individuals who have experienced benzene poisoning requiring treatment show a substantially increased risk of mortality from leukemia.

Chronic exposure to benzene can reduce the production of both red and white blood cells from bone marrow in humans, resulting in aplastic anemia. [7]

Chromosomal aberrations in human peripheral lymphocytes are associated with occupational exposure to benzene. Chromosomal aberrations, micronuclei, sister chromatid exchange and sperm head abnormalities have been seen in laboratory species treated in vivo. Chromosomal aberrations and mutations were seen in human cells in vitro and in laboratory animal cells in some in vitro studies.

Benzene is fetotoxic in mice and rabbits following maternal exposure by inhalation, causing a reduction in birth weight. It is not, however, teratogenic in experimental animals, even at maternally toxic doses. [8]
Numerous epidemiological studies have documented decrements in pulmonary function and various other health problems associated with long-term air pollution exposure. [9]

Health problems posed by the pollutants at the work environment of an individual are closely linked to the nature and level of exposure to these hazardous chemicals. It has been known for quite some time that air pollution from diesel exhaust is a major respiratory hazard for workers exposed to it in enclosed space. [10]

Diesel exhaust, in addition to generating pollutants like hydrocarbons, oxides of nitrogen and carbon is a major contributor to particulate matter in most places of the world. Symptoms like chronic cough, wheezing and breathlessness have been reported on exposure to these pollutants. [11]

At high ambient concentrations, well defined and marked systemic pulmonary inflammatory response is also observed. [12]

Various occupational exposures to petrol/diesel products have been shown to affect different systems of body. [13] Several animal studies have also demonstrated a consistent association between the air pollutants and the altered lung function. [14] Petrol pump workers (filling attendants) are continuously exposed to the organic and inorganic substances present in the petrol. The average daily exposure to these chemicals in India generally exceeds about 10 h/day. Some of them are working for more than ten years now. [15]

1.4 Health problems associated with petrol

Atmospheric concentration of gasoline vapor (approximately 2000 ppm) is not safe when inhaled even for a brief period of time (seconds). During fuelling of vehicles, the concentration of gasoline vapor in the air is between 20 and 200 ppm. Many of the harmful effects seen after exposure to gasoline are due to the individual chemicals in the gasoline mixture, such as benzene, lead and oxygenates. Breathing small amounts of gasoline vapors can lead to nose and throat irritation, headaches, dizziness, nausea, vomiting, confusion and breathing
difficulties. Some effects of skin contact with gasoline include rashes, redness, and swelling. Allergic reactions (hypersensitivity) have been reported but these are rare occurrences. Occupational diseases in gasoline-filling workers have been recognized for many years, and affect workers in different ways, such diseases are still problems in all parts of the world. \[^{[16]}\]

The numbers of such work-related diseases in developing countries are much higher in reality than the numbers that are reported. The numbers of cases and types of occupational diseases are increasing in both developing and industrialized countries. Hazards in the gasoline-filling stations can be found in a variety of forms, including chemical, physical, biological, psychological, and non-application of ergonomic principles, etc. Because of the multitude of hazards in such workplaces and the overall lack of attention given to health and safety by many employers, work-related accidents and diseases continue to be serious problems in all parts of the world. Although many types of petrol derivatives have delivered daily in Sulaimani petrol stations, gasoline and kerosene automobile fuels are the major derivatives of great concern regarding daily exposure. The present study was designed to on the plasma proteins profile and kidney function, with respect to the duration of exposure in gasoline-filling workers within Sulaimani city area. \[^{[17]}\]

