CHAPTER I

INTRODUCTION

At present, air pollution is one of the major problems in Thailand because the number of vehicles is increasing rapidly, especially in Bangkok Metropolitan Area and urban areas, as shown in Table 1.1. Levels of traffic exceed the capacity of the road system which causes congestion on the main traffic arteries. Slow speeds, frequent stops, deceleration and acceleration result in incomplete combustion in the engine causing several toxic gases.

Table 1.1 Number of vehicles and projected annual growth in Thailand (1)

Vehicle Type	Year			Average annual Growth, %
	1993	2003	2013	
Motorcycle	6,660,000	11,310,000	20,140,000	5.7
Tuk - Tuk	34,000	46,000	62,000	3.1
Passenger Car	990,000	2,590,000	6,100,000	9.5
Taxi	30,000	45,000	60,000	3.1
Pick-up	1,760,000	3,980,000	8,720,000	8.3
Trucks	530,000	1,110,000	2,215,000	5.4-12.3
Buses	85,000	155,000	260,000	5.9
Totals	10.1 millions	19.2 millions	37.5 millions	

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 particulates. Diesel engine exhaust emissions can be divided into two categories: those which impact on local air quality (hydrocarbon (HC), nitrogen oxides (NO_x), carbon monoxide (CO), sulphur dioxide (SO_2) and particulate matter (Pm), and those which impact on global air quality (carbon dioxide (CO_2)). The emissions from diesel vehicles which have an impact on local air quality are summarised in Figure 1.1. Currently the diesel vehicle emissions of greatest concern are Pm and NO_x, the former because of its unsightly nature and possible health impact and the latter because of its contribution to ground-level ozone and to acid rain (2).

Emission and Source		Effects
Carbon monoxide	Incomplete combustion	Hinders breathing Impairs coordination
NO_x	High temperature combustion	Acid rain component Ozone contributor
Hydrocarbon	Incomplete combustion	Ozone contributor
Hydrocarbons + NO_x	= OZONE = SMOG	Respiratory / Eye irritation Damages trees / crops
SO_x	Combustion of fuel sulphur	Acid rain component
Diesel Particulates	Incomplete combustion	Possible carcinogen

Figure 1.1 Diesel Vehicle Emissions

The emissions from diesel engines differs from those of gasoline engines, because gasoline engines operate with a deficiency of combustion air, whereas the diesel engine operates with a substantial excess of combustion air and with a substantially higher compression ratio.

Diesel emissions are influenced by engine design, maintenance and fuel quality. Several diesel fuel properties have been identified as having significant effects on diesel engine emissions. For heavy-duty diesel engines, the fuel properties of aromatics, the back end volatility (represented by the 90 percent boiling point), and sulfur were examined in a CRC VE1 study in which reductions in all three properties decreased regulated emissions (NO_x, particulate, HC, and CO) to varying degrees. Ullman and co-workers demonstrated that increasing the cetane number of the fuel significantly reduces all the regulated emissions, especially the particulate matter and the nitrogen oxide emissions (3).

Increasing the cetane number of diesel fuel can be achieved either by lowering the aromatic content of the fuel or by addition of chemical cetane improvers. Refiners in California, to meet CARB mandates, have demonstrated that chemical cetane improvement additives represent a low cost alternative to obtaining higher natural cetane through aromatic reduction (4).

The local and global environmental impact of road transport is coming under increased scrutiny in many countries. Governments, the automobile industry and the oil industry are seeking to minimise the environmental impact of road transport by reducing exhaust emissions levels through legislation driven improvements in vehicle technology and fuel quality (2). In Thailand, one of the steps already taken has been to improve diesel quality through a reduction of sulfur content from 1.0% to 0.5% by weight and lowering the 90% distillation point (T90) from 370 to 357 degree Celsius. In the future it is planned to reduce the sulfur content to 0.05% and T90 may be lowered to 338 degree Celsius (5).

Objectives and Scope of the Research

The principle objectives of this research were to study the effects of engine conditions and diesel fuel properties on exhaust emissions. Specifically, we planned to study the emissions at various engine loads (0%, 50%, and 80%) and different speeds (1500, 2500, and 3500 rpm.), and to study the effect of T90 and cetane number of base fuels with 52-58 natural cetane number on emissions. Additionally, EHN and DTBP cetane improvers were added to base fuels to raise the cetane numbers, allowing a comparison of emissions. Tests were conducted using ISUZU (model 4JA1) engine and NO_X, HC, CO and BTX were evaluated.