A STUDY ON HYDROGEN CONCENTRATION IN THE CRANK CASE OF A HYDROGEN INTERNAL COMBUSTION ENGINE

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ABSTRACT
Hydrogen internal combustion engines have been seen as a countermeasure to global warming. Furthermore, it can be used in severe climates where EVs cannot adapt like too hot or too cold. The hydrogen content in blow-by gas is one of the serious problems of hydrogen engines. The concentration of hydrogen in the crank case should be lowered less than the explosion limit of hydrogen 4%. The authors' previous study shows that a narrower top ring gap lowers the hydrogen concentration in the crank case in spite of about the same hydrogen concentration in the combustion chamber for both ring gaps [1].

In this study, the effect of the top ring gap on the hydrogen concentration in the crank case was investigated. Additionally, effective measures for reducing hydrogen concentration were studied. The second land pressure and blow-by gas were calculated following Furuhama's method [2]. The hydrogen concentration in the combustion chamber was set to an estimated value around the top ring obtained by fluid analysis for the intake and the compression strokes, and it was assumed to be zero for the explosion stroke. Then, the change of hydrogen concentration in the crank case was calculated.

The effects of injection timings and top ring gap widths were investigated. Table 1 shows the calculation conditions. Fig.1 shows the results of the calculation. It was found that the estimated hydrogen concentration at crank case of case2 was higher than that of case1. It was assumed that a wider top ring gap caused fluttering of the top ring around -330 deg. BTDC. At that time, hydrogen concentration in the combustion chamber was assumed to have the highest value. Therefore, it was found that the gap of the top ring and injection timing were important elements for the reduction of hydrogen concentration at the crank case. This paper also investigated the effect of those elements, the number of compression rings, etc.

Table 1 Specifications of cases

	Engine speed	Comp. ratio	λ	Ign. timing	Gap width	Injection start timing
	rpm	-	-	deg. BTDC	mm	deg. BTDC
Case1	1810	9.46	2.2	10	0.2	365
Case2					0.37	415

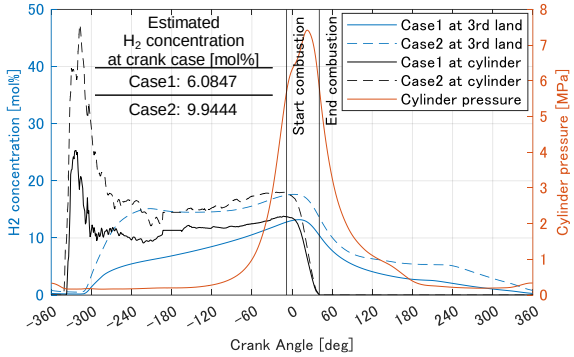

Fig.1 The effect of top ring gap width and injection timing on H_2 concentration at crank case and 2nd land

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