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Review Article

A STUDY OF BRAKING MATERIALS, THEIR TESTING AND ANALYSIS

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ABSTRACT

Braking is normally achieved by friction between the disc and pad. Friction materials are complex mix of fibres, modifiers, additives, fillers, and a binder resin which holds them together and are composed of between 5 and 20 elements in the composition. Each element has its own function and changing any element or its weight percentage of the friction material properties will change. Brake performance is limited by wear and friction. Understanding the wear mechanism will help us to develop the competency in the design and development of the brake disc and pads. Generally the disc brakes and are made up of cast iron and the brake pads are made up of asbestos material. Asbestos pads are very highly used because they deal with very high temperature. But the health effects of asbestos are dangerous. Due to the health related problems as well as the better performance quality the brake pads are replaced by semi metallic material. As we know that the semi metallic materials contains friction modifiers that bond all the components together. These are having excellent heat transfer and better friction with less wear.

INTRODUCTION

Semi-metallic Materials

Brake pads serves an important role in braking system. A composite of brake pads consist of structural materials, matrix, filler, abrasives and lubricants, with each components plays different roles in braking performance. Braking is associated with the release of wear particles in the form of elements, organic, and inorganic compounds. In order to achieve certain properties, the formulation of brake pads are continuously changed for improvements. The aim is to obtain the preferable wear and friction of environmental conditions. Brake materials typically contain the solid lubricants, abrasives, and other reinforcement fibres. When the brake materials become more complex, then the wear particles will be generated during friction processing. Morphology of samples were observed by SEM (Do-Wan, *et al*., 2008; Rukiye and Nurettin, 2010; Mohsen, *et al*., 2004).

Brake Pad

Brake pads systems in automobiles must have good wear resistant, stable coefficient of friction during service life, high thermal conductivity, and low thermal expansion properties. Metal matrix composites (MMCs) are considered as a unique material and is mainly used to produce light weight high strength and also used to reduce cost of technical applications and fuel consumption. Brake pads are mainly used to obtain the steady friction coefficient. Variety types of brake pads are available in market. Al-based MMCs are well known for their high specific strength, hardness, and tribiological properties. The main advantage of metallic brake pads comparing to the asbestos brake pads are absorbing more energy and wear resistance under high speed. The influence of the additives such as the graphite, and abrasives, in the metallic matrix on the formation of the friction layer was investigated by using a scanning electron microscope (SCM) equipped with energy dispersive

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X-ray spectroscopy(EDX) and Auger electron spectroscopy(AES).

EXPERIMENTAL DETAILS

Here we are going to discuss about the scanning electron microscope and the optical microscope.

Scanning Electron Microscope

We know that the scanning electron microscope is used to scan the sample images by scanning it with a focussed beam of the electrons. Whenever the electron interacts with the atom it produce various signals that can be detected and that contain the information about the about the various sample surface and its composition. SEM is mainly used because it can achieve the resolution better than 1nanometer (Kermca, *et al.*, 2005; Samrat and Chugh, 2007; Gurunath and Bijwe, 2007). In this process the specimen can be observed through high vacuum, low vacuum (Fig. 1).

Optical Microscope

The optical microscope is mainly used to collect the light samples. At the lower end of the optical microscope there are one or more objectives of the lenses collect the light from the sample. Microscope objectives are mainly characterised by the two parameters. They are magnification, and the numerical aperture. The former typically ranges from 5x to 100x while the latter ranges from 0.14 to 0.7 corresponding to the focal length of 40 to 2mm, respectively.

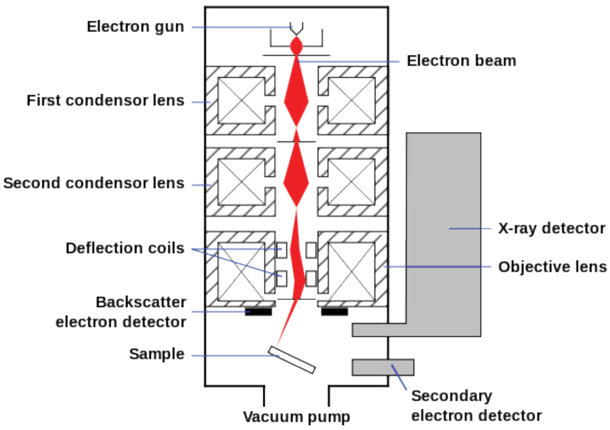

Fig. 1 Optical microscope.

Principle

The objective lens is having a very short focal length. It is brought very close to the specimen being examined so that the light from the specimen comes to a focus inside the microscope tube. This creates the enlarged image of the subject. By carefully focussing a brightly lit specimen, a highly enlarged image can be seen. If we see this real image that is viewed by the eyepiece lens that will provide the further enlargement.

