SURFACE DURABILITY OF HOLLOW ROLLING ELEMENTS

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INTRODUCTION

The main concern with high speed rolling bearing is increased centrifugal forces at higher oprating speeds which cause larger contact stresses. This would reduce the fatigue life considerably. The use of lower inertia rolling elements has been attempted to combat such arduous contact stress problems. Hollow rolling elements are being tried out. The use of hollow rolling elements, reduces the inertia forces, provides better cooling, [1] offers outstanding characteristics of accuracy of rotation and stiffness [2] and allows preloading for performance improvement [3]. The present paper illustrates data on the significance of percentage hollowness and surface coatings on the performance of hollow rolling elements.

EXPERIMENTAL

Hollow rollers were made of HSLA steel microalloyed with Nb, with different percentage hollowness D-d/D% (30%, 37.5% and 50%). They were tested in a pin-disc set up for their performance in contact fatigue. The test rollers were held against the disc by rolling supports simulating the actual bearing situation. During the test, the performance was evaluated by periodically recording the surface textures and measurement of wear by weight loss. The observations are presented in the following sections.

RESULTS AND DISCUSSION

Influence of % Hollowness on wear:

Fig.1 illustrates the influence of % hollowness on the wear performance. It is seen that 37.5% hollowness has resulted in greater control on wear. Hollow rolling elements posses lower inertia and better heat dissipation. Due to the applied load, they undergo increased deflection, increasing thereby the contact area. This reduces the contact stress. Apart from the reduction in contact stress, the lower inertia and reduced centrifugal forces (spinning on own axis) also minimised the severity of working at the contact. This increases the fatigue life of hollow rollers. As the percentage holowness increases, the roller would behave very much like a solid rolling element. With too high a bore diameter, the rolling element becomes slender,

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with poor flexural rigidity. These observations would illustrate the existence of optimum hollowness for wear resistance.

Run-in characteristics of hollow rollers:

Fig.2 illustrates the variations of surface texture with test duration. It is seen that, the surface texture of rollers with 35% hollowness exhibited the best run in characterstics around 13.5 x 10^6 cycles. Fig.3 illustrates the influence of hollowness on run-in characteristics. It is seen that compared solid rollers, rollers with 37.5% hollowness exhibited better run-in characteristics. With hollow rolling element, the occurrence of severe surface distress is also delayed.

Performance of Treated hollow roller

For enhancing the performane of the hollow rollers, the roller of 35% hollowness, were subjected to surface treatments. Both Tufftrided and sur-sulf treated hollow rollers were tested in the contact fatigue test set up. Fig.4 shows the performance of tufftrided hollow rollers. It is seen that, for better performance, the thickness of the tufftrided layer is to be minimum. Fig.4 also shows the performance of sur-sulf treated hollow rollers. It is seen that these rollers with the maximum thickness perform better. It is known that while the tufftriding process produces a harder layer with minimum porosity, sur-sulf treatment produces thicker and relatively porous layers of identical hardness. Further, it is evident that good compatability would be achieved with the sub-strate with relatively thinner tufftrided layer, while the same is achieved with thicker sur-sulf layer. This has illustrated in their wear performance.

CONCLUSION

1. 37.5% Hollowness resulted in better performance
2. Thin Tufftrided layer, and relatively thicker sur-sulf treated layer on hollow elemnts improve the wear performance.

REFERENCES

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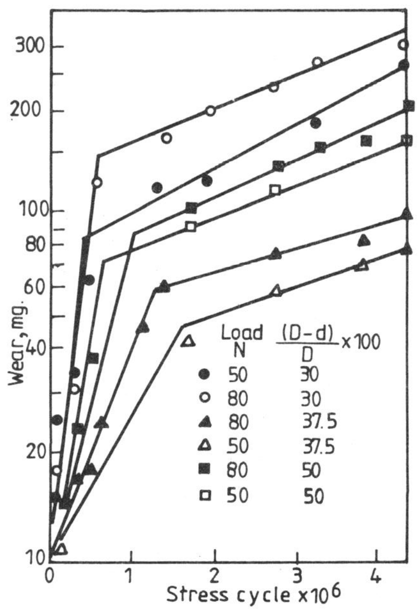

Fig.1 % Hollowness on wear

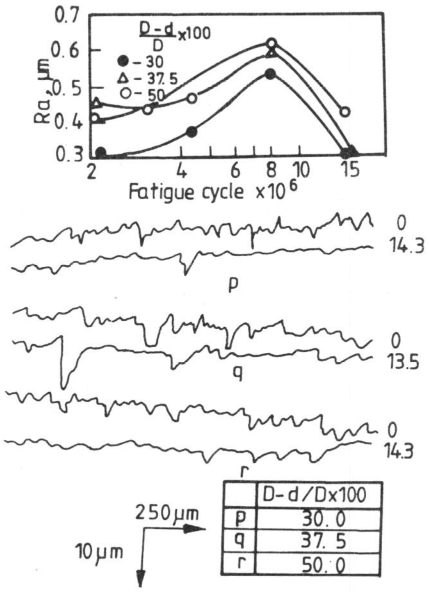

Fig.2 Run-in characteristic of hollow rolling element

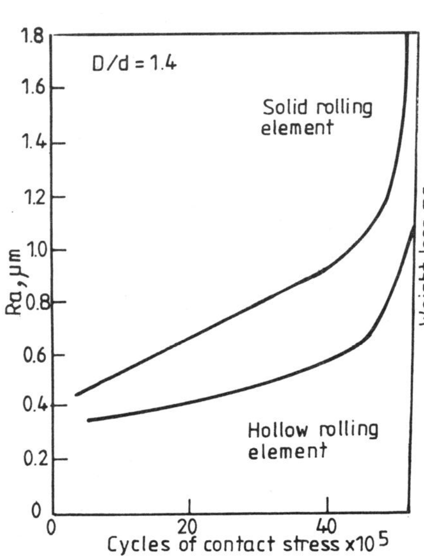

Fig.3 Influence of hollowness on surface distress

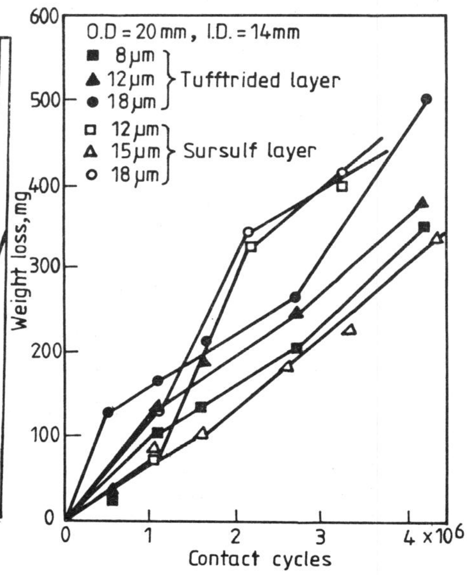

Fig.4 Performance of surface treated hollow roller