

The Environmental Impact of Leaded Gasoline in Venezuela

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The continued sale of only leaded gasoline in Venezuela by the state-owned petroleum company (PDVSA) has caused significant adverse health effects for a large segment of society. Despite producing and exporting unleaded gasoline, PDVSA imports lead additives. Although the Venezuelan government has pledged to offer unleaded gasoline for its internal market, this will not occur in the foreseeable future and both the economic and health costs are likely to be large.

Many state-owned corporations in developing countries, such as those dealing with oil, petrochemicals, mining, water management, and forestry, operate in sectors of high environmental impact, even when sensibly managed. Irresponsible environmental policies within these industries may ultimately result in social and economic problems and hinder sustainable development. The oil industry in Venezuela provides a case study of the environmental problems generated by a 100% state-owned corporation, *Petróleos de Venezuela, S.A. (PDVSA)*. Oil is Venezuela's main industry, and since 1976, when the industry was nationalized, PDVSA has maintained a monopoly and is the only provider of gasoline for consumption in Venezuela. Despite possessing technologies to eliminate the use of lead in gasoline, PDVSA has not adopted such methods for the gasoline it sells within that country. In fact, unleaded gasoline and additives are exported, and only leaded gasoline is available to Venezuelan consumers (Romero & Prato, 1993). The focus of this examination will be the harmful effects of lead pollution generated by the combustion of leaded gasoline.

Lead tetraethyl was introduced as an additive for gasoline in 1923 to eliminate the ping or knock of four-stroke motors. However, its adverse health effects were not adequately appreciated (Reich, 1992). Not until 1968 did researchers find that methyl tertiary butyl ether (MTBE) is a useful substitute for tetraethyl lead that avoids introducing lead into the atmosphere (Schmidheiny, 1992). Most countries are moving toward

using MTBE and similar additives to produce only unleaded gasoline. Indeed, in December 1994 at the Summit of the Americas, Central American leaders pledged to eliminate the use of leaded gasoline and most other Latin American countries are moving in that direction (Finkelman, 1996; Howson, Hernández-Avila, & Rall, 1996). Yet Venezuela seems to provide a counter example: Lead pollution is widespread and severe, and despite the importance of eliminating the production and sale of leaded gasoline, the Venezuelan government has yet to take effective measures to that end (Romero, 1992).

Lead Pollution in Venezuela

Venezuela has the highest number of automobiles per capita in Latin America (one vehicle for every 6.71 people) and low fuel prices (averaging about U.S. \$0.05 per liter in 1995) (Romero and Prato, 1993; A. Romero Sr., personal communication, April, 1996). The large and increasing number of vehicles in circulation and the low price of fuel has resulted in a drastic increase in the consumption of gasoline in recent years. Despite the decline in the amount of tetraethyl lead used per liter, overall there is an increase in the amount of lead emitted in the atmosphere (Finkelman, 1996). Although lead is not the only contributor to lead exposure (water pipes, lead paint, and industrial smelters are minor sources), it represents 85% of the lead pollution sources in Venezuela. For the 1986 to 1991 period, lead concentrations in the air of major cities in Venezuela exceeded the United States standard in Caracas, as well as in five other cities (University of Carabobo, 1992) (see Table 1). Beginning in April 1992, minimum permissible levels of particulate lead in the air were established in Venezuela. Nevertheless, because the lead content in gasoline has not changed and automobile use has increased, it is likely that the lead pollution problem has worsened in the last few years.

Lead in the air typically finds its way into people's blood and can lead to serious and costly adverse effects (Schwartz, 1994). In 1983, the first study of lead in blood in Venezuela showed an average of 15 micrograms per deciliter ($\mu\text{g}/\text{dl}$) for residents of Caracas and 12 $\mu\text{g}/\text{dl}$ for people in Valencia (University of Carabobo, 1987), well above the standard of 10 $\mu\text{g}/\text{dl}$ set by the U.S. Centers for Disease Control (1991). In 1991, blood lead levels were the same or slightly higher, suggesting that the lead pollution problem worsened between 1983 and 1991. These blood level data are based on samples taken from Venezuelans more than 12 years old, but lead pollution is likely to affect all age groups. For example, a study in Maracay in 1991 found that 62.75% of newborns had blood lead levels greater than 10 $\mu\text{g}/\text{dl}$ (Feo, 1991). Assuming the persons sampled are representative of the general population, then roughly three fourths of Venezuelans living in cities (nearly 14 million people) have blood

Table 1
Levels of Lead in the Air and in the Blood of Inhabitants of Large Venezuelan Cities in 1991.

