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The Introduction of Unleaded Gasoline to Thailand

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The introduction of unleaded gasoline into the motor vehicle and mass transport scene in Bangkok and several other major Thai cities is an important step forward in combating our ever-growing problems of air pollution and its threat to our national environment and the very health of our citizens.

It should be emphasized from the start, however, that the introduction of unleaded gasoline is by no means a panacea. It is a step forward, but only a step and much more needs to be done. In this article I shall try to explain why this is so.

As noted in a 1990 TDRI Year-End Conference report (publication code: Y90J), urban Thailand now exhibits the vehicle-based air pollution problems typical of all large industrial areas the world over. In 1990, according to a Japan International Cooperation Agency (JICA) report, the number of motor vehicles in the Bangkok Metropolitan Region (BMR) totaled 1.9 million. Motorcycles accounted for 39.8 percent of this figure; private passenger cars, 35.8 percent; and pickup trucks, 21.7 percent. Buses accounted for only 1.2 percent, whereas taxis and tuk-tuks (motorized tricycles) accounted for only 1 and 0.5 percent, respectively.

The existence of such large numbers of private passenger cars and motorcycles in the BMR clearly indicates these as the major gasoline consumers in the BMR's overall transport fuel demand. Typically, private passenger cars and motorcycles run on gasoline, whereas nearly all taxis and tuk-tuks run on liquefied petroleum gas (LPG). Buses and pickups normally use diesel fuel. Table 1 shows the breakdown of transport fuels in the BMR by kind of fuel and by vehicle type. In 1989 gasoline accounted for 45 percent of the total transport fuel demand in the BMR, while the share for diesel and LPG were 47 and 8 percent, respectively.

EXTENT OF THE PROBLEM

The high quantity of gasoline and diesel fuel emissions in the BMR area poses serious health risks for those living in or frequently traveling through its high-traffic-density areas.

Primary air pollutants that can damage the health of city dwellers include carbon monoxide (CO), suspended particulate matters (SPM), non-methane hydrocarbons (HC), acid aerosols (SO_2 and NO_x emissions) and lead. Table 2 specifies the quantity of these emissions in the BMR in 1989. Over a million tons of the CO emissions come mainly from gasoline engines in passenger cars and motorcycles. Other emissions, also mainly from gasoline, are non-methane hydrocarbons (0.295 million tons) and lead (500 tons). These emissions have reached a level definitely detrimental to public health. Periodic monitoring reports by the National Environment Board (NEB) on Bangkok's ambient air quality during 1985-1989 clearly indicate that SPM and CO levels have reached or exceeded NEB standards in many of its monitoring stations.

The levels of HC and lead have also reached an alarming point in many city locations. Prolonged exposure to these substances is damaging to human health. CO can cause an extended loss in the capability of the blood to fully transport oxygen to critical body tissue, resulting in headaches, dizziness and even death by asphyxiation. HC (non-methane) emissions such as benzene are highly toxic carcinogenic organic compounds. SPM can irritate the eyes and the respiratory system. It can also absorb other toxic organic compounds that are equally hazardous to health. Lead is a toxin causing retarded child development. It can

also cause high blood pressure and affect both the nervous system and the kidneys.

TDRI's study shows that 27 percent of NO_x emissions, 93 percent of HC and 96 percent of CO generated by the BMR transportation sector come from the use of gasoline. Literally all the lead emission comes from the gasoline used in cars and motorcycles. Most of the SO_2 and SPM emissions come from diesel fuel. Thus the use of gasoline has been significantly detrimental to the BMR environment. This problem has been aggravated, particularly over the last few years, through ever greater gasoline consumption, deteriorating traffic conditions and, even more importantly, the lack of proper environmental measures to control gasoline production and use.

MAIN CAUSES OF THE PROBLEM

First, until recently, gasoline sold in Thailand contained relatively high levels of lead. The maximum amount of lead currently allowed in gasoline is 0.4 gram per liter. Gasoline sold in North America and Japan, however, is lead free. Unleaded gasoline is also widely used in the EC countries and in Australia and New Zealand (CONCAWE Report No. 2/90). The EC limit for lead in leaded gasoline is now set at no higher than 0.15 gram per liter. The schedule for the introduction of low-leaded and unleaded gasoline in Thailand has only now been established.

Second, the high level of CO in Bangkok is also due to poorly tuned engines and poor automotive maintenance generally. Although annual car inspections are officially required by law, this regulation is seldom enforced because of the lack of manpower in the government agencies concerned.

Third, poor city planning and the absence of a good mass transit system have led to more and more private passenger vehicles using the same inadequate road system, leading to increasingly severe traffic jams. Reduced average traffic speed in turn has exacerbated air pollution problems as the level of CO is significantly higher under "stop and start" conditions as compared to free-flowing traffic.

Fourth, vehicles in Thailand do not presently require equipment to control tailpipe or other emissions. A three-way catalytic convertor, widely used in other countries, can effectively reduce the levels of HC, CO and NO_x from gasoline engine cars. However, unleaded gasoline has to be available before the use of such pollution-reducing convertors is possible, much less made mandatory. The presence of lead in gasoline would permanently damage this equipment.

