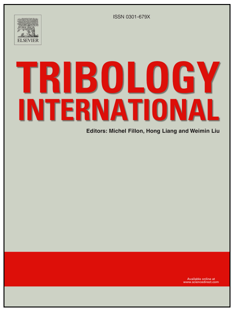
Accepted Manuscript



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PII: S0301-679X(17)30583-2

DOI: 10.1016/j.triboint.2017.12.025

Reference: JTRI 5009

To appear in: *Tribology International*

Received Date: 11 October 2017

Revised Date: 13 December 2017

Accepted Date: 16 December 2017

Please cite this article as: Tooptong S, Park K-H, Kwon P, A comparative investigation on flank wear when turning three cast irons, *Tribology International* (2018), doi: 10.1016/j.triboint.2017.12.025.

A Comparative Investigation on Flank Wear When Turning Three Cast Irons

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Abstract

A series of turning experiments is conducted on Flake Graphite Iron (FGI), Compacted Graphite Iron (CGI), and Nodular Graphite Iron (NGI) under dry condition. With uncoated carbide inserts, the adhesion layer, covering the entire tool-work interfaces, is formed when cutting CGI and NGI, which reduced flank wear compared to FGI. By contrast, the flank wear on the multilayer-coated inserts, obviously significantly reduced compared to the uncoated inserts, is significantly higher for CGI and NGI compared to FGI. Finite Element Analysis (FEA) is used to estimate the average flank temperature under various cutting conditions, which indicates the elevated cutting temperature with CGI and NGI. With the cutting temperatures from FEA simulations, the observed flank wear for FGI, CGI, and NGI conforms to the two-body abrasive wear model, indicating a common abrasive wear mechanism. Therefore, the main reason for the poor machinabilities of CGI and NGI is the higher cutting temperatures on the cutting tools when cutting CGI and NGI.

1. Introduction

Gray cast iron or flake graphite iron (FGI) has many industrial applications because of its excellent castability and machinability. The excellent machinability of FGI has been studied and demonstrated for many decades. When machining FGI, many factors such as graphite size and distribution, ferrite/pearlite ratio, abrasive cementite content and non-abrasive inclusions were identified to influence tool life. Griffin et al. [1] performed turning experiments with three types of pearlitic FGIs with the same strength and hardness with uncoated carbide inserts at the cutting speeds of 200, 250, 375, 500 m/min and stated that tool wear was higher with the FGIs with lower graphite content and higher hard inclusion content (alloyed carbide and steadite). Li et al. [2] conducted the drilling experiments on many FGIs with varying graphite and pearlite contents using M7 high speed steel drills at the cutting speed of 30 m/min. Among the FGIs with the same graphite content, FGIs with higher pearlite contents had better machinabilities. Among the FGIs with the same pearlite content, FGIs with higher graphite content in general provided better machinabilities. Kato et al. [3] studied the machinability of FGI with binderless cubic boron

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