Development of ammonia mixed combustion engine for automobiles

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KEY WORDS: heat engine, compression ignition engine, fuel economy, alternative fuel, ammonia mixed combustion [A1]

In order to develop a retrofit compatible ammonia mixed combustion engine for automobiles, we utilized the property of ammonia to dissolve easily in water and used a "water mixed fuel generation device" developed by the National Fisheries University to produce ammonia water mixed fuel. An experiment was carried out in which ammonia was injected as a liquid at normal temperature under atmospheric pressure. To clarify the combustion characteristics and DPF performance when ammonia is used in a small high-speed engine, 214kW/3101min⁻¹ diesel engine with a DPF was operated using a fuel made from a mixture of gas oil and ammonia water, and the engine performance and characteristics of NOx, PM, and DPF were analyzed. As a result, it was clarified that ammonia can also be used in small high-speed engines.

- (1) Fig. 1 shows the changes in water mixing ratio and gas oil consumption when the engine is operated at a relatively high load (160kW/2817min⁻¹). In the figure, when ammonia water is mixed with the gas oil, the consumption of gas oil decreases as the mixing ratio of ammonia to the fuel increases. This indicates that ammonia was effectively combusted.
- (2) Fig. 2 shows the changes in water mixing ratio and NOx when the engine is operated at a relatively high load (160kW/2817min⁻¹). In the figure, when the mixing ratio of ammonia to fuel is about 6%, NOx shows the same tendency as when water is mixed, but when the mixing ratio of ammonia exceeds about 11%, the reduction rate becomes smaller; At 16%, there is an increasing trend. This is because the amount of fuel NOx produced by combustion of ammonia exceeds the amount of NOx reduced by mixing with water.
- (3) Fig. 3 shows a photograph of PM taken while the engine was operating at a relatively high load using a mixture of gas oil and ammonia water, and the results of Soxhlet analysis of the PM components.



Fig.1 Relationship between water mixing ratio and FOC



Fig. 2 Relationship between water mixing ratio and NOx

As shown in the figure, by mixing ammonia water with fuel, the soot contained in PM is significantly reduced, but the proportion of SOF increases.

(4) From the results shown in Figures 1, 2, and 3, it is possible to achieve a triple reduction in gas oil consumption, NOx, and PM by mixing ammonia water with gas oil.



Fig. 3 PM components of ammonia water mixed fuel