EFFECTS OF DIMPLE SHAPE AND ARRANGEMENT PATTERN ON OIL FILM PRESSURE BETWEEN TWO SLIDING SURFACES

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KEYWORDS
Texturation; fluid lubrication; physics of friction; fluid lubrication analysis

ABSTRACT
Dimple improves supplying the lubricating oil and it reduces friction of the sliding surface. Its effect varies depending on the dimple shape and arrangement pattern, therefor generic design method of dimples has not been clarified. The purpose of this study is to propose a design method of dimples based on fluid pressure under fluid lubrication.

We analyzed maximum load carrying capacity and fluid pressure using the TED/CPA when a single dimple was applied load and sliding velocity in oil lubrication. Figure 1 shows an analytic model, and Table 1 shows analytic conditions. Lubricating oil is compressible viscous fluid, and elastic deformation and surface roughness of materials is not considered. Furthermore, material A slides against material B with dimples. Figure 2 shows a dimple pattern model. We changed the diameter of dimple, depth, curve. The function of curve is denoted by $z = (2/D)^a \cdot d \cdot x^a$ and D, d and a being the diameter of dimple, the depth of dimple and the curve factor, respectively. Dimple becomes flat bottom and cylindrical with increasing the curve factor.

Figure 3 shows the fluid pressure distribution. The oil film pressure reached the maximum pressure on the right side from the center of the dimple. Figure 4 shows the maximum load carrying capacity vs. diameter, depth and curve factor. The maximum load carrying capacity increases with increasing the dimple diameter, and maximum load carrying capacity decreases with increasing the depth of dimple. There is an appropriate curve degree dependance on the depth of dimple. As a result, we proposed the method to investigate the influence of dimple shape on maximum load carrying capacity and fluid pressure.

Table 1 Analytic conditions

Sliding speed, m/s	10
Viscosity, MPa·s	4.6×10^{-9}
Density, g/cm^3	1.0
Film thickness, μm	1.0
Analysis area, mm^2	1.5×1.5

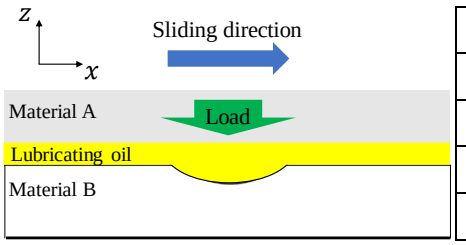


Fig. 1 Analytic model

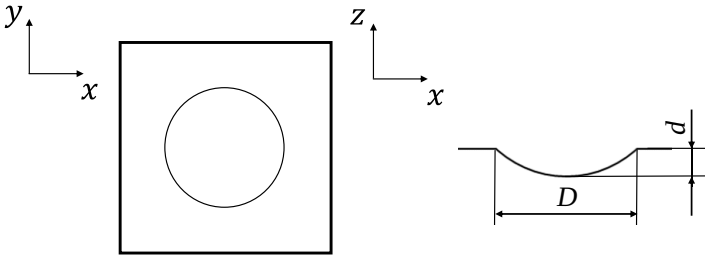
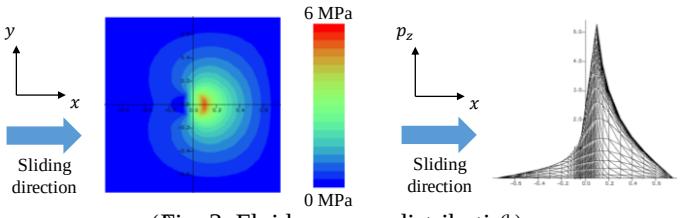


Fig. 2 Dimple pattern model



(a) y-p_z (b) x-p_z

Fig. 3 Fluid pressure distribution

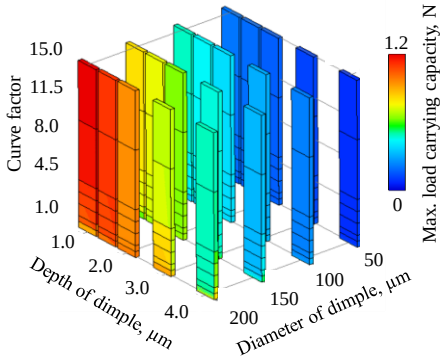


Fig. 4 Analytic result

REFERENCES
[1] D. B. Hamilton, et. Al., A theory of lubrication by microirregularities, Transaction of the ASME, Journal of Basic Engineering, 88 (1996), 177.