### 1.5 Toxicity of lead

Lead is one of the oldest heavy metals; it is the most widely studied occupational and environmental toxin. Petrol contains heavy dangerous heavy metals as lead, Lead and its compounds are potentially toxic; its toxicity can cause aberrant function to multiple human organs. It inhibits many enzymes, including pyruvate dehydrogenase, and enzymes of the haem synthetic pathway. Blood lead is the most reliable index of exposure, because 90 percent of lead in blood is bound to red blood cells. The symptoms of acute lead poisoning include: abdominal pain, convulsions, hypertension, and renal dysfunction, loss of appetite, fatigue, sleeplessness,
hallucinations, headache, numbness, arthritis, and vertigo. Chronic exposure can result in birth defects, autism, psychosis, allergies, dyslexia, mental retardation, and paralysis. [18]

2. Rationale
Exposure to solvents like benzene can lead to deleterious effects on respiratory, hematological and thyroid functioning. Exposure to petroleum cause many health problems. The International Agency for Research on Cancer has classified benzene as carcinogenic to humans (Group 1); Diesel vapors can irritate eyes, nose, throat and lungs. Excessive short-term exposure can lead to dizziness, drowsiness, and loss of coordination, blood pressure elevation, headaches, nausea, asphyxiation and lung damage. Breathing diesel vapors for long periods of time can cause kidney damage and reduce the clotting ability of blood. Diesel fuel can irritate the skin and aggravate any existing skin condition. A large skin exposure can lead to severe redness, pain and chemical burn blisters. If the fuel is not cleaned from the skin quickly, it is absorbed into the blood stream where it can cause symptoms identical to inhalation exposure. There was evidence of increased risk for lung cancer in men estimated to have had substantial exposure to diesel fuel. There was also an indication of an increased risk for cancer of the prostate in these workers. Bus drivers and garage mechanics may be routinely exposed to diesel fuel. There has been too little research on the long-term, chronic effects of this type of exposure. Every effort, therefore, should be made to reduce or eliminate exposure. [19]

3. Objective of the study
The objective of this study is to investigate whether exposure to petrol in petrol filling workers has adverse effect on their health.

4. Results and discussion
In 2006 Mayank Singhal et al assessed the pulmonary functions in petrol pump workers (filling attendants) who are continuously exposed to petrol/diesel vapors during duty hours; the study was carried out in India. Thirty healthy non-smoker males working in petrol pump for more than one year formed the study group, while thirty healthy non-smoker males from hospital staff served as control group. The pulmonary functions were assessed using computerized spirometer. They found that most of the parameters were decreased significantly in petrol pump workers as compared to controls. Both the inspiratory and expiratory flow rates were also decreased in the study group.[20]

In 2013 Naza et al investigated the changes in plasma proteins profile and renal function (serum levels of urea and creatinine) in benzene filling workers the study was done in Kordestan. The study include screening plasma protein profile and renal function in 74 male petrol-filling workers and compares them with corresponding values in 27 sex- and age-matched controls using spectrophotometry and electrophoresis method respectively. They found that Plasma albumin was significantly elevated and gamma-globulin was significantly decreased in workers. Meanwhile, serum urea and creatinine levels were significantly elevated. No correlation with exposure time was reported. They concluded that Gasoline-filling workers do not show marked changes in most of plasma proteins, they demonstrate a decrease in gamma globulin levels and biochemical evidence of impaired renal function, which were not positively correlated with the duration of exposure. [21]

In 2014 Tiwari Seema studied blood lead level (BLL) among petrol pump workers of the Bhopal city BLL was determined experimentally by taking the blood sample of 26 peoples with a varying age group from 18 years to 66 years. It was observed that BLL was on the higher side for the peoples working in the petrol pumps. The effects of different factors on the estimated BLL of individuals in the present investigation have been comprehended and are
elucidated in terms of descriptive statistics such as means and standard errors including lower and upper bound 95% confidence intervals (CI). \[22\]

IN 1996 Hardman et al studied the intoxication with leaded gasoline regardless of exposure pathway. In the occupational setting lead poisoning remains one of the most important occupational and environmental health problems. Major symptoms of intoxication with leaded gasoline. The victims suffer from Insomnia, nightmares, anorexia, nausea & vomiting, diarrhea, headache, muscular weakness and emotional instability. With continued exposure, CNS manifestations progress to delusion, ataxia, exaggerated muscular movements and finally a maniacal state. In the case of severe exposure death may occur within a few hours or may be delayed for several weeks. \[23\]

