様式 8

論　文　内　容　要　旨

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学位論文題目	A Study on Mixture Formation of Diesel Spray at Initial Stage of Injection Affected by Ambient Conditions and Injection Parameters ディーゼル噴霧の噴射初期の混合気形成に及ぼす雰囲気条件と噴射諸元の影響に関する研究		

内容要旨

Diesel engine is more efficient as compared to gasoline engine. Its high compression ratio allows for better efficiency compared to gasoline engine. It typically delivers 25 to 30 percent better fuel economy than similarly performing gasoline engine. However, diesel engine is one of the largest contributors to environmental pollution which cause by exhaust emission. Owing to the energy constraint with the rising cost of raw petroleum and environmental change such as the expanding request of vitality preservation and environmental protection, the need of emission reduction is indispensable. Furthermore diesel engine can be dirtier because it still does not burn as cleanly as gasoline. The amount of fume discharge, which contains nitrogen oxides (NO_x) and particulate matter (PM) such as soot, is larger compared to gasoline. To avoids and reduce this emission, more research needed to be done on engine combustion, air-fuel mixture, power yield and diminishment of fume discharge with the specific end goal of reducing NOx emission and increasing the engine efficiency.

The spray is one area in diesel engine that contributes a significant energy production during combustion process. Comprehensive spray research, would lead to an increasing engine performance and efficiency, great economical fuel consumption and reduction in pollutant emission of the exhaust. Study of diesel spray formation and its management is critical for improved performance and reduction of pollutant emissions in diesel engine. In order to control and manage spray formation, its dependent parameters such as the ambient density and temperature, injection pressure, breakup regimes and multiple injection strategies should be fully studied and understood.

In the applications, the experimental setups and observations of the spray characteristics would be done at the conditions that are as close as possible to the actual diesel engine. The main focal point for investigation in this study are the ambient density and temperature and their effects on spray formation at initial stage of injection. However, other parameters that influence spray formation such as injection pressure and nozzle hole diameter would also be considered in this study. It would then be interesting to note how the dependency of these parameters and their correlation to the spray formation and subsequently

translated into high engine performance and reduction of particulate emissions. Rapid compression machine that provides any ambient temperature and density that match the real conditions would be used. Furthermore, this study has applied dual nano-spark shadowgraph photography method using constant volume spray chamber filled with high density and high temperature inert gas. The system has two sparks that send high intensity spark light towards the spray at a short time interval, and then images of same spray at different timing can be captured on separate still cameras. Analysis of the images can reveal dynamic behavior of droplets formation and droplets evaporation of spray. The result of the observations of the study would be in the form images that are captured using shadowgraph photography technique and subsequently analyzed using computer software.

In this study, spray atomization and evaporation development have been main focusing on this investigation. In addition, qualitative data that has been extracted from spray formation images would bring details information according to each conditions that have been applied in this study. Since the objective of this study is to provide valuable information on spray formation as the effect of ambient density and temperature on the mixture formation observation on droplet behavior and spray evaporation at spray boundary under low fuel injection rate (pilot injection) would also be carried out. This would bring sufficient information as to what really happen at fuel-air mixture process during ignition delay period.

Due to this observation and analysis, affect on high ambient density and high temperature environment shows greatly promotes on droplets evaporation and atomization of spray. According to this circumstance, the mixture formation are first promoted at the middle stream of spray region. Influence of small nozzle hole diameter and high injection pressure of spray shows some improvement on spray evaporation and droplets size distribution. Furthermore, the first flame have been occur at downstream and begin develops toward downstream region. This is due to spray evaporation which have improved under high injection pressure condition. This condition has prevail the previous study finding.

Detailed observation and analysis of the images show that droplets immediately lose their momentum after pilot injection. High density atmosphere decreases droplets velocity after injection. Droplets at middle stream region of spray change their flying direction, in particular, at downstream region of spray boundary under high density condition and some droplets move outward of spray at downstream region. High density atmosphere promotes droplets evaporation near outlet of injector just after pilot injection; however, large size droplets tend to remain near outlet of injector even after small amount of injection.