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Applied Thermal Engineering 25 (2005) 1315–1324
APPLIED THERMAL ENGINEERING
www.elsevier.com/locate/apthermeng

An experimental study of the effect of octane number higher than engine requirement on the engine performance and emissions

Cenk Sayin, Ibrahim Kilicaslan *, Mustafa Canakci, Necati Ozsezen

Department of Mechanical Education, Technical Education Faculty, Kocaeli University, 41100 Izmit, Turkey

Received 18 December 2003; accepted 24 July 2004
Available online 15 December 2004

Abstract

In this study, the effect of using higher-octane gasoline than that of engine requirement on the performance and exhaust emissions was experimentally studied. The test engine chosen has a fuel system with carburettor because 60% of the vehicles in Turkey are equipped with the carburettor. The engine required 91-RON (Research Octane Number) gasoline was tested using 95-RON and 91-RON. Results show that using octane ratings higher than the requirement of an engine not only decreases engine performance but also increases exhaust emissions.

Keywords: Spark ignition engine; Gasoline; Research octane number; Specific fuel consumption; Exhaust emissions

Abbrevations: RON, research octane number; WOT, wide open throttle; CO, carbon monoxide; HC, hydrocarbons; ppm, particulate per million; rpm, revolution per minute; bsfc, specific fuel consumption, g/kWh.

* Corresponding author. Tel.: +90 262 3231048; fax: +90 262 3313909.
E-mail addresses: ibrkilicaslan@hotmail.com, ikaslan@kou.edu.tr (I. Kilicaslan).

1359-4311/$ - see front matter
doi:10.1016/j.applthermaleng.2004.07.009

Nomenclature

$\dot{m}$	mass flows rate, kg/s
$\dot{m}_f$	fuel mass flow rate, kg/s
d	diameter of the orifice plate, m
D_p	diameter of PVC pipe, m
Re_p	Reynolds number in the PVC pipe
ε	expansion factor
Φ	orifice plate diameter ratio, d/D_p
ρ_a	air density, kg/m^3
ρ_f	fuel density, kg/m^3
l	liter, dm^3
P_e	effective power, kW
μ	dynamic viscosity, Pa s
ΔP	pressure drop across the orifice plate, Pa
V_f	volume of consumed fuel, m^3
t	fuel consumption period, s

1. Introduction

In the research studies on spark ignition (SI) engine fuels, the aim is to improve the fuel properties, to decrease the engine fuel consumption, to augment engine power and to diminish the unwanted exhaust emissions. Considerable progress has been made in the spark ignition engine over its more than 100-years history, particularly in recent years. Examples [1,2] include the adaptation of SI engines to three-way catalysts, advancing engine design and improving fuel properties. Additionally, in recent years, researchers [3,4] have interested in octane number since exhaust emissions from automobiles and engine performance are known to have a very close relationship with gasoline quality (octane number). Therefore in this study, engine performance and exhaust emissions were investigated using gasoline powered SI engine with two different octane number gasoline.

Gasoline is the main fuel for the SI internal combustion engine. Increasing fuel efficiency, changing its attributes and progressing features are the major research areas in the automotive industry. The octane number of gasoline is one of the most important parameter determining the fuel quality. The effect of octane number on detonation has been investigated by several researchers since the octane number of a gasoline is a measure of its resistance to detonation [5–8]. The octane number of an engine is determined according to the engine design and compression ratio. The weather, driving conditions, and mechanical conditions of the engine are some examples that will be able to influence this requirement. For instance, combustion-chamber deposits decrease volumetric efficiency, which boost octane requirement and probability of detonation. Diminished cooling efficiency, problems in fuel systems, ignition troubles and failure of emission controls can also change octane requirements [9,10].