CHAPTER 6

INFLUENCE OF COATING ON SPUR GEAR VIBRATION

6.1 INTRODUCTION

Coating plays a major role in the modern engineering industries. Majorly coating is being done to protect the surface of the component from enviro-effect like exposure to oxidation, to resist chemical reactions, to protect from sea water erosion or sea breeze, to reduce the friction in the contact areas. But in this research, coating like MoS$_2$ and Xylan has been done on gears to identify the damping effectiveness of coating in spur gear vibration.

6.2 IMPORTANCE OF COATING IN GEARS

Coating in metals can be done either for technical reason or may be for an aesthetic look. The coating which has certain indispensable technical requirement can also be called as functional coating. The coating is done with different materials like PTFE, MoS$_2$, Teflon, etc. according to its functional attribute towards the application. These coatings are being done by several methods like spray coating, powder imprinting and fringe coating and so on. PTFE is coated primarily for low – friction on the contacting surfaces. MoS$_2$ resists heavy loads and reduces the friction and wear at low speed. PTFE is suitable for surface protection from atmospheric condition. Among those xylan is one of the varieties of coating. Xylan, itself has several categories like PTFE1010, 1014, 1052 and 1054. Among those 1014 and 1052 are friction and corrosion resistant respectively. 1052 is the combination of PTFE and Molybdenum Di-sulphide which has more hardness, anti-galling and can
also resist high temperature. It has more vibration damping capacity due to the cross linked helical morphologised flurorine in the PTFE Structure. PTFE 1052 has been selected for the coating in this research. All these coating has the fluropolymer base. Coating in gears plays a vital role in resisting the tooth wear during operation and also it reduces the fatigue and rusting, if it is a ferrous gear. But the traditional method of coating deals about the technique used for wear resistant and enviro – resistant. Xylan coating as shown in Figure 6.2 is a low-friction material which reduces the wear in the interface surfaces between metal to metal contacts. These are suitable in boundary lubrication system. Low – friction coating provides a good vibration damping quality. The surface roughness of the xylan coating is around 0.4 to 0.6microns.

6.3 SPECIAL FEATURES OF MoS₂ AND XYLAN COATING

The gear coated with MoS₂ is shown in the Figure 6.1 is designated as gear F. The gear F has been assembled experimentally and the measurements are taken as such in the other type of gears discussed in the previous section. The coating thickness of the MoS₂ has been given in the section 6.1. The gear has very good vibration damping control and friction control.

PTFE is one of the important coating polymer materials for wider applications in the modern trend in engineering. Since it has good corrosion resistant and wear resistant property, it is being used in many industrial and engineering applications. The aim of selecting Xylan is, it belongs to PTFE family and also in addition, it has MoS₂ to resist the wear. The performance of this gear G shown in Figure 6.2 is excellent in vibration damping, when comparing with all the other gears.
6.4 EXPERIMENTAL RESULTS AND DISCUSSION ON GEAR F AND G WITH GEAR A

Coated gear has an effective damping control than all the other types of gears i.e. material modified gears and grooved gear. When the load of 216N is applied and the gears are operated at the speed of 1200, 1500 and 1800rpm (Figure 6.3 to 6.5), gear A has the higher amplitude than the gear F and gear G, but the gear F and gear G has a good control over this speed range in all the measurement positions from the bearing 1 to 4. During the speed of 1200rpm, the gear F has a reduction of almost 15% and the gear G has a reduction of almost 25% and more (Figure 6.3). When the speed is increased to 1500rpm for the same load condition, the gear F has the control (Figure 6.4, 6.5) but the percentage of reduction in vibration is not so high. Where as gear G, Xylan coated gear has an appreciable vibration reduction in all the speeds.
Figure 6.3  Comparative velocity analysis of Gear pairs F and G with A with the load of 216N at 1200rpm

Figure 6.4  Comparative velocity analysis of gear pairs F and G with A with the load of 216N at 1500rpm
Figure 6.5  Comparative velocity analysis of gear pairs F and G with A with the load of 216N at 1800rpm

When the load is increased to 324N, the gear F has an higher amplitude than the gear A at the speed of 1200rpm (Figure 6.6). It shows that the gear F may not have the effective damping nature for the higher load and with lower speed. But at the same time, when the speed is increased, the gear F has a tendency of controlling the vibration at 1500rpm and at 1800rpm (Figure 6.7 6.8). But in all the speeds and in both the load conditions, the Xylan packed gear G has a good control in vibration, which shows that the Xylan coating has an advantage than the other type of coatings in reducing the vibration of a gear. Figure 6.9 and 6.10 shows the comparative performance of the Functionally coated gears with gear A at the various measuring positions at all the speeds.
Figure 6.6  Comparative velocity analysis of gear pairs F and G with A with the load of 324N at 1200rpm

Figure 6.7  Comparative velocity analysis of gear pairs F and G with A with the load of 324N at 1500rpm
Figure 6.8 Comparative velocity analysis of gear pairs F and G with A with the Load of 324N at 1800rpm

The following Figures 6.9 and 6.10 shows the performance of the coated gears and the plain steel gear for the three speeds with the load of 216N and 324N respectively.

Figure 6.9 Comparative velocity analysis of Gear pairs F and G with A with the load of 216N and at all speeds
Figure 6.10  Comparative velocity analysis of Gear pairs F and G with A with the load of 324N and at all speeds

6.5  CHAPTER SUMMARY

The chapter comprises the experimental study and analysis of a MoS₂ coated gear pairs and a Xylan coated gear pairs. It also includes the importance of coating in gears with MoS₂ and Xylan.