Experimental and theoretical analysis of creep groan of disc brake

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Creep groan noise is generated when a brake pedal is slowly released in an automatic transmission car which is initially stationary. The stick-slip phenomenon of friction material and brake disk is the source of creep groan noise. The stick-slip phenomenon is caused by the difference between static fictional coefficient and dynamic fictional coefficient, and it leads to momentary change in braking force. The noise is transferred to the cabin through suspension and body. So it is generally recognized that brake system is the source of creep groan and the suspension is the transfer path of creep groan. As a result, engineers always try to solve creep groan noise through changing the friction material. But the effect of such solution is limited.

The self-excited vibration model is usually used when analyse the stick-slip phenomenon. In this model, whether the stick-slip phenomenon happens depends on the difference between static and dynamic fictional coefficient, the velocity of conveyer belt, the normal force imposed on the mass block, and the vibration characteristics of the spring mass system. Most people think the spring mass system stand for the brake pad and caliper. This is also why manufacturer believe that it is the brake supplier’s responsibility to solve the creep groan.

In this paper, the spring mass system is considered as the longitudinal bending deflection of the shock absorber strut. So the suspension system becomes more than a transfer path, but also a boundary condition of creep groan. A lumped parameter model will be established in this paper to simulate the whole process of an automatic transmission car from brake stop to move again. The stick-slip phenomenon happens in simulation is similar to the subjective test.

Besides, we have found in subjective test that the suspension attitude also effect the creep groan. The wheel base has decreased in braking process and it would not recover before the wheel moved again because both front and rear wheels were locked. We call this phenomenon “the bow effect” and it is due to the suspension K&C characteristics. Another lumped parameter will be established to analyse how K&C characteristics influence the creep groan.

This paper makes a conclusion that it wouldn’t be sufficient just to focus on brake system when solving creep groan problems. From the lumped parameter model, changing the suspension vibration or K&C characteristics is also a good choice. Besides, engineers can improve creep groan as well through changing the brake strategy of ABS or shift strategy of automatic transmission.