RESULTS AND DISCUSSION

Sem Analysis

Fibers are indicated by Black arrow, metal particles are indicated by red arrow and powder material is indicated by blue arrow (Fig. 2).

Sem Edax Analysis

The element of CK contains 96.68%weight and the atomic range is 97.76%, the element of OK contains 02.78% weight and the atomic range is 02.11%, the element of SK contains 00.11% weight and the atomic range is 00.04% and finally the element of FeK contains 00.43% weight and the atomic range is 00.09%.

The element OK contains 04.64% weight and the atomic range is 16.28%, the element FeK contains 02.10% weight and the atomic range is 02.11%, the

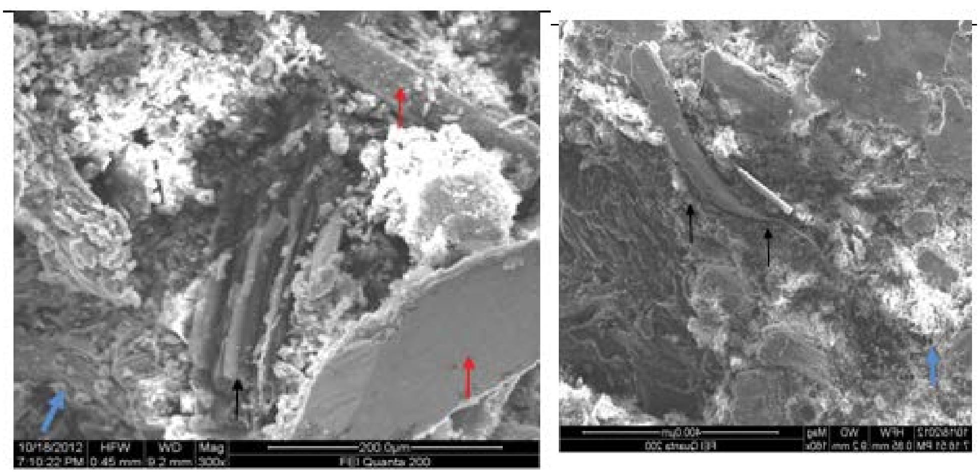

Fig. 2 SEM images have shown that clear picture about the distribution of fibers, metal particles and other particles.

element CoK contains 00.19% weight and the atomic range is 00.18%, the element CuK contains 57.65% weight and the atomic range is 50.97% and finally the element ZnK contains 35.43% weight and the atomic range is 30.45% (Fig. 3).

Optical Microscope

Microstructure examination on worn surface revealed that the wear composed of a complex mixture of abrasion and adhesion type of wear were happened as shown in (Fig. 4a, 4b and 5). Thus, it can be concluded that the wear surfaces became smoother with increase in braking time. It also shows that determination mechanism where it revealed the wear particles flake off from the wear surface and transferred to disc surface (Zmago, *et al*., 2007; Peter, *et al*., 2007; Min, *et al*., 2006).

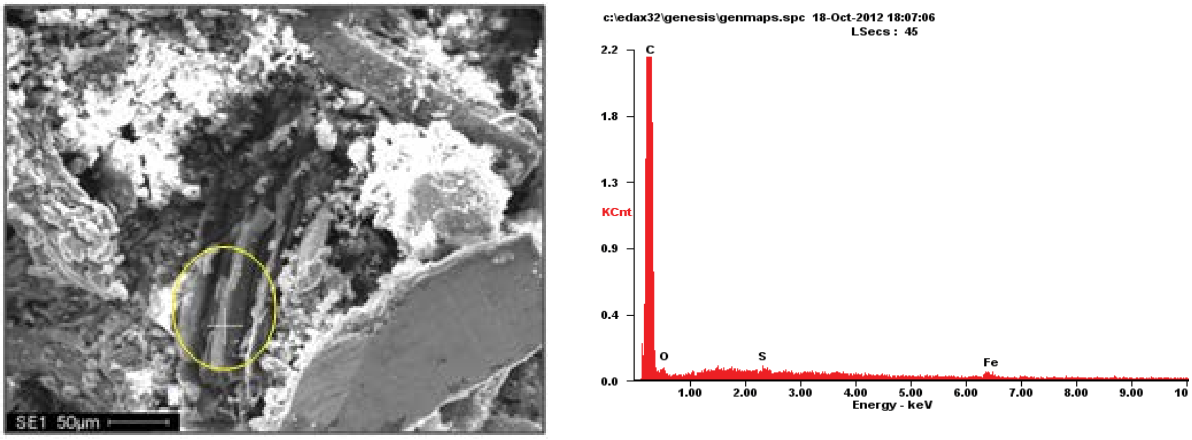

Fig. 3 Carbon fibers identified in the brake pad materials.

