GASOLINE AS A KEY SOURCE OF LEAD IN THE ATMOSPHERE

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1.0 Introduction

1.1 Petroleum refining yields various petroleum products such as LPG, gasoline (petrol), kerosene, fuel oils, lubricating oils, asphalt etc. In ordinary refining about 45 percent of the product yield is gasoline and it is about the most important petroleum product used worldwide for transportation. To obtain maximum performance from gasoline, it is imperative to increase its octane rating. This rating is a measure of gasoline's combustion stability or its ability to burn in an automobile engine without knocking (sharp metallic noise caused by uncontrolled burning of gasoline) and high-octane gasoline has better anti-knock properties than lower ones.

1.0.2 In the 1920s the oil industry discovered an inexpensive way of obtaining higher octane by blending tetraethyl lead (TEL) into gasoline. It was latter discovered that newer model cars do not require high octane for smooth engine performance. This is because according to the American Motor Vehicles Manufacturers Association, about 90 percent of all cars manufactured since 1982 do not require high-octane gasoline. Only cars with high compression engines require premium grades of gasoline (94), while the rest are designed to use regular fuels with standard octane number (87). The petroleum refinery companies have however been marketing high-octane gasoline under the banner of premium or super grade fuels. For example, a 1992 Report titled "Fueling the Public" revealed that oil companies dupe motorists of billions of dollars at gasoline pumps each year, through advertising high-octane gasoline, which most cars do not need. In most cases, high-octane gasoline is not only unnecessary, it is also wasteful because the production of high octane, unleaded gasoline requires more complex and energy intensive refinery processing which contributes little or nothing to the end-product. As one oil industry executive said in 1988, "Octane demand is a situation forced on users as a marketing advantage over competitors because

the major companies have installed so much octane equipment." TEL is the most environmentally dangerous application of lead, with 70-80 percent of the lead added to gasoline being emitted as fine particulate aerosol in vehicular exhaust fumes. Thus, the addition of TEL to gasoline introduces lethal pollutants into the environment in the form of aerosols containing particulate lead and unburnt hydrocarbons.

2.0 Genesis of Lead Free Environment Campaign

2.1 Due to public outcry in the early 1970s over environmental pollution caused by heavy metals such as lead, cadmium, mercury etc, efforts were then initiated to reduce the use of TEL in gasoline. Regulatory measures accompanied by stringent penalties were introduced in some countries to limit the amount of TEL admissible in gasoline with the ultimate aim of discouraging its use completely. Lead was banned in gasoline in the United States under the Clean Air Act of 1970, and was eventually phased out.

2.2 In order to replace lead as an octane booster, the U. S. oil refiners chose a class of aromatic hydrocarbons- principally Benzene, Toluene, Ethylbenzene and Xylene, known as the BTEX group. With BTEX aromatics, octane levels were greatly boosted, but these substances were soon indicted for their own contribution to environmental and public health dangers. BTEX are naturally occurring in crude oil at various low levels, but by altering the refining processes and product steams, BTEX levels in gasoline was raised significantly. In the 1970s and 1980s, the oil industry invested heavily on BTEX making capability. By 1990, BTEX comprised 35 percent by volume of all gasoline sold in the United States. Some premium grades contain as much as 45 percent. As BTEX levels rose in high-octane gasoline during the 1980s, so did air pollution.

2.3 The United States EPA then found that benzene concentrations were 14 times higher in city air than in rural air and this could be linked directly to aromatics in gasoline. It should however be recanted that in the 1970s, when the aromatics were introduced, safer alternatives could have been developed. As Lead was being phased out during the 1970s and 1980s, the companies could have chosen cleaner alternatives such as Alcohol and Ethers (oxygenated

hydrocarbons). Aromatics were however chosen because they could be manufactured in refineries and thus under the control of refiners.

2.4 On the other hand, alcohol production was not under their control, and large-scale production would have required investments outside of the oil industry. The refiners clearly had the technology to produce cleaner fuels and this was made clear in 1989 when the industry was threatened with alternative fuels legislation in the United States. Within six months to the implementation of the Clean Air Legislation (which called for developing alternative fuels), some companies had already introduced a less polluting substitute called "Emission Control – 1". This brand of gasoline contained Methyl Tertiary Butyl Ether (MTBE) and cuts gasoline's aromatic content by more than 33 percent.

