IJR International Journal of Railway
Vol. 5, No. 4 / December 2012, pp. 152-155

The Korean Society for Railway

Characteristics of Graphite Particle Size comprised in Metallic Friction Material

Young Gyu Kim, Jong Seong Lee, Sang Ho Kim and Hi Sung Lee†

Abstract

The essential element of brake device for railway vehicle is in demand for higher performance along side the trend of railway vehicle size and speed. Essential element of brake device for high speed train is composed of metallic friction material and brake disc. Thus, brake distance, duration and brake stability shall be determined due to friction materials and friction characteristics. Also friction characteristics are influenced by metallic friction material's properties of matter, manufacturing process and component parts. Various materials and configurations of metallic friction materials are currently being implemented to railway vehicles, For this reason study of friction characteristics in accordance with materials is necessary, but study of these important elements are not actively being accomplished. Therefore, in this study, wished to study the graphite's friction characteristic comprised in friction material in accordance with particle size and amount of volume through lab-scale test.

Keywords **:** *Metallic Friction material, Brake disc, Graphite particle size, Lab-scale test*

1. Introduction

High speed rail vehicles based on the braking device to switch to kinetic energy, thermal energy, the Pearl and the only lecture the braking device, cast iron discs (brake disk) and metal sintering friction material (metallic friction material). These deal with the braking performance of high speed rail between friction characteristics, especially friction: friction thermal effect of high temperatures that occur due to the complexity of the phenomenon in terms of friction and friction is the key factor that determines the attributes.

Friction in several events in the metal-sintered friction materials and material characteristics and friction of the material characteristics of friction materials that make up is determined by the ingredients. Currently, ost being applied as the metal-sintered friction Cu and Fe core components are Cu-Fe (Cu-Fe Base) SiO_2, Al_2O_3, SiC, Cr on the base, adjust the friction of Graphite, such as $ZrSiO_4$ and lubrication materials, such as Ca Fe, and the combination of this friction between these consists of ash to determine the friction characteristics. In this study, lubricating materials, geometry and being used in metal-graphite sintered friction materials and brake disk you would like to research the symptoms and characteristics of friction between.

2. Equations of Motion

2.1 Test method

Current rail vehicles and metal-sintered friction materials of Cu-Sn-Fe-friction materials produced using the sample, test evaluation. Cu-Sn-Fe-an important component of friction and the base organization, Cu-Sn, Fe, including SiC, Al_2O_3 and SiO_2 friction adjustment material and graphite $ZrSiO_4$ (graphite) lubrication consists of this experiment, as Table 1 is the same as the other ingredients other than the graphite and particle geometry (standing and Edition) this corresponds to a cusp of other graphite by varying the powder mixed and produced by molding, sintering process sample.

Table 1 and shown in Fig. 1 as the sample produced a small inertial power tester (Lab Dynamo Tester) through the Friction behavior and to characterize the size of 35 ×

† Corresponding author: Seoul National University of Science and Technology
E-mail : hslee@seoultech.ac.kr

Table 1. Formulation of Metallic Friction Material for Test Sample

Sample	Matrix	Friction Modifier			Lubricant	
	Cu+Sn+ Fe	SiC	SiO_2	Al_2O_3	Graphite (Granule Type)	Graphite (Flaky Type)
No.1	Balance	10 - 20			5	1
No.2					3	3
No.3					1	5

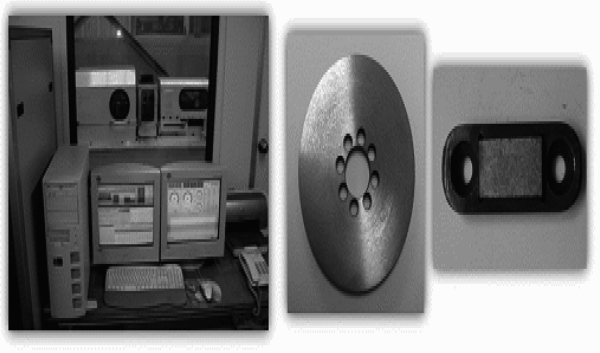

Fig. 1 Lab scale dynamometer

16 mm × 10 mm specimens, respectively 8 m/s, 10 m/s, 12 m/s speed of the braking pressure of 0.6 MPa at 50 times through the coefficient of friction and brake test reliability coefficient of friction, wear rate were compared and analyzed.

In addition, a small inertia lab scale dynamometer repeated braking tests with after each test used for measuring friction and disk surface roughness and friction materials, each with roughness of the disk (friction measuring length: 12 mm, disc measuring length: 16 mm) measured and SEM / EDS through analysis and XRD analysis of the friction surface is formed on friction/wear and tear arising from the brake pads and analyzed the phenomenon of friction between disks.

