Indoor Air Quality at Stations: Development of a Methodology for Quantifying Railway Customers' Perception of Odor at Stations

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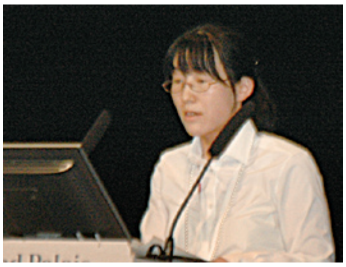

From the customer's point of view, providing a more comfortable station environment is important. From the railway's point of view, it is also essential for retaining railway customers. As a result of surveys addressing the comfort and cleanliness of railway stations and airports, approximately 90% of customers answered that airports are more comfortable and cleaner than railway stations. Customers have also shown a keen interest in the indoor air quality and odor in stations. Therefore, the authors began to carry out surveys to evaluate the indoor air quality of railway stations by trying to relate customers' views to investigations of airborne microorganisms.

Airborne microorganisms in 200 L of air were collected on to agar plates using an air sampling device. After cultivation of the plates, the number of microorganism colonies on each agar plate was counted. To study customers' views with respect to the indoor air quality of stations, surveys of 278 customers were also conducted at the same stations where the surveys of microorganisms had been carried out.

The number of airborne fungi in underground areas was greater than that in locations on the surface. There was a strong correlation (r = 0.72) between the degree of unpleasant odor judged by the customers and the number of airborne fungi (Fig. 1), and a weak correlation (r = 0.29) between the degree of unpleasant odor judged by the customers and the number of airborne bacteria. This result suggests that airborne fungi are an effective index in the evaluation of station air quality. Approximately 10% of the customers experienced strong sensations of odor in the station where the amount of airborne fungi was 500 cfu/m^3 (colony-forming units per cubic meter). We can predict how customers would sense and evaluate the odor in stations by measuring the amount of airborne fungi, using the results shown in Fig. 1.

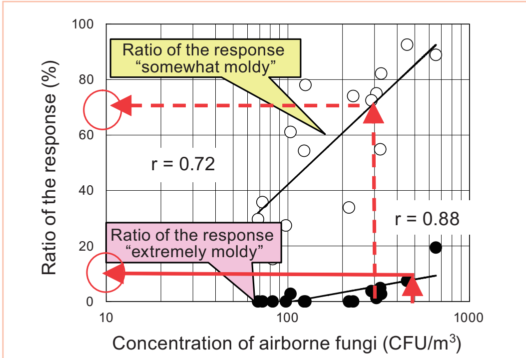

Fig. 1 Correlation between the ratio of the response "moldiness noticed" and the concentration of airborne fungi in stations

Improving the Running Safety of Railway Vehicles against an Earthquake

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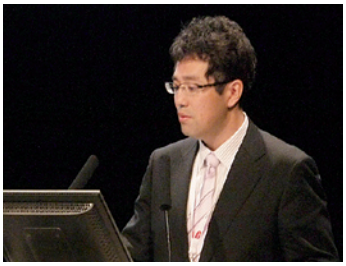

In October 2004, a Shinkansen train was derailed in Japan as a result of the Mid Niigata Prefecture Earthquake. This was the first ever earthquake-related derailment of a Shinkansen train running at high speed. Following the accident, there were calls for safety measures to counter the problem of earthquakes. To respond to these needs, we calculated how the safe running performance can be improved by modifying the parameters of the bogie, and we determined that running safety against earthquakes could be effectively improved by increasing the damping force of lateral dampers.

In this paper, we describe how we developed a lateral damper to improve the running safety of railway vehicles against an earthquake (Fig. 1). The damper we developed has the same damping force characteristics as those of a conventional lateral damper in the usual piston speed region to avoid deterioration of either ride quality or running stability under normal conditions. However, it has larger damping force characteristics than those of a conventional damper when the piston operates at unusually high speed.

We experimentally tested the damper using a full-scale vehicle model consisting of one bogie and a half carbody on our own large shaking test facilities. The damper we developed increases the oscillation amplitude as the wheel load becomes zero by approximately 8%. We also numerically verified the safety performance of the damper against an earthquake. Figure 2 shows the results calculated for the increased running safety limit in comparison with a conventional damper; the result is shown as a ratio between the two types. From Fig. 2, it can be said that the running safety limit with the damper we developed is higher than or equal to that of a conventional damper in all frequency regions from 0.3 Hz to 3.0 Hz. In particular, the increasing ratio in the frequency region from 1.2 Hz to 2.2 Hz is so large that the developed lateral damper can suppress the upper center rolling vibration of a vehicle more effectively. Finally, we carried out on-track running tests and confirmed that the lateral damper that we developed behaved like a conventional damper when running under normal conditions.

We collaborated with East Japan Railway Company in carrying out this research.

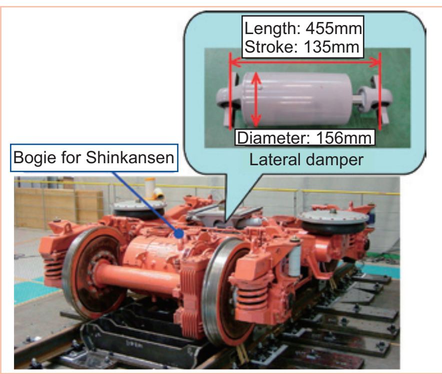

Fig. 1 Lateral damper developed to improve running safety during an earthquake

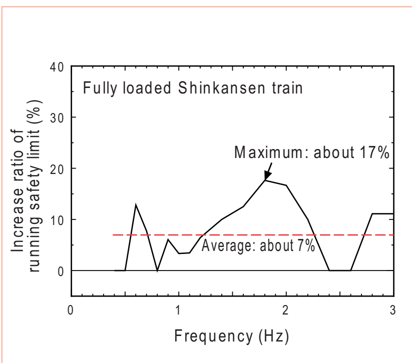

Fig. 2 Increase ratio of running safety limit of Shinkansen obtained by simulations