CHAPTER I

INTRODUCTION

During the past decade, air pollution has become one of the major problems in Thailand, especially in large cities such as Bangkok, Chiengmai, Songkhla, and Khonkan, as well as in dense industrial areas. An increasing rate of population growth in rapidly growing cities where more and more cars are being introduced onto a limited amount of roads and freeways, has made air pollution a problem that needs urgent attention.

Table 1.1 Volume of air pollution of Thailand in 1982 (1)

Source	Air pollution (thousand tons / year)					Total	Percent
	CO	SO_2	HC	NO_2	DUST		
Transportation	406.6	47.3	18.0	35.4	7.5	514.8	35.20
Power plant	2.1	153.1	1.1	43.0	96.3	295.6	20.11
Industry	110.2	106.7	6.6	24.0	62.7	310.2	21.10
Service	108.9	2.2	1.5	5.1	4.2	121.9	8.29
Fishery	4.9	1.2	2.3	12.2	0.0	20.6	1.40
Agriculture	34.7	3.6	1.9	8.2	54.0	102.4	6.97
Domestic	4.9	3.0	4.9	24.8	67.1	104.7	7.12
Total	672.3	317.1	36.3	152.7	291.8	1470.2	100.00

Note : CO = Carbon monoxide

SO_2 = Sulphur dioxide

HC = Total hydrocarbon

NO_2 = Nitrogen dioxide

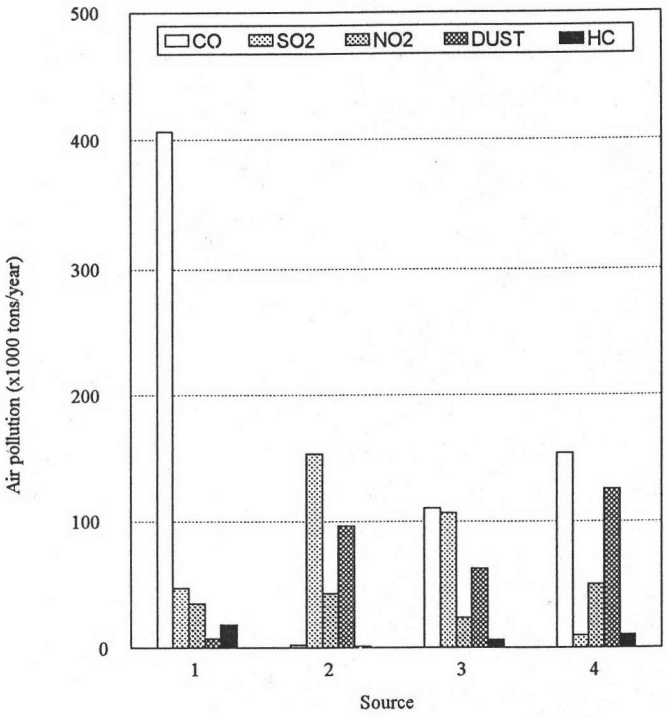

Figure 1.1 Sources of air pollution in Thailand (1)

Note : 1 = transportation
2 = power plant
3 = industry
4 = service+fishery+agriculture+domestic

Table 1 and Figure 1 show that vehicles are the most important source of air pollution. Air pollutants include many kinds of gas such as carbon monoxide, oxides of nitrogen, hydrocarbons, and lead compounds. Carbon monoxide is harmful to humans and animals due to its ability in combining to hemoglobin at a faster rate than oxygen molecule which can cause the cells in

the body to have insufficient amount of oxygen. Compounds other than carbon monoxide are as harmful, for example, lead compounds have some effects on human respiratory and digestion system, hydrocarbons and oxide of nitrogen are the cause of photochemical smog, or conceivably a carcinogen.

Air Pollution from Vehicles

Air pollution from vehicle can be controlled in two different parts:

1. Engine (2):

a) life time of the engine.

b) conditions of the engine.

c) maintenance of the engine.

d) running condition of the engine.

-Idle--if the temperature of the engine is not sufficiently high, the fuel will not completely evaporate causing the engine to produce more carbon monoxide and hydrocarbons.

-Cruising Speed--the air/fuel ratio of the engine combustion depends upon the speed of the vehicle. The temperature of combustion is higher when the vehicle is cruising at a lower speed which produces less hydrocarbons and carbon monoxide.

-Acceleration--during the acceleration of the engine, the need for more fuel doesn't upset the air-fuel ratio (FAR). This leads to high carbon monoxide and hydrocarbon production.

-Deceleration--in this system, less air will be transported into the cylinders than usual which will also cause an imbalance in the air-fuel ratio.

2. Fuel (3-8)

Due to the shortage of fuel in 1975, oxygenated compounds were introduced as a substitute for fuel. Nowadays, these compounds are used as octane improvers which lowers the requirement of lead in the fuel. Lead compounds are one of the ingredients in fuel known as antiknock compounds. Oxygenated compounds increase oxygen available to the fuel which consequently leads to complete combustion into engine.

Oxygenated compounds that are widely used are methanol, ethanol, and MTBE. But methanol and ethanol gasoline blends have the most serious problem that when their water content exceeds a critical level, the blend separates into hydrocarbon and alcohols phases. Higher molecular weight alcohols such as TBA, IBA, or IPA can be practically blended with methanol, increasing the gasoline solubility of the polar phase thus increasing the equilibrium concentration of methanol in the gasoline phase. However, it has been found that methanol and formaldehyde in exhaust gases can cause slight air pollution. MTBE is more commonly used because it does not have the problems mentioned above. The increasing demand of MTBE will lead to insufficient supply in future, therefore there are many research projects to discover other compounds that can work as efficiently as MTBE.

Organotin compounds were selected for detailed investigation ; tin is in the same group as lead in the periodic table so they should have similar chemical properties. Tetrabutyltin and tetrahexyltin were used in the selected base fuel and both show improvement of the antiknock property. A mixture of tetrahexyltin and an alcohol such as IPA or IBA was

used in the selected base fuel, boosting octane 2-5 units. Use of tetrabutyltin, MTBE, and IPA boosted octane 3-5 units.

In addition, organotin compounds can solve the pollution problem for its combustion products, inorganic tin compounds, are nontoxic and very inert. Furthermore, tin metal is an excellent lubricant when allowed to come into contact with moving parts of the engine, thus providing the necessary lubrication and compensating for the loss of lead's lubricating qualities.

Objective and Scope of the Research

1. Objective

The objective of this study is the studies of the effect of organotin compounds in the exhaust gases and its efficiency when they are used with gasoline.

2. Scope of the Research

1) To synthesize tetrahexyltin by Grignard reaction.

2) To compare regulated and unregulated emission for various engine timings and speeds for the blends of tetrabutyltin, MTBE, and IPA-gasoline.

3) To compare regulated emissions and the production of unregulated ones for blends of organotin, MTBE, and IPA-gasoline versus base-fuel gasoline and commercial gasoline.

4) To analyze unregulated hydrocarbons in exhaust emission from tetrabutyltin, MTBE, and IPA-gasoline.