2.2 Test results

2.2.1 Characteristics of the friction braking

By LSDT 16 m/s, 22 m/s, 28 m/s at a rate of braking pressure of 0.5MPa given a brake test results of 50 times, respectively, each samples average friction coefficient is shown in Fig. 2.

As shown in Fig. 2, the results of the kind of doped graphite friction characteristic varies according to the proportion. Graphite plate with the increase of the rate of speed in the range of friction coefficient (μ) tended to be higher. Graphite typically natural graphite plate (natural graphite) the structure known as a high lubricity, but the

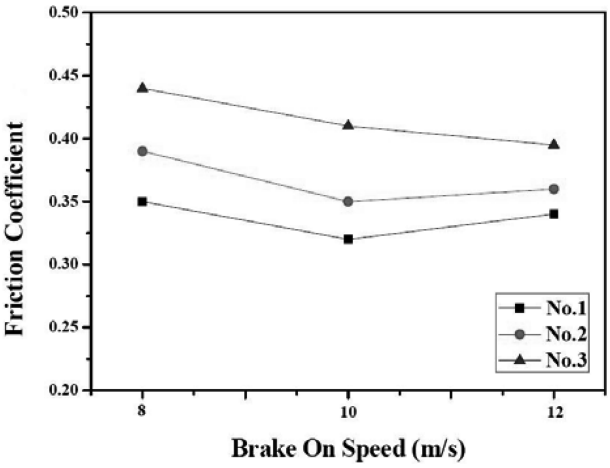

Fig. 2 Relation between friction coefficient at different brake time for metallic friction material

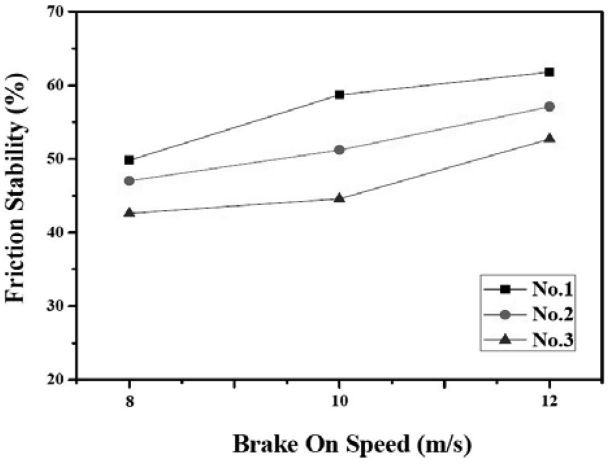

Fig. 3 Relation between friction stability at different brake time for metallic friction material

actual test results rather high coefficient of friction respectively.

2.2.2 Friction coefficient stability Reliability

Fig. 3 is the coefficient of friction depending on speeds.

As shown in Fig. 3 The results of graphite containing the kind of stability, according to the proportion of each sample, the coefficient of friction increases both the rate showed a tendency of increasing the proportion of graphite platelets entire speed range with increasing stability in the coefficient of friction tended to be higher.

2.2.3 Wear Characteristics

Fig. 4 is sintered metallic friction materials for the wear.

As Shown in Fig. 4, The results of graphite doped according to the proportion of the type of disk surface

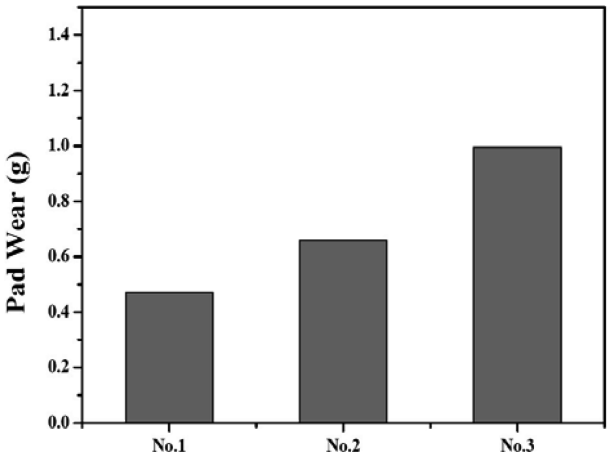

Fig. 4 Relation between pad wear & surface roughness for metallic friction material

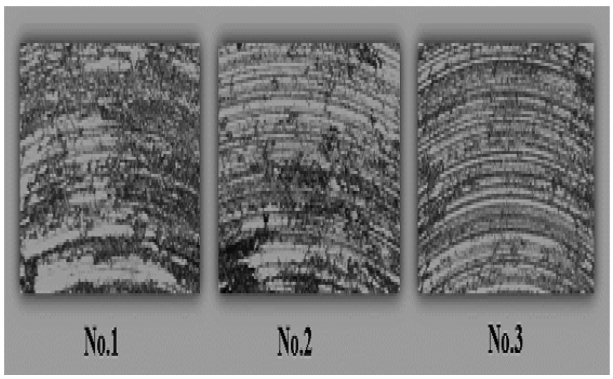

Fig. 5 Friction surface of metallic friction material

roughness and wear rate of sintered friction material metallic cage and could be confirmed. Platelet graphite metallic with increasing the ratio of wear rate of sintered friction materials showed a tendency to increase compared to No.1 No. 3 cases, about two times the amount of wear was a lot of.