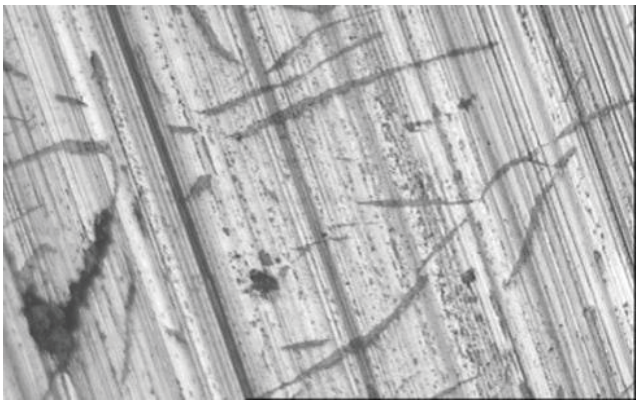

Fig. 4a Abrasive wear-disc shows the manifestation of abrasion wear mechanisms where it reveals the graphite flakes on the surface.

Fig. 4b Abrasive wear-disc manifestation of adhesion mechanism. Adhesion wear mechanism composed a process of two-way transfer during sliding caused the formation of transfer layers on.

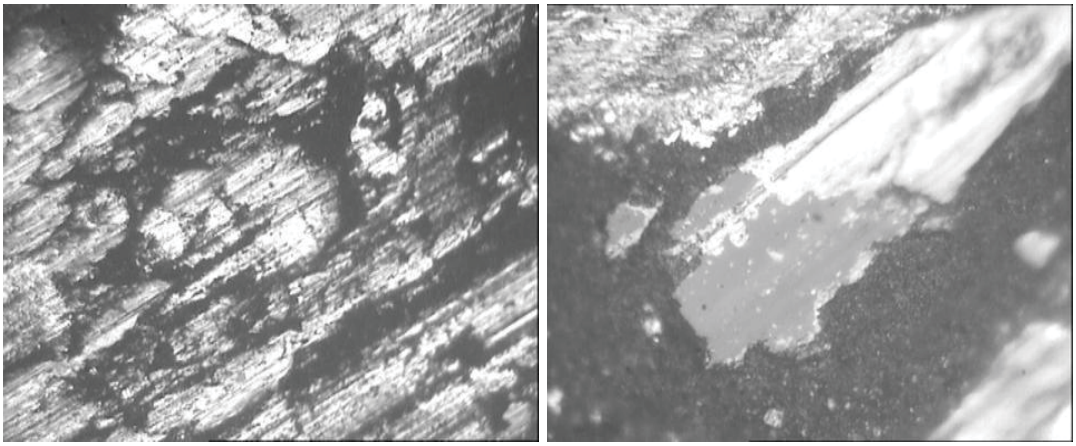

Fig. 5 Adhesive wear – Pad shows transfer layers appeared to be sheared, flattened and smeared on their surfaces.

CONCLUSION

From this work we came to know that the, different values of the coefficient of the friction optical microstructure, SEM analysis are to be carried out.

The following conclusions are to be made from the present work.

1. In optical microstructure for disc brake material and disc pad material are having abrasive wear and adhesive wear in nature.

2. SEM with EDX analysis for the brake pad material shows the different types of elements present in it.

REFERENCES

Do-Wan, L., Tae-Hwan, K., Jin-Ho, C., Jin-Hwe, K. and Hong-Sik, P. (2008). A study of the strength of carbon–carbon brake disks for automotive applications. *Composite Structures.* 86 : 101-106.

Gurunath, P.V. and Bijwe, J. (2007). Friction and wear studies on brake-pad materials based on newly developed resin. *Wear*. 263 : 1212-1219.

Kermca, M., Kalina, M. and Vizintina, J. (2005). Development and use of an apparatus for tribologicalevaluation of ceramic-based brake materials. *Wear*. 259 : 1079-1087.

Min, H.C., Jeong, J., Seong, J.K. and Ho, J. (2006). Tribological properties of solid lubricants (graphite, Sb2S3, MoS2) for automotive brake friction materials. *Wear.* 260 : 855-860.

Mohsen, M., Peter, J.B. and Delia, D. (2004). Characteristics and morphology of wear particles from laboratory testing of disk brake materials. *Wear*. 256 : 1128-1134.

Peter, J.B., Brian, C.J., Jun, Q., William, H.P. and Craig, A. (2007). Blue tribological investigation of titanium-based materials for brakes. *Wear*. 263 : 1202-1211.

Rukiye, E. and Nurettin, Y. (2010). An experimental study on the effects of manufacturing parameters on the tribological properties of brake lining materials. *Wear*. 268 : 1524-1532.

Samrat, M. and Chugh, Y.P. (2007). Development of fly ash-based automotive brake lining. *Tribology International*. 40 : 1217-1224.

Zmago, S., Kristoffer, K. and Tomaz, K. (2007). Friction and wear of sintered metallic brake pads on a C/C-SiC composite brake disc. *Journal of the European Ceramic Society.* 27 : 1411-1417.