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R. Ghasemi, L. Elmquist, E. Ghassemali, K. Salomonsson, A.E.W. Jarfors

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Abrasion Resistance of Lamellar Graphite Iron: Interaction Between Microstructure and Abrasive Particles

R. Ghasemi [a,*], L. Elmquist [b], E. Ghassemali [a], K. Salomonsson [a] and A. E. W. Jarfors [a]

[a] Department of Materials and Manufacturing, School of Engineering, Jönköping University P.O. Box 1026, SE-551 11 Jönköping, Sweden

[b] Swerea SWECAST, P.O. Box 2033, SE-550 02 Jönköping, Sweden

**Corresponding author: Tel: +46 36101179; fax: +46 36166560*
E-mail address: Rohollah.Ghasemi@ju.se

Abstract

This study focuses on abrasion resistance of Lamellar Graphite Iron (LGI) using microscratch test under constant and progressive load conditions. The interactions between a semi-spherical abrasive particle, cast iron matrix and graphite lamellas were physically simulated using a sphero-conical indenter. The produced scratches were analysed using LOM and SEM to scrutinise the effect of normal load on resulting scratch depth, width, frictional force, friction coefficient and deformation mechanism of matrix during scratching. Results showed a significant matrix deformation, and change both in frictional force and friction coefficient by increase of scratch load. Furthermore, it was shown how abrasive particles might produce deep scratches with severe matrix deformation which could result in graphite lamella's coverage and thereby deteriorate LGI's abrasion resistance.

Keywords: Lamellar graphite cast iron, abrasion resistance, scratch test, microstructure, pearlite deformation

1 Introduction

Lamellar **G**raphite **I**ron (**LGI**) alloys are commonly used in applications such as piston rings and cylinder liners in heavy-fuel marine diesel engines, where an excellent combination of thermal and tribological properties are required [1, 2]. The self-lubricating performance of LGI is basically due to the presence of graphite lamellas in the microstructure, in which, under sliding condition, the graphite particles are worn out and the graphite residues end up onto the tribosurfaces. This lubricating film formation mechanism; thereby, improves the wear response of sliding system by decreasing friction and specific wear rate [3]. In addition, the smearing process of the graphite between the sliding surfaces results in reducing of scuffing and seizure risks as well [4, 5]. It is well-understood that it is tribologically beneficial and is an essential solution to keep the graphite particles open on the sliding surfaces in order to avoid scuffing, especially under unlubricated or