Effect of both the interactions between scratches and the asperity attack angle on friction in an iron ore rock

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1. Introduction

The value of mineral production, benefited and commercialized in 2016, was estimated at 88 billion reais [1].

In the processes of prospecting, extraction and processing, several types of tools, among them, sintered tools with dispersed diamonds, necessary to carry out these steps, end up being worn through severe abrasive processes [2].

A type of lithology, in which, tools have low performance, is known as banded iron formation. This rock is composed of alternating bands, of iron oxides and silicates.

One of the steps to understand this complex tribological system is the analysis of the coefficient of friction. In this work, the relationship between friction coefficient and the angle of attack of the asperity and the degree of interaction between the scratches were studied.

2. Experimental Procedure

Samples of the rock were ground and polished to 1 µm. After preparation, tests were carried out in a CETR Universal Macro-Tribometer model Apex.

Two types of diamond indenters were used, in an edge parallel to scratch configuration, to achieve three different attack angles (Table 1). Scratches were done with these indenters, varying the normal load, and the apparent friction coefficient was measured.

Table 1 Indenters parameters

Indenter	Angle between edges	Attack angle	Normal loads
Vickers	148º	16º	0,2-8 N
Knoop	172º5’	3,75º	0,2-8 N
Knoop	130º	25º	0,2-8 N

Besides, tests varying the distance between scratches were done with the Vickers indenter at 5 N constant load. The distances ranged from five times the scratch width to superimposed scratches.

3. Results

In practically all the tests, lower friction was observed in the lower loads. From certain critical values, the friction stabilized, not being influenced by the normal load.

Comparing the results of friction for the higher loads, a correlation of friction and attack angle was observed, as shown in figure 1.

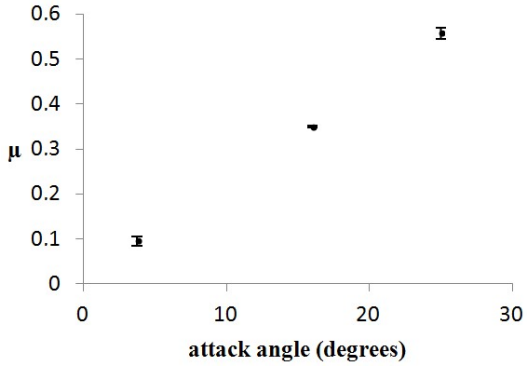

Figure 1 Variation of friction with attack angle

In the tests studying the effect of interactions between scratches on friction, no correlation was founded for the iron oxides band neither for the silicates band, as observed in figure 2. Also, it is possible to notice that the apparent friction coefficient is higher in the iron oxides than silicates.

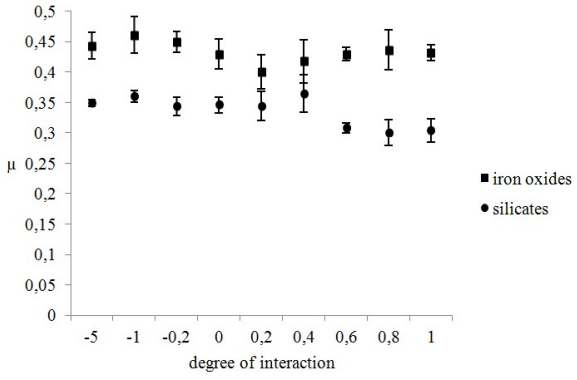

Figure 2 Variation of friction with attack angle

4. References

[1] DEPARTAMENTO NACIONAL DE PRODUÇÃO MINERAL. Diretoria De Planejamento e Desenvolvimento da Mineração. Informe Mineral. Brasília, 2016.

[2] Beste, U., A. Lundvall, and S. Jacobson. *Micro-scratch evaluation of rock types—a means to comprehend rock drill wear.* Tribology International **37.2** (2004): 203-210.