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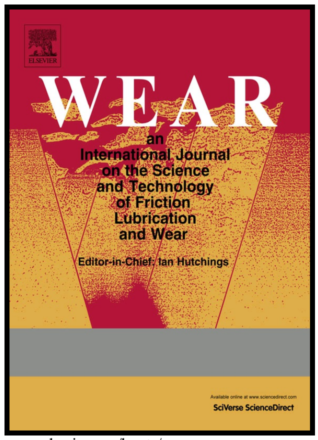

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Influence of surface modification on wear behavior of fly ash cenosphere/epoxy syntactic foam

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Abstract

The present study deals with investigating the surface modification effect of fly ash cenosphere (as received and surface treated) on the friction and wear response of epoxy syntactic foams. Such lightweight syntactic foams have the potential in using them as tribo-materials for friction applications like in brake pad composites. This study also addresses the environmental linked disposal issues of fly ash cenospheres by incorporating them (up to 60 vol.%) in the epoxy matrix. Cenosphere content and surface modification influence on the friction and wear response of cenosphere/epoxy syntactic foams is investigated against EN31 steel disc under dry sliding conditions. Wear behavior is studied at room temperature for different velocities (2 and 5 m/s), applied loads (30 and 50 N) and sliding distances (3, 5 and 7 km). Neat epoxy exhibits maximum wear rate as compared to foams. Wear rate decreases with increasing sliding distance and cenosphere content at all tested conditions. With the increase in the applied load and the sliding velocity, higher wear rate is noted for neat epoxy samples while it decreases with increasing filler loading. Surface modified cenosphere reinforced foams exhibit better wear resistance compared to as received cenosphere dispersed foams and neat epoxy for all the operating conditions owing to the good interfacial bonding of treated cenospheres with epoxy matrix. Specific wear rate decreases significantly with an increase in applied load. Further, the coefficient of friction decreases with higher filler loading and surface modifications. Scanning electron microscopy is used to study the wear mechanisms. Wear debris is analyzed and disc temperature is also reported. Finally, wear rate results are summarised and compared with the data available from literature and are presented in a property map.

Keywords: Surface modification, Syntactic foams, Cenospheres, Wear.

Nomenclature

ρ	Density of the composite (kg/m^3)	w_t	Wear rate (mm^3/km)
ρ^{th}	Theoretical density (kg/m^3)	w_r	Wear resistance (km/mm^3)
ρ^{exp}	Experimental density (kg/m^3)	w_s	Specific wear rate (mm^3/km-N)
ϕ_V	Void content (%)	F	Applied force (N)
V	Sliding velocity (m/s)	μ	Coefficient of friction
W	Wear volume	F_T	Tangential force (N)
D	Sliding distance (mm)	F_N	Normal force (N)

1 Introduction

Weight sensitive structures demand higher specific properties necessitating the usage of lightweight polymer matrix composites like syntactic foams. Syntactic foams are realized by infusing hollow microballoons in the matrix resin and find applications in naval, transportation and aerospace components because of better damage tolerance coupled with lower weight [1, 2]. Other applications of these closed cell foams include buoys, underwater vehicle components, buoyancy modules and sports goods [3, 4]. Syntactic foams have also been explored for automotive brake lining applications as friction materials [5]. Although