3.0 The Global Phase-out Initiative

3.1 In 1994, the United Nation's Commission on Sustainable Development (CSD) called upon governments of the world to eliminate lead from gasoline. This call set in motion efforts by international agencies such as the World Bank to assist nations to take actions to phase out this principal source of lead pollution, which is lead in gasoline. Many governments responded to the initiative and by the end of 1999, 36 countries including Argentina, Austria, Brazil, Canada, Denmark, United States etc. have completely phased out lead in gasoline. Between 2000 and 2005, another 19 countries are expected to join the club of complete lead phase-out, as most have made substantial efforts towards this regard. Notable countries among these are Belgium, Portugal, India, The United Kingdom, France, China, Switzerland, Italy, India, Poland etc.

3.2 Currently, about 85 percent of all gasoline sold in the world is unleaded. This leaves only about 15 percent leaded fuel sold and used mainly in Africa, parts of Asia and eastern Europe. In many of these countries, there is still a poor understanding of the risk of lead exposure and confusion about the technical difficulty of eliminating leaded gasoline.

3.3 The larger countries especially those with high gasoline consumption are the major targets of the CSD initiative for lead in gasoline phase-out. Countries so targeted include Nigeria,

South Africa, Venezuela, Turkey, Israel, Indonesia etc. The World Bank launched the Clean Air Initiative in Sub-Saharan African cities in 1998 in line with its worldwide Clean Air Initiative. I believe this workshop is a follow-up on the one held in June 2001 and a continuation of the campaign to make Nigeria and other sub-Saharan countries lead-free compliant. This campaign is worthy and demands the support of all stakeholders.

3.0 The Nigerian Refineries and Lead Pollution in Nigeria

3.1 TEL is still used as an octane enhancer in Nigerian gasoline, and this is a matter of serious concern that this practice has continued till today since 1965 when the first refinery was constructed in Nigeria. In 1985, it was reported that about 3,326 tonnes of TEL or 2,128 tonnes of lead was added to the Nigerian produced gasoline. If 75 percent of this lead volume is released into the environment in form of exhaust fumes, it meant that in 1985, a minimum of 1,600 tonnes of lead was dumped into the Nigerian atmosphere. The current national requirement of gasoline in Nigeria is estimated at 25 million litres per day. This demand can be met by the four local refineries with a daily refining capacity of 445,000 barrels of crude oil. However, technical and managerial problems have conspired to limit the production outputs from these refineries, hence the resort to massive importation of the shortfall.

3.2 The current lead limit in gasoline sold in Nigeria is 0.7g Pb/l. However, the lead level in the Nigerian produced gasoline averages about 0.25g Pb/l. With a national consumption of 25 million litres and a 75 percent emission rate of lead as lead particulate, it could be deduced that up to 5 tonnes per day or 1,800 tonnes of lead per annum would be unleashed into the Nigerian environment in 2002. Thus, over the seventeen-year period spanning 1985 - 2002, a total of about 30,000 tonnes of lead has been unleashed into the Nigerian environment. The environmental and health implication of this level of lead pollution is enormous. It is ironic that three of the country's refineries were designed as lead-free refineries as they were equipped with Fluid Catalytic Cracking and Reforming Units, which are high-octane producers, and which eliminated the need for TEL. Unfortunately, they resort to TEL each time the Fluid Catalytic Cracking and Reforming Unit breaks down, and this scenario seems to be the rule instead of the exception. To

reduce the level of lead in the Nigerian environment, the options proposed include changing to other less toxic anti knock additives, or strive through operational adaptations to meet national gasoline octane requirements without adding any octane number improvers.

3.3 Ambient air quality has been of particular concern especially in densely populated urban areas because of the concentration of vehicular and industrial pollution. In the United States, the EPA has set National Ambient Air Quality Standards (NAAQS) for six pollutants, namely carbon monoxide, lead, nitrogen dioxide, ozone, particulate matter and sulfur dioxide. Significant progress has been made over the past 20 years in reducing the concentration of these pollutants in the atmosphere.

3.4 The air quality over Nigerian cities is abnormally high due to the presence of large numbers of industrial concerns operating with minimal regards for the environment. Equally, the large number of old and poorly maintained vehicles on the streets compound this problem. Lead pollution in Nigerian cities can be computed from

- The total quantity of gasoline consumed
- The maximum lead content of the gasoline sold

These two quantities when multiplied will give the leaded gasoline emission. The value of exposure to lead is obtained by dividing the leaded gas emission by the population density.