In 2010 Laith Abdulmajeed determined the level of lead in blood of fuel station workers and in a group of people not occupationally exposed to lead. 53 control subjects with low risk lead exposure and 45 fuel station workers comprising the study group were included in this study in a period from September 2008 to December 2009. Blood samples were collected and analyzed for each subject by Lead Care Blood Testing System. The average blood lead levels of each group were compared using the independent sample (Mann – Whitney U) test. They found that The median (range) 14.1 (7.5–56) µg/dl concentration of lead in the blood of fuel stations workers was significantly higher than the median (range) 6.5 (4.0–1.6) µg/dl concentration of lead in the blood of the control group \(p<0.001\). The results obtained also showed that the values of blood lead levels in many workers were higher than action and upper limits acceptable for adults. In fuel station workers, the duration of exposure to leaded fuel was significantly correlated with the blood lead level; they concluded that Occupational exposure to lead is prevalent among many fuel station workers in Basrah. A policy action to improve working conditions and to phase out the use of leaded gasoline is recommended. \[24\]
In 2012 Sadiqa et al assessed the Pulmonary Function Tests (PFT) in petrol filling workers in Mysore city. Twenty-eight nonsmoker males in the age group of 18–30 year working in petrol filling station as petrol filling workers for more than 2 years formed the study group. Age and sex matched individuals not exposed to fuel vapour served the control group. Pulmonary function parameters FEV1, FVC, PEFR, MVV, and FEV1/FVC were assessed using computerized Spirometer during their working hours and were statistically analyzed. They discovered that there was a statistically significant decrease in FEV1 and FVC in study group compared to control group with normal FEV1%. The decrease in PEFR, and MVV was statistically non-significant. They concluded that the above findings point towards adverse effects of petroleum vapours on lung function, mainly on lower airways with restrictive pattern of disease.\textsuperscript{[25]}

Tayrab, et al conducted a study between the period from November 2013 and March 2014. The aim of their study to determine the levels of lead in blood of 50 Sudanese males employed in fuel stations in Khartoum city with mean age (30.1±1.4yrs), and 42 non exposed healthy men as control with mean age (28.0±1.3yrs). Flameless atomic absorption was used for blood lead measurement. The study showed that the mean blood lead the fuel station workers was (33.6±2.2μg/dl; range: 10.5–97.5μg/dl), while in the non-exposed healthy control men was (8.1±0.31μg/dl; range: 5.0–14.1μg/dl). Blood lead is significantly elevated in the fuel stations workers in Khartoum City (P value = 0.000), they concluded that Fuel pump filling workers are at risk of lead exposure toxicity and its health complications and recommended a policy action to improve working conditions and to phase out the problem of the lead in fuel stations.\textsuperscript{[26]}

5. Conclusion

Long-term occupational exposure to petrol products have been reported to have toxic effects on various organs and systems.
Acute exposure to petrol lead to lead pollution, also affect the nature of pulmonary, it lead to decrease the respiratory and inspiratory flow rate and it has adverse effects on lung function, it will lead to decrease in gamma globulin levels which is a biochemical evidence of impaired renal function

6. Recommendations

As it is clearly from the above results that the irregular use of petrol and it is products is very harmful we recommended to reduce the long exposure to petrol and its derivatives at petrol filling stations as far as possible by following best practices in location, design and extraction, to minimize emissions from vehicle exhausts by improved design and regular monitoring of engine settings. Also the dwelling spaces should be separated from areas where vehicles and benzene-containing products are kept. In particular, isolate children from indoor exposure to vehicle emissions also to avoid domestic use of benzene-containing products. Raising public awareness regarding sources of exposure to petrol and its derivatives measures, conducting educational activities to discourage the use of benzene or petrol for cleaning and degreasing in industry and domestically.
References


