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A Review Paper on Disc Brake

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A B S T R A C T

When developing new vehicles, the safety aspect in automotive engineering is considered a top priority. Brakes convert friction into heat, but when the brakes get too hot, they stop working because they can't dissipate enough heat. Ventilated disc brakes are the most advanced technology in automotive braking systems. In this study, an FEA method was employed to identify the temperature distribution and behaviour of a transient disc brake rotor. This paper reviews previous researchers' work on transient thermal analysis of ventilated disc rotors and rotor designs to evaluate and compare their performance. Apply a time-varying temperature load to the rotor and analyse the temperature distribution taking into account cooling parameters (convection and radiation). The main purpose of this review is to examine various studies conducted in the past to improve the heat transfer rate of disc brakes (vented) by changing blade geometry and materials.

Key Word: Disc brake, Heat Transfer coefficient, Dry contact, Heat flux & thermal Analysis.

1.Introduction

Disc brakes are available in fixed, fixed and ventilated. A disc brake is a device used to slow or stop the rotation of a wheel. Brake discs (or rotors), usually made of cast iron or ceramic composites (including carbon, Kevlar and silica) and bonded to the wheel and/or axle. To stop the wheels, friction material (mounted on so-called brake callipers) is pressed against both sides of the brake disc mechanically, hydraulically, pneumatically or electromagnetically. These brakes provide better braking performance than comparable drum brakes, including resistance to "brake fade" caused by overheating of brake components and quick recovery from immersion (wet brakes are less effective). Discs are now the more common form in most passenger cars, although many (especially light vehicles) use drum brakes on the rear wheels to reduce cost and weight and simplify the provision of parking brakesFriction brakes work by creating friction when two or more surfaces rub against each other.

The braking force or braking performance of a friction brake depends on the contact area and coefficient of friction of the tread and the applied driving pressure. Wear occurs on working surfaces, and the durability (or lifespan) of a particular brake depends on the type of friction material used in the brake's replaceable surfaces. When the Drake disk is in a solid state, the heat transfer rate is very low. The time required to cool the disc is very short. When the brake disc is a solid body, the contact area between the brake disc and the brake pad is larger, so the braking effect is higher.

2. Literature Survey

Subhasis Sarkar 2014 The purpose of the current study is to investigate and analyze the temperature distribution of the rotor disk and use FEA analysis to determine the critical temperature during operation. A static thermal analysis of disk rotors is performed to evaluate and compare their performance and to analyze the temperature distribution taking into account cooling parameters (convection and radiation). Comparative studies were conducted between different materials, such as B. AMMC, asbestos and GCI [1].

Table 1 Comparative Table between Gray cast iron & Aluminum Composite

Sr. No.	(Km/Hr)	Maximum Temperature (K)
Grey Cast Iron		
1.	80 km/hr	440
2.	90 km/hr	476
3.	100 km/hr	502
Aluminum Matrix Metal Composite		
4.	80 km/hr	432
5.	90 km/hr	464
6.	100 km/hr	488

S. Manavalan, AswinGopi, J. Arivarasu 2019 Braking is the process of converting the mechanical energy of a vehicle into mechanical energy that is dissipated in the form of heat. If there is no rest in the car, the driver may be placed in an unsafe position. Brakes convert friction into heat, but when the brakes get too hot, they stall because they can't dissipate enough heat. It is necessary to perform a structural analysis within the Clearance Action Thermal Analysis in ANSYS to examine the stability and stiffness behaviour of the rotor material. Results obtained with finite element simulations and smart materials are highly recommended. Research on the shortcomings of the ANSYS Ceramic Disc Brake System software package applied to transient thermal analysis in resistive heating. Obtain a simulation of the thermal behaviour exhibited in numerous disc brake rotor materials,

The basic equations for thermal conductivity are solved for 3 materials, with initial boundary conditions and thermal loads such as heat flow at the interface between the disc and pad. Here carbon material is used instead of traditional ceramic disc brakes. By adding it, it reduces heat generation as it is an honest conductor of heat. As a result, the life of the brakes is increased, while the mileage is increased due to the lighter weight than others.

