

Wear Characteristics of AISI 4140 under Nano Fly Ash Based Engine Oil

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Extended Abstract

The nano fly ash (FNP) particles, when used with stabilizer in lubricant, have been found beneficial in improving the tribological behavior of alloy steels. Present experimental wear test was carried out to comprehend the significant parameters responsible for lowering the wear alloy steel of grade AISI 4140 when nano fly ash particles treated with oelic acid were well dispersed in SAE10W-30 engine oil. L9 orthogonal array of Taguchi was designed and the variable selected were load, Sliding length, Sliding velocity and percentage of nano particles. Pin on Discs wear test tribometer as per ASTM standard G99-17 was used for the experimentation. S/N ratio Smaller the Better approach for S/N ratio was followed for minimizing wear loss. This experimental study was conducted to find the effect of the parameters on the wear loss of AISI 4140 under nano lubricant by means of Analysis of Variance. The outcomes portrayed that percentage weight of fly ash nano particles had the highest impact on wear loss attributes. Though load and sliding length also affected wear loss but effect of nano fly ash particles surpassed the results. The predicted value of optimum wear loss was computed using optimization Taguchi methodology. Lastly authentication test the average value of wear loss by the weight i.e 5.32 mg was found in 95 % CI (confidence interval).

Nano additive can find important role in improving the performances of alloy steels under lubrication. These nano additives may be helpful in saving energy, thereby increasing the efficiency of the system. Potential of nano particles with proper surfactant in lubricants, in reducing wear in lubricated system can not be ignored [1–7]. Many nanoparticles as per the literature review like alumina nanoparticles, nano titanium oxide, nano ferric oxide and nano calcium oxide has depicted better tribological results when used as an additive in lubricants [8–10]. Many researchers have reported nano copper particles in engine lubricating oils as to lower the wear loss characteristics [11]. Some even used nano zirconia, nano silica, nano CuO, nano TiO₂ as add on in lubricants got promising results [12–14]. Nano additives like nano zinc oxide with graphene do evidenced to enhance the tribological attribute in the base oil [15]. Hydrogen boron nitride and tungsten disulfide nano particles having small nano size particles in SAE 20W-50 have depicted lower wear loss when AISI 52100 steel alloy balls were rubbed against EN8 steel disk as compared to the lubricant SAE 20W-50 alone [16]. The concentration of nano particles is important in this concern. Concentration of nano nickel from 0.2 to 0.5% wt. in lubricants showed lower wear loss properties [17]. Nano silicon oxide optimum range was 0.05–0.5% wt. and for the blend of nano aluminum oxide and silicon oxide had optimum range upto was 0.5% wt for best tribological results [18,19]. Surface modification, particle size, form, structure and concentrations are important characteristics of additive in the lubricants to lower the wear loss in the alloy steels under lubrications [20-21].

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