3.5 Lagos, the commercial capital of Nigeria has a population of about 12 million people and harbours about 60 percent of all industrial and commercial activities in the country. About 60 percent of all new vehicle registration in Nigeria are also in Lagos (Table 1). Therefore, over 500,000 cars, buses and trucks daily clog the less than 3,000 kilometers of road network in Lagos. Also accounting for about 60 percent of the total fuel consumption in Nigeria, the daily lead injection into the Lagos environment amounts to about 3 tonnes. This is considered high for the small land area occupied by the city. A lot of activities like street trading, hawking and open market stalls expose a large population of Lagos citizen especially children to the deleterious effects of lead pollution.

Table 1

Registered Vehicles in Nigeria, 1986 – 1995

Year	No of Vehicles registered
1986	58,595
1987	40,165
1988	21,079
1989	7,925
1990	9,303
1991	37,134
1992	48,667
1993	78,716
1994	57,883
1995	57,471

Source: Annual Abstract of Statistics 1996

4.0 Other Sources of Lead Pollution in Nigeria

4.1 Because lead is cheap and useful, it has very many useful applications in both industrial and consumer products. The main sources of lead pollution in Nigeria besides gasoline include:

- Lead Mining and Smelting
- Paints
- Piping, fixtures and solder
- Lead-based battery
- Hobbies and Recreational Activities that use lead

Therefore, the main sources of human exposure to lead poisoning are through man-made processes and products. Though the amount of lead pollution from leaded gasoline in Nigeria has been quantified with some level of accuracy, the contributions from these other sources are still subject of speculation. This problem needs to be resolved quickly if a holistic approach to the complete elimination of lead in the Nigerian environment is to achieved. Nevertheless, the contribution of lead in gasoline dwarfs those from the other identified sources. Globally, the use of lead as TEL in gasoline is not the most predominant use of lead, it accounts for between 80-90 percent of all environmental lead. In Nigeria, with its small industrial sector, it is estimated that TEL will contribute no less than 95 percent of lead pollution. Therefore, if the problem of TEL is solved, most of the problems associated with lead pollution in Nigeria will be solved.

4.2 Due to concerns about the health impacts of lead on human health, many uses of lead in those applications have been prohibited or restricted in many countries. In Nigeria however due

to the very low level of environmental awareness, these lead generating processes and products continue to be used and patronised even by governments and their agencies.

5.0 Conclusion

Lead is an extremely toxic substance and medical evidence has demonstrated that even at low exposure levels lead accumulation in the body causes disturbances in the mental development of children, resulting in behavioral and learning problems. It causes elevated blood pressure in adults, resulting in hypertension and cardiovascular problems and even death in extreme cases of exposure. Many countries in Africa still use leaded gasoline, even though lead exposure has significant health consequences. The phase-out of lead-based gasoline has been widely recognized as technically feasible in Nigeria with minimal investments. This was accompanied by a statement by the Nigerian National Petroleum Corporation (NNPC) which gave December 2002 as the year for complete lead phase out in Nigerian gasoline, while 2005 was set as the phase out date for the Sub-Saharan region. These actions will effectively reduce ambient environmental lead concentrations and human exposures in the region and make us a model for the other regions.

We at Friends of the Environment will like to emphasize that we are in total support of this World Bank initiative, which is in tandem with one of our objectives. This is because as early as 1997, we organized a National Workshop on Vehicular Emissions and Lead Poisoning in Nigeria. The major objective of that workshop was to draw attention of government and other stakeholders to the increasing dangers posed by increasing lead pollution in Nigeria. We are glad to note that some of the policy makers who attended that workshop are here today and have been working hard to eliminate this potential danger in the Nigerian environment. We offer our support to all stakeholders working on this venture and state that through advocacy, we intend to hold the NNPC to its promise of December 2002, which is barely 8 months away.

Finally, we will like to reemphasize the need for collaborative efforts between Government and other stakeholders but especially the Non-governmental organizations, the Media, Labour (NUPENG tanker drivers, petrol dealers and attendants, road transport workers) etc. This inclusive policy and public-private partnership is required if the campaign for the phase-out of lead in gasoline is to succeed.

Thank You.

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