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Friction and wear characterization of graphite/Polytetrafluoroethylene composites against stainless steel: A comparative investigation under different environments

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Abstract. The friction and wear characteristics of Polytetrafluoroethylene composites filled with 15 wt.% and 25 wt.% graphite were investigated against stainless steel under dry sliding and in aqueous environments. A pin on disc tribometer was employed for experimentation at room temperature. The friction performance of 15 wt.% Graphite/Polytetrafluoroethylene proved better than 25 wt.% Graphite/Polytetrafluoroethylene under all conditions, however the wear performance was better for 25 wt. % Graphite/Polytetrafluoroethylene. Moreover, the tribological behaviour of all the composites enhanced in natural sea water environment. An average COF (0.02) and wear rate (1.27×10^{-5} mm^3/Nm) were attained for 15 wt. % Graphite/Polytetrafluoroethylene in sea water, and an average COF (0.0293) and wear rate (3.2×10^{-6} mm^3/Nm) were obtained for 25 wt. % Graphite/Polytetrafluoroethylene in sea water. From SEM analysis it was revealed that the better tribological performance of graphite/Polytetrafluoroethylene in sea water is due to the formation of lubricious films on the surfaces in sea water.

1. Introduction

Polytetrafluoroethylene composites are widely used as self-lubricating materials for dry running applications where the use of lubricating oil is avoided. Moreover, polytetrafluoroethylene composites are also suitable for use in aqueous environments like sea water due to low water absorption and good chemical resistance [1, 2]. Since its discovery by Dr. Plunkett at DuPont Laboratory USA in 1938, research has been extensively conducted on Polytetrafluoroethylene composites and it has been applied successfully in self-lubricating applications in bearings and seals [3-5].

The literature enlightening the tribo-performance of polytetrafluoroethylene composites with various reinforcements like glass fibers, carbon fibers, MoS_2, TiO_2, graphite, bronze etc. is sufficient with regard to dry sliding [6-27]. However, limited literature is available with regard to friction and wear behaviour in aqueous environments. Moreover, very limited amount of work has been reported on graphite/Polytetrafluoroethylene composites. Wang and Yan examined the tribological performance of 15 vol.% graphite/Polytetrafluoroethylene under dry sliding and observed that graphite/Polytetrafluoroethyleneexhibited better wear resistance than virgin Polytetrafluoroethyleneowing to strong adhering of the transfer film on the counter body [28]. Goyal