City	Population	Average Lead in Air ($\mu\text{g}/\text{m}^3$)	Average Lead in Blood ($\mu\text{g}/\text{dl}$)	Sample Size	Percentage of Sample $>10\mu\text{g}/\text{dl}$	Percentage of Sample $>20\mu\text{g}/\text{dl}$
Barquisimeto	745,444	0.8	16.3	150	94.63	22.82
Caracas	2,784,042	1.3	15.6	500	87.58	19.70
Maracaibo	1,363,863	2.3	18.5	150	89.26	35.57
Maracay	799,884	1.8	16.7	150	94.70	24.50
Puerto La Cruz	429,072	1.0	12.3	150	72.08	27.92
Puerto Ordaz	455,860	1.0	10.9	150	45.72	4.72
San Cristóbal	336,100	n.a.	19.6	150	100.00	n.a.
Valencia	1,031,041	1.2	16.7	150	84.17	20.86

Note: The data are summarized from a confidential study by the Universidad de Carabobo [University of Carabobo] (1992). The contents of the study were published in Romero & Prato (1993), which is available from several academic libraries as well as from the author.

levels above the U.S. standard. Of course, not all lead exposure can be attributed to motor vehicles. Detailed modeling is required to determine the outcome of eliminating leaded gasoline; nevertheless it is not unreasonable to assume, based on the experience in the United States (Schwartz, 1994), that there will be a substantial reduction in blood lead levels following the elimination of leaded gasoline.

Symptoms of high blood lead levels include weakness, anemia, low performance in work or school, memory loss, irritability, and lack of coordination (U.S. Centers for Disease Control, 1991). All of these symptoms can be attributed erroneously to other causes, which may cause the problem to be misdiagnosed. The cost of effective medical treatment for the millions of Venezuelans affected by high blood lead levels is substantial, as is the value of lost productivity and reduced cognitive ability. On the other hand, eliminating the use of tetraethyl lead will likely raise the cost of gasoline production. Although a formal benefit-cost analysis has not been performed for Venezuela, studies for the United States suggest that the benefits of eliminating leaded gasoline in Venezuela would far exceed the costs (Reich, 1992; Schwartz, 1994).

Discussion and Summary

Why is leaded gasoline still used in Venezuela? Unleaded gasoline and MTBE are both produced in Venezuela, whereas tetraethyl lead must be imported. Although PDVSA has never publicly acknowledged it, officials of that corporation who spoke to me on condition of anonymity have confirmed that PDVSA is contractually obligated to export all the MTBE it produces. It is difficult to understand why PDVSA would have entered into a contract with a clause making Venezuela dependent on leaded gasoline.¹ However, it is interesting to note that former high-ranking PDVSA officials have acknowledged on a recently televised Venezuelan program that they were acting as consultants for the companies that sell lead additives to Venezuela.²

Eliminating tetraethyl lead should cause a significant decline in air and blood lead levels; the benefits of such an action are substantial and almost certainly exceed any associated costs. However, reliable sources of the Venezuelan oil industry have confirmed that all MTBE production is committed to international markets until the year 2000. Until that year, PDVSA will sell only leaded gasoline in Venezuela; unfortunately, the costs of doing so will continue to build.

1. Cars manufactured in the United States, Western Europe, and Japan (the only three sources for imported cars in Venezuela) are designed to use only unleaded gasoline, and must have their catalytic converters removed upon arrival in Venezuela.

2. A copy of the video, *Contaminación por plomo* [Lead contamination], is available from the author upon request.

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