

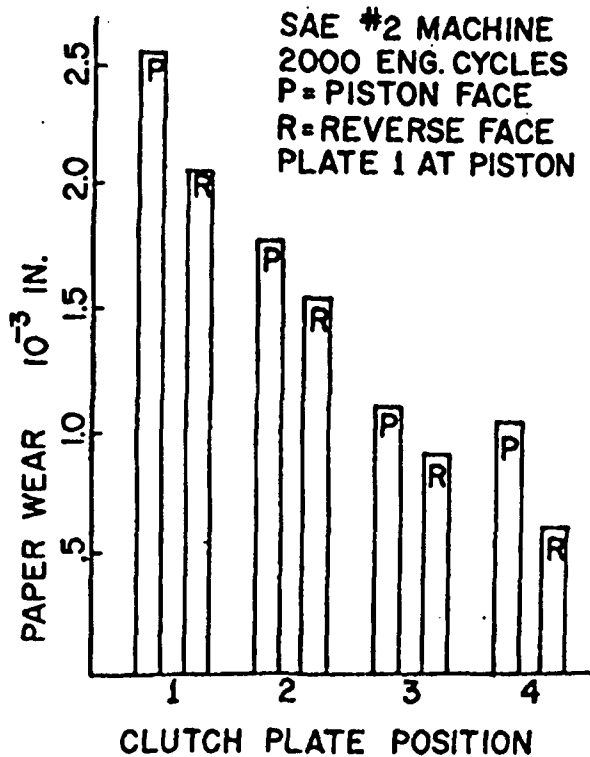


Fig. 12 - Paper plate wear as function of pack position

optical microscope, it was found that the "scales" open readily as the paper surface is loaded in compression by a flat glass plate. Apparently the "scales" are relatively free to move, thereby influencing friction only in the relatively short squeeze film period.

WEAR OF A CLUTCH PACK

A pack of four new paper plates was measured at several locations on each face and tested for 2000 cycles on the SAE No. 2 clutch machine. Plates were periodically removed during the test for wear measurements and squeeze film testing, then reinstalled in the same order and orientation. The wear of the paper plates was uneven at first, being greatest toward the plate OD and at circumferential locations where the total pack thickness was greatest. Thus, in some plates the wear was not a maximum at the point of maximum plate thickness. These findings were expected, since the largest mechanical contact pressure should occur at the thickest section of the pack and be biased toward the OD due to mechanical deflections of the end plate. After about 500 cycles, the OD bias diminished rapidly. The paper wear from 1000-2000 cycles was essentially uniform from OD to ID, but was not yet uniform circumferentially. The wear of the facing closest to the apply piston was greatest, with wear generally decreasing for more remote positions (Fig. 12). This may be attributed to the effect of spline friction, since displacement of the clutch and separator plates is required to maintain torque in the

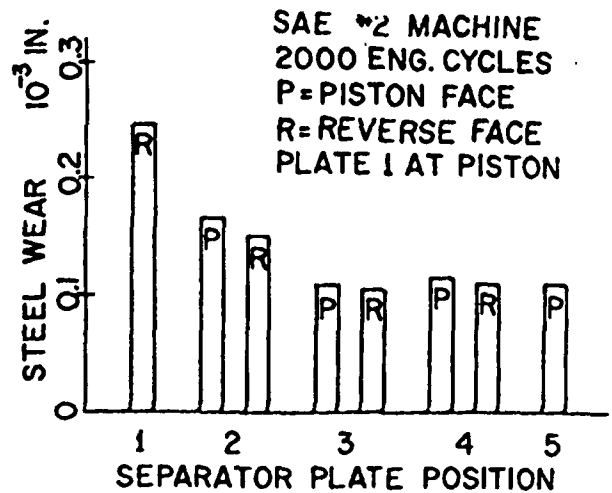


Fig. 13 - Separator plate wear as function of pack position

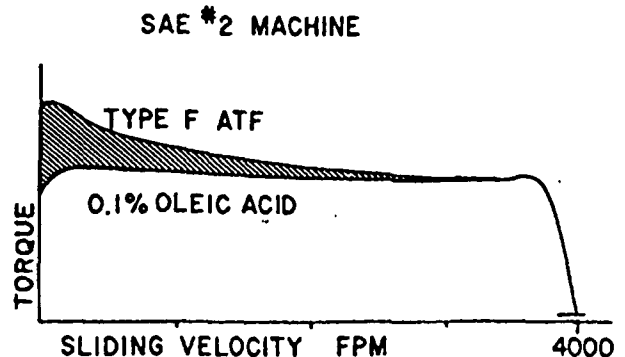


Fig. 14 - Effect of fatty acid on clutch torque

squeeze and squash film phases. The plates nearest the piston then have a larger average apply pressure and a slightly longer apply time. Since the wear occurs primarily at the end of the engagement, these relatively small differences of load and time can produce significant differences of paper wear rate.

The steel separator plates exhibited a similar trend (Fig. 13). Steel plate wear was variant with angular position, also tending to reduce the total separator pack thickness variations. The greatest wear on each plate occurred at the same angular location. Some minor scoring was observed in these tests, which appeared to have resulted from abrasive inclusions in the asbestos.

EFFECT OF FATTY ACIDS

In an attempt to determine experimentally the extent of mechanical contact, a clutch plate was cycled under closely controlled conditions on the SAE No. 2 machine until steady-state frictional behavior was reached. Several successive torque-velocity traces were recorded using a Type F fluid. At the end of one of these engagements a syringe was used to inject 0.1% oleic acid into the fluid chamber of the test machine.