Belhocine uses ANSYS Multi Physics for the temperature distribution of the rotor disc during braking. The work uses finite element analysis techniques to predict the temperature distribution on an intact and ventilated brake disc and to determine the critical temperature of the rotor by taking into account certain parameters such as : Material used, disc geometry and braking type

Ali Belhocine and Mostefa Bouchetara concluded in this work that the modelling of temperature distribution in disc brakes is used to identify all factors and input parameters relevant to the braking process, such as brake type and geometric design. CD and one of the materials used. The coupled transient thermal and stress fields were numerically simulated using an ANSYS-based sequential thermal-structural coupling method to evaluate the stress field and deformation occurring in the disk and the contact pressure on the pad. Compared with the technical literature [4], the simulation results are satisfactory

HasseneDjemel presents a thermo mechanical model of an automotive braking system. For this purpose, three-dimensional calculations of laminar, transitional and turbulent flow in the brake disc ventilation duct are performed. The calculation is based on the finite volume method. Modelling the friction of a pad against a moving disk, a new technique was developed called the "slip boundary condition", which allows us to account for the spatial and temporal variations of the friction-generated heat flow and update its dependence on quantity and velocity. Moving scene. In fact, we solve this problem in two completely independent computational stages. During the preliminary calculation phase, the speed and temperature of the plates are kept constant. Correlations are established that give the cooling kinetics required for conduction transfer in the computing disc.In a second calculation phase, we have used the equations giving the kinetics of the cooling disk for the thermal loading of the disc resulting in calculation of the transient temperature field. The results obtained by the simulation are satisfactory compared with those of the specializedliterature [5]

Katerina Kravchenko 29.-31. May 2019 One of the typical problems of modern high-speed transportation is its energy efficiency. The drag of the vehicle accounts for a large part. Usually attention is paid to the geometry and cross-sectional dimensions of the front of the vehicle. But airflow around rotating components, especially brake discs, also has a significant effect on overall drag. On the one hand, the airflow through the brake disc is required for cooling. On the other hand, when pan cooling is not required, it causes significant energy losses. The study of disk cooling channels helps minimize this airflow resistance. The authors deal with the estimation of brake disc drag through computer simulation analysis and experiments on special test rigs. This article describes special test benches and suggested measurement methods. The obtained results were compared with computer simulations.

Mr.SumeetSatope April 2017 The energy conversion causes the speed to slow down and bring the vehicle into a steady state. Heat dissipation during driving has a significant impact on braking performance. High stress during operation can cause wear and discoloration. The performance parameters can be improved by considering the thermal properties of the disc brake material. The aim of this study was to investigate the thermochemical behavior of different brake discs under extreme operating conditions, to evaluate their efficiency and stability, and to identify their weaknesses. In this paper, a study is carried out by considering different materials used to manufacture brake discs and their thermal behavior in load state analysis of disc rotors of different shapes and different materials

JurajGerlici&Yuliia Fomina 2021 For high-speed trains, the effectiveness of the braking system and the aerodynamic section modulus are looming when disc brakes are used for braking and result in reduced train traction. This paper discusses the possible causes of brake discs Aerodynamic loss level. The aerodynamic drag of various ventilated disc configurations as well as solid discs was evaluated. By analysing the described measured and simulated data, the dependence of the aerodynamic losses on the rotational and linear velocity of the rolling stock is derived for different disc designs, namely radial vane, tangential vane, combined and solid disc. An example of calculating ventilation losses for different train sets is shown

Pietro Tooling & Lorenzo Montesano Procardia Structural Integrity 33 (2021) this study proposes two laser coatings to improve the wear resistance of cast iron brake discs. Wear resistance is assessed by pin-on-disk and ring-block laboratory testing. Commercial lining materials are used as counterparts in

friction systems. Regular cast iron samples were used as reference material. During the test, the coefficient of friction is continuously recorded with sliding distance and the wear rate of the disc and pad material is calculated at the end of each test

