

INVESTIGATION OF THERMAL STRATIFICATION EFFECT ON N-HEPTANE/ISO-OCTANE-AIR MIXTURE HCCI COMBUSTION

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ABSTRACT–The HCCI combustion mode poses its own set of narrow engine operating by knocking. In order to solve this, inhomogeneity method of mixture and temperature is suggested. The purpose of this research is to get fundamental knowledge about the effect of thermal stratification on HCCI combustion of n-Heptane/iso-Octane-Air mixture. The temperature stratification is made by buoyancy effect in combustion chamber of RCM. The analysis items are pressure, temperature of in-cylinder gas and combustion duration. In addition, the structure of flames using the two dimensional chemiluminescence's images by a framing camera are analyzed. Under stratification, the LTR starting time and the HTR starting time are advanced than that of homogeneous. Further, the LTR period of homogeneous conditions became shorter than that of the stratified conditions. With the case of homogeneous condition, the luminosity duration becomes shorter than the case of stratified condition. Additionally, under stratified condition, the brightest luminosity intensity is delayed longer than at homogeneous condition.

KEY WORDS : Homogeneous charge compression ignition, Rapid compression machine, Combustion, Thermal stratification, Buoyancy effect

NOMENCLATURE

C_p : specific heat at constant pressure
 dP/dt : rate of pressure rise
 dT/dt : rate of temperature rise
 F : flow volume
 I : luminescence intensity
 M : molecular weight
 m : mass
 n : number of heat
 $P(t)$: pressure
 Q : amount of heat
 $V(t)$: volume
 $T(t)$: mass average temperature
 t : time after compression start
 Δt : time difference
 ε : compression ratio
 Φ : equivalence ratio
 γ : mole fraction
 κ : ratio of specific heat
 σ : standard deviation
 R : universal gas constant
 $T(t)$: temperature
 ρ : density
 X : piston position from btc

BTDC : bottom dead center
HCCI : homogeneous charge compression ignition
HTR : high temperature reaction
LTR : low temperature reaction
TDC : top dead center
I.I. : image intensifier

1. INTRODUCTION

The Homogenous Charge, Compression Ignition (HCCI) combustion is the process in which a homogeneous pre-mixture is auto-ignited through compression. The unique property of HCCI makes possible the combustion of very lean or dilute mixtures. As a result, the combustion temperatures become low, which dramatically reduce engine-out NO_x emissions. Also, unlike the conventional diesel combustion, the charge is well mixed, that means PM emissions can be very low, while still providing high diesel like efficiencies. Moreover, dilution levels are high enough that the engine is operated essentially unthrottled, which results in significantly reduced pumping works (Najt and Foster, 1983; Thring, 1989; Ryan and Callahan, 1996; Aoyama *et al.*, 1996; Christensen *et al.*, 1998; Igarashi and Iida, 2000).

In spite of these advantages of HCCI combustion, this combustion mode pose its own set of unique problems, such as the narrow engine operating by knocking or misfire, has difficulty in controlling the combustion phase

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