Fifth, Bangkok has over one million motorcycles, about 90 percent of which have two-stroke engines. Motorcycles with two-stroke engines emit twice as much the amount of HC and SPM as do four-stroke types, thus furthering worsening pollution.

Finally, the city lacks a continuous and detailed ambient air quality monitoring system that accurately records changes in the environmental conditions resulting from worsening traffic problems.

Many environmental problems, therefore, are inextricably associated with the transportation sector. To improve the air quality of the city and its environs, all aspects of these problems must be addressed, preferably with urgency. Emissions from the industrial sector must also be dealt with. As a first step toward seriously controlling such unhealthy emissions, the government has now set a timetable for lowering the lead level in gasoline: first, the maximum lead level in gasoline must be lowered to 0.15 gram per liter by 1 January 1992; unleaded premium gasoline—95 RON (Research Octane Number)—must be made available by oil companies by 1 January 1993; all car manufacturers are required to install catalytic convertors on all new cars to be sold after 1 September 1993 (see Table 3). Any oil companies wishing to introduce unleaded or low-leaded gasoline prior to the specified date can, of course, do so and are so encouraged. Several major oil companies, in fact, started selling unleaded premium gasoline as early as the beginning of May 1991.

ABOUT UNLEADED GASOLINE

One of the most important specifications of gasoline is its octane rating, or "anti-knock," ability. A car using too-low octane will experience such a "knocking" as a result of the spontaneous combustion of unignited gas in the combustion chamber. As a general rule, the appropriate level, or octane number, for a particular car depends on its compression ratio. Cars with high compression ratios require gasoline with a higher rate of octane. Cars with a compression ratio of 7.5, for example, normally require 88 RON, while those having a compression ratio of 9 require 98 RON gasoline (Shell Science and Technology 1989).[1] Straight-run gasoline from primary distillation processes, however, has very low octane and should be raised to the required level by using one of two methods:

First, the octane level can be hiked by using complex refining processes such as catalytic reforming, catalytic cracking, and polymerization, among others. Second, the octane can also be raised by using "additives" to supplement the gasoline upgrading process.

Lead, in the form of tetraethyl or tetramethyl, is a low-cost and effective additive that raises octane levels. Since its discovery in the 1920s, its use has been widespread.

Environmental problems resulting from the use of lead during the past decade, however, have forced refiners to find other kinds of additives. Common nonlead additives currently in use are alcohols (ethanol, methanol and TBA) and ethers (MTBE). These additives are also called oxygenates because they contain oxygen (methanol is 50 percent oxygen by weight) . There is a limit to the use of oxygenates in gasoline, however, as the presence of oxygen in gasoline alters the fuel/air mixture. Also, some oxygenates, such as methanol, are corrosive. More importantly, they are more expensive than lead. Increasing the octane number from 91 RON to 93 RON, for example, raises the production cost by 0.031 baht/liter using lead; 0.27 baht/liter using MTBE; and 0.58 baht/liter using ethanol (Preeyaporn no date). Finally, there is a limited global supply of both MTBE and TBA.

Because of these limitations, the use of oxygenates will not be extensive in the future. In the long run, refiners will probably choose to upgrade their refining processes to increase gasoline octane (CONCAWE Report No. 11/83R).

THE USE OF UNLEADED GASOLINE

A recent survey by Shell indicated that about 87 percent of passenger cars produced in Thailand during the past 10 years could use unleaded gasoline all the time. These were mostly Japanese-made cars, plus several models of European cars. As for the remaining cars whose engine valve seats were not hardened, they could also run on unleaded gasoline, provided leaded grade was used for every fourth or fifth fill (Shell Science and Technology 1989).

PRICING OF UNLEADED GASOLINE

Unleaded gasoline costs 0.7 baht/liter more to produce than leaded premium grade. The government, however, has subsidized unleaded gasoline during the introduction period to encourage its use. The lower Oil Fund levy imposed on unleaded gasoline has made the fuel 0.3 baht/liter cheaper than the leaded grade (see Table 4). This policy appears to have been effective, as the share of unleaded premium has soared to 30 percent of total premium gasoline sales only 30 days after its introduction!

FUTURE POLICY MEASURES

Removing lead from gasoline should be seen as only the first step on the long path toward clean air. The government should begin to draw up both short- and long-term measures to control transportation emissions. Removing the lead from premium gasoline and installing catalytic convertors on all old and new cars would, however, at best reduce only half of the CO emissions and one-fifth of those of HC and NO_x.

This is because the BMR would still have a huge number of two-stroke motorcycles that will continue to be run on leaded regular gasoline. Moreover, emissions from diesel vehicles have yet to be dealt with. Issues such as an annual car inspection requirement, traffic plans and mass transit system improvement also must

be resolved. Further steps toward creating a better and healthier environment should be taken now, particularly as the public is becoming more and more aware of the need to protect Thailand's environment.

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