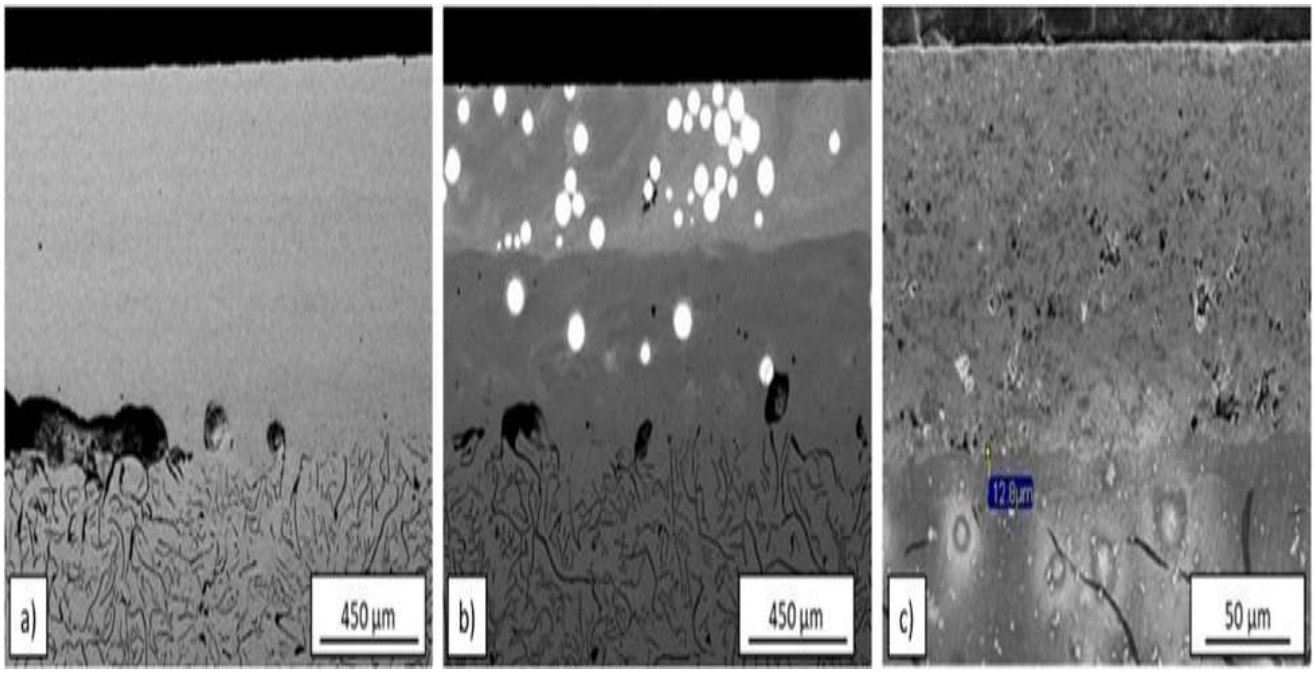

Fig.1Crosssectionmicrostructureofcoatings:a)SS;b)R-SS;c)CommercialHVOF.[8]

Laboratory-scale wear test results show that the proposed laser-plated SS coating containing WC particles is effective in improving the wear resistance of brake discs and linings compared to conventional uncoated GCIs. The wear rate of the R-SS layer is slightly higher than that of the HVOF layer, but the advantages can be achieved (according to the layer manufacturer) by a cost-effective deposition process and without the use of contaminants. In contrast, the wear properties of laser etched SS coatings are poor

3. Conclusion

The role of disc brake design in heat transfer is as important as other variables such as plate and blade thickness, fin material and flow patterns. From the results, it can be concluded that the temperature of both materials increases with increasing vehicle speed, but the heat generation rate of AMMC is lower than that of GCI. Comparing all available temperature measurement techniques, the thermocouple method shows clear advantages. They are very effective for measuring the contact temperature of friction pairs. In this case, there is a so-called "hot end" or hot junction very close to the friction surface. It has been found that, of the inflatable designs, the radial vane design causes the highest losses. The tangential blade design has lower losses. The combined design is the most efficient; it has radial and tangential inserts. Solid panes have very low ventilation losses, which is an advantage, but at the same time it has low cooling characteristics, that limits its use.

REFERENCES

[1]Subhasis Sarkar IJSRD - International Journal for Scientific Research & Development| Vol. 2, Issue 03, 2014 | ISSN (online): 2321-0613

[2] S.Manavalan,AswinGopi,J.Arivarasu Engineering (IJRTE) ISSN: 2277-3878, Volume-7 Issue-6S2, April 2019

[3] Belhocine A., Abu Bakar A.R., Bouchetara M., Numerical Modeling of Disc Brake System in Frictional Contact, Tribology in Industry 36 (1) (2014), 49-66

[4] Ali Belhocine, Mostefa Bouchetara, Investigation of temperature and thermal stress in ventilated disc brake based on 3D thermo mechanical coupling model, Journal of Ain Shams Engineering 4 (2013), 475–483

[5] Hassene Djemel, Mohamed Kaffel, Zied Driss, Hedi Kchaou, Mounir Baccar, Survey of the Streamlined and Thermal Behaviour of a Ventilated Disc Brake, International Journal of Mechanics and Applications 4(2) (2014), 21-28

[6] 13th International Scientific Conference on Sustainable, Modern and Safe Transport (TRANSCOM 2019), High Tatras, Novy Smokovec – Grand Hotel Bellevue, Slovak Republic, May 29-31, 2019

[7] Mr.SumeetSatope IJIRST–InternationalJournal forInnovative ResearchinScience&Technology|Volume3|Issue11| April2017

[8] Juraj Gerlici & Yuliia The dependence of the brake disc aerodynamic drag on the rolling stock motion speed.PublishedbyELSEVIERB.V. 2021

[9] Pietro Tonolini & Lorenzo Montesano The effect of laser-cladding on the wear behavior of gray cast iron brake disc.PublishedbyELSEVIERB.V. 2021