Development and production of high performance automotive brakes


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1. Overview

On automotive brakes, have remarkably more demands for higher brake performance, better stability for safety side, improvement in noise and vibration for comfort, moreover improvement in weight reduction for fuel performance. The demand is that to surpass conventional specification, to have stable braking performance and weight reduction at high temperature condition. A commercial road vehicle with top speed exceeds 350km/h, equipped with pads which enhanced its heat resistance for more than 200 ℃ through heat-resistant carbon-based lubricant made originally, in addition with development of ceramic base carbon disc. Furthermore, mass production was established with extreme downsizing through large weight reduction, along with driving comfort within a city area. Therefore, the technology proved that it is capable using in extreme condition.

2. Technical contents

The high performance automotive brakes consist of three main parts, namely: caliper, pad, and disc. (fig.1) In order to achieve weight reduction, stepped into downsizing of the disc, improved cooling performance and developed raw material of friction material originally to eliminate increment in heat load due to reduction in heat capacity, and established the brake with light weight and high temperature suitability.

At regular vehicle term of use, and at limited space in the race circuit, one of the driving situations to let a vehicle to perform its full performance is to repeatedly apply the brake from the speed range 70 – 300 km/h, declaration will be 2G at maximum. The disc temperature would rise up to 750℃. (fig. 2)

At high temperature region such as temperature above 600℃, the material consisted in the friction material, carbon-based lubricant, will oxidize leading to worsen brake performance and life of friction material. To encounter the problem, application of nano-scaled heat-resistant film at the tip of carbon lubricant help raise the thermal decomposition temperature by 200℃, this is the highest heat resistance abled solid lubricant in the market, and thus developed heat-resistant carbon-based lubricant. (fig. 3)

The caliper is made of aluminum alloy casting, adopted opposed pistons located at both side of disc. On the process of advancing weight reduction, implemented different approach for structure analysis from conventional method, since pedal feeling is greatly influenced by stiffness, and designed the structure with both weight and stiffness come into effect.

For minimization of disc size, the prediction of temperature due to increase in heat load is crucial. Therefore, dynamometer test and high resolution simulation for even the air flow around the brake leads to improvement in cooling performance and decision of size.

3. Summary

The technology of stable performance at time of high load and large weight reduction will play a large role in the future development of minimization and weight reduction of automotive. The acquired technology for high brake performance is already publicized to other mass produced brakes and possible to contribute to eco energy or effective usage of resources. Furthermore, heat-resistant carbon-based lubricant will increase application in larger field for not only for automotive pads but expand into the field outside the automotive brake, also largely contribute to the society through providing its lubricant function of high heat resistance and capability of application in high load condition.

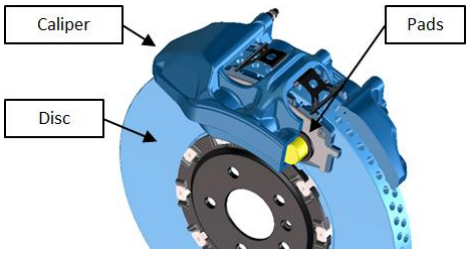

fig.1 High performance automotive brakes

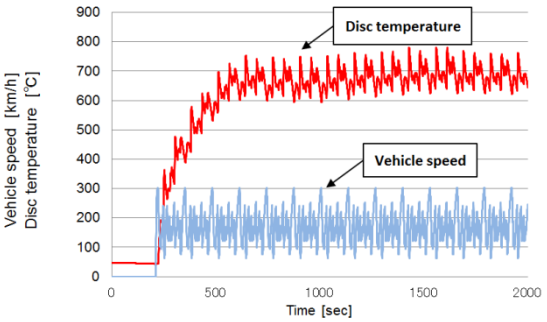

fig.2 Disc temperature and vehicle speed

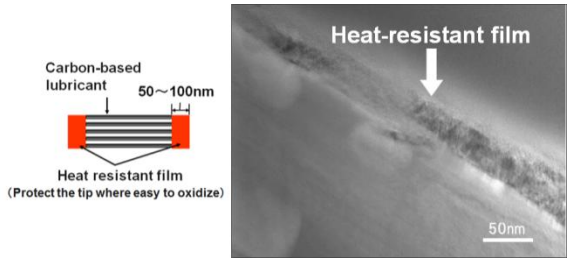

fig.3 Heat-resistant carbon-based lubricant

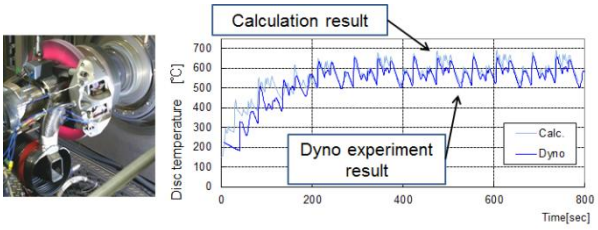

fig.4 Disc temperature calculation