2.3 Analysis of results

Graphite plate with increasing amounts of Fig. 2 As can be seen from the results of all the speed in the range showed a trend of frictional coefficient. Graphite plate usually structurally high lubricity. But this experiment showed different patterns. Fig. 5 LSDT after the friction of each sample observed that the surface of a plate of Fig. 5 shows that this amount was increased graphite grinding on friction surface to wear (Abrasion) observed that a wide-uniformly distributed could be. Of the friction material and braking The friction and wear between the disk occurs in the course of a relatively large specific surface area of the plate - graphite friction easily separated from the base of

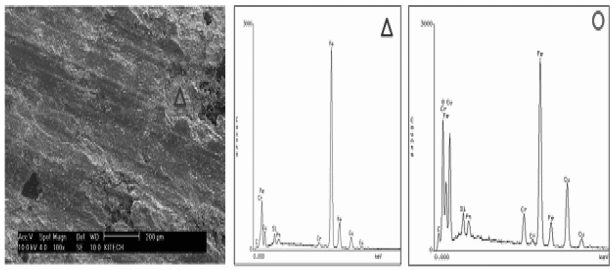

Fig. 6 Friction surface of SEM (scanning electron microscopy) & EDX spectrum

the organization by forming more abrasive particle relatively large abrasive wear is the judgment to be made. This is shown in Fig. 4 as a result of plate - Graphite with increasing amounts tend to increase the amount of wear, indicating the same reasons as are determined. As shown in Fig. 3, the results of the stability number as you can see from the plate that is lowered with increasing amount of the graphite incense, respectively. The laminar friction with increasing amounts of the graphite surface abrasive particle subject to increased friction surface is considered heterogeneous due to friction.

Fig. 5 relate as shown in Fig. 3 The results of graphite containing the kind of stability according to the proportion of each sample, the coefficient of friction increases both the rate showed a tendency of increasing the proportion of graphite platelets entire speed range with increasing stability in the coefficient of friction tended to be higher.

Friction surface of metallic friction material l as can be observed in Fig. 5, while the friction surface to abrasive wear (Abrasion) increases with the amount of the flaky graphite friction surface portion of the light evenly distributed could be observed. Figs. 5~ 6 of the friction surface of the SEM (scanning electric microscopy) and EDS Spectrum to be observed through the light areas in Figs. 5~ 6 to smooth in (display) and the oxidized film were analyzed by EDS. Typically, the formation of a uniform oxide film showed a stable friction characteristics, but rather uniform in this experiment

No. 3 sample oxidized film formed on the friction characteristics were unstable. The abrasive wear and oxidative wear in terms of friction when a mixture of abrasive wear of the wear mechanism that overrides are considered.

3. Conclusion

1) Graphite plate with increasing amounts of the friction coefficient and wear rate showed a tendency of increasing. wear and tear on the relatively large surface area of

the base plate friction material graphite in the organization can easily been eliminated as more according to form abrasive particle abrasive wear is determined by the impact.

2) Graphite plates with increasing amounts of the stability of the friction coefficient showed a decreasing trend. Graphite plate with increasing amounts of the plane of friction with increasing abrasive particle if friction is considered a non-uniform due to friction.

3) Increasing the amount of the graphite surface friction plate anodized but the formation of uniform grinding coexistence of wear and oxidation wear of the abrasive wear mechanism acting preferentially gathered Matthew is considered.

References

1. Suh, N. P and Sin, H. C. (1981). “The genesis of friction”, wear, Vol. 69, pp. 91-114.
2. International Union of Railway (1985). “Disc brake and disk brake linings”, International Union of Railway, 3rd Edition.
3. Kim Sang Ho and Lee Hi Sung (2007). “Railway disc brake tribological characteristics”, Journal of the Korean Society of Tribologist and Lubrication Engineers, Vol. 23, No. 1, pp. 19-28.
4. Kim Gi Youl, Kim Sang Ho, Lee Beom Joo, Jeong Jin Hyun and Cho Jeong Whan (1998). “A investigation on the friction materials for high speed train”, Journal of the Korean Institute of Metals and Meterials, Vol. 11, No. 2, pp. 134-143.

Received(December 5, 2012), Revised(December 9, 2012), Accepted(December 17, 2012)