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Influence of Natural Rubber on the Frictional and Mechanical Behavior of the Composite Brake Pad Materials

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Abstract : The ingredients of composite materials used for the production of composite brake pads play an important role in terms of safety braking performance of automobiles and trains. Therefore, the ingredients must be selected carefully and used in appropriate ratios in the matrix structure of the brake pad materials. In the present study, a non-asbestos organic composite brake pad materials containing binder resin, space fillers, solid lubricants, and friction modifier was developed, and its fillers content was optimized by adding natural rubber with different rate into the specified matrix structure in order to achieve the best combination of tribo-performance and mechanical properties. For this purpose, four compositions with different rubber content (2.5wt.%, 5.0wt.%, 7.5wt.% and 10wt.%) were prepared and then test samples with the diameter of 20 mm and length of 15 mm were produced to evaluate the friction and mechanical behaviors of the mixture. The friction and wear tests were performed using a pin-on-disc type test rig which was designed according to NF-F-11-292 French standard. All test samples were subjected to two different types of friction tests defined as periodic braking and continuous braking (also known as fade test). In this way, the coefficient of friction (CoF) of composite sample with different rubber content were determined as a function of number of braking cycle and temperature of the disc surface. The results demonstrated that addition of rubber into the matrix structure of the composite caused a significant change in the CoF. Average CoF of the composite samples increased linearly with increasing rubber content into the matrix. While the average CoF was 0.19 for the rubber-free composite, the composite sample containing 20wt.% rubber had the maximum CoF of about 0.24. Although the CoF of composite sample increased, the amount of specific wear rate decreased with increasing rubber content into the matrix. On the other hand, it was observed that the CoF decreased with increasing temperature generated in-between sample and disk depending on the increasing rubber content. While the CoF decreased to the minimum value of 0.15 at 400 °C for the rubber-free composite sample, the sample having the maximum rubber content of 10wt.% exhibited the lowest one of 0.09 at the same temperature. Addition of rubber into the matrix structure decreased the hardness and strength of the samples. It was concluded from the results that the composite matrix with 5 wt.% rubber had the best composition regarding the performance parameters such as required frictional and mechanical behavior. This composition has the average CoF of 0.21, specific wear rate of 0.024 cm^3/MJ and hardness value of 63 HRX.

Keywords : brake pad composite, friction and wear, rubber, friction materials
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