

Effect of Oil Properties on Oil Distribution in Pattern Coating Piston

Kenta Sato ¹⁾ Akito Watanabe ¹⁾ Moritsugu Kasai ²⁾ Hiroshi Oki ²⁾
 Hisanobu Kawashima ¹⁾ Hidekazu Suzuki ¹⁾ Tsuneaki Ishima ¹⁾

1) Gunma University,
 1-5-1 Tenjincho, Kiryu, Gunma, 376-8515, Japan
 2) Idemitsu Kosan Co., Ltd.,
 24-4 Anesakikaigan, Ichihara, Chiba, 299-0107, Japan

KEY WORDS : Heat Engine, Engine Component, Tribology, Piston Skirt, Visualization, Oil Film [A1]

Pattern coating pistons are generally used to reduce friction loss in automobile engine. The friction reduction seems to be due to the change in oil film distribution depending on the coating pattern type. Using low engine oil viscosity is recent trend for reducing friction loss. However, the effect of low-viscosity oil on the oil film distribution on the piston skirt is still unknown. Oil film distribution on the piston skirt is visualized with three kinds of oil viscosities in test engine with sapphire cylinder.

Table 1 shows the specifications of three types of oils. The oil film image was taken by the LIF method. The oil film thickness was obtained by analysis of oil film images. The experimental conditions were firing condition with 1500 rpm and 2000 rpm, and the IMEP was 500 kPa. During the experiments, the oil temperature monitored by cylinder surface temperature was around 100°C.

Figure 1 shows the oil film thickness on the piston skirt analyzed from the visualized images at crank angle of 400 degrees. In the rectangular area shown by the black line, it was found that the oil film thickness became thinner when the oil viscosity was decreased.

Figure 2 shows oil film distribution on the skirt at crank angle of 450 degrees obtained from visualization experiments. In the red rectangle, oil was contained in almost half of the concave area. The oil remaining in the concave area was no difference with oil types.

Figure 3 shows a comparison of the oil film thickness on the skirt by calculation and visualization experiments. The results show similarity in the tendency and order by the oil viscosity.

Table 1 Specifications of Engine Oils

Viscosity Grade		#20	0W-20	#8
Kinetic Viscosity [mm ² /s]	40°C	52.6	29.8	25.3
	100°C	8.5	7.7	5.2
HTHS Viscosity(150°C) [mPa·s]		2.8	2.6	1.9
Viscosity Index[-]		137	244	139

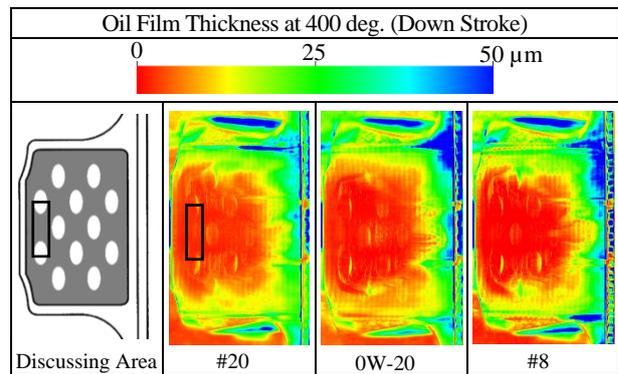


Fig. 1 Oil Film Distribution on the Skirt with Color Scale (1500 rpm, 500 kPa (IMEP))

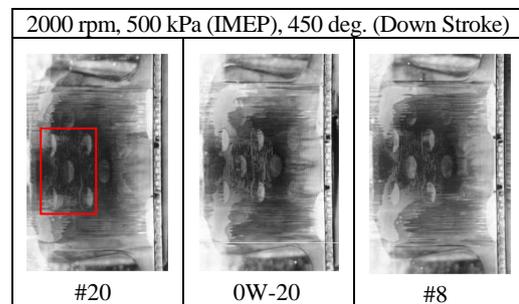


Fig. 2 Concave Area with Half Filled Oil

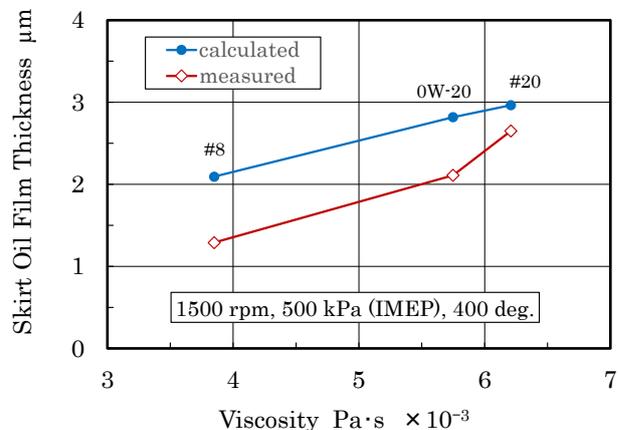


Fig. 3 Comparison of Skirt Oil Film Thickness Obtained from Images and Calculation