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Reuse of Rubber
- Shutting off Noise and Vibration from Under the Floor –

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○ Meeting Needs in the Age of Ecology

To meet needs in the "age of ecology," our company has taken initiatives ahead of others to develop vehicle technology that is friendly to people.

Among these initiatives is the development of an elastic floor structure using old tires and other refuse organic materials (Fig. 1).

The common method to dispose of old tires is to burn them using a combustible material. In this case, burning tires gives an off odor and smoke that are sometimes unbearable.

The author and his collaborators made a study to find a method for reusing old tires in a way that contributes to the protection of the global environment. We eventually devised a method for reusing them as floor material.

Rubber has long been used for the floors of schools, as well as hospitals and other medical institutions. This use has proved effective in facilitating walking by increasing floor elasticity; subduing clatters resulting from walking; and preventing serious injuries from falling-down.

How can old tires be reused?

Passengers get on a train car with various kinds of footwear on. For example, they may wear leather shoes, sandals or high heels. A vehicle floor must be strong enough for all conceivable kinds of footwear. Accordingly, every part of a floor must have the same hardness. Just cutting tires into small pieces and laying them over the floor area will result in large differences in hardness, and make it impossible to assure a satisfactory floor quality. Also, all the rubber portions of a tire do not have the same hardness; the portion contacting the ground is different from that on the wheel side in terms of hardness. Furthermore, a tire is a mixture of rubber and fibrous portions.

To solve these problems, we devised a method for crushing old tires to chips, and thereby separating main rubber portions from fibrous and other unnecessary portions. Using this method, we succeeded in securing a stable hardness.

The elastic floor structure developed by us is formed by crushing old tires for reuse as floor filling; and mixing chips, made from the tires, with a binder to be later plastered on the floor.

○ Difference from Other Rubber

There may be the concern that rubber in an old tire has deteriorated beyond useability. However, we confirmed that the rubber had maintained a satisfactory quality, by cleaning the rubber surface of an old tire before crushing.

For comparison, we also formed a floor structure using tire chips and another using ethylene propylene rubber (EPDM), and determined the acoustic and attenuation characteristics of both floors. EPDM has been marketed widely, and is quite popular among manufacturers.

As indicated by Fig. 2, the acoustic characteristics of both floors, shown as frequency distribution, are quite similar to each other, and present hardly any audible differences.

Fig. 3 shows that regarding attenuation also, EPDM and tire chips have similar characteristics.

As for the elasticity of the developed floor, there is some concern about distortion (concavity formation) under load. We conducted a concentrated load test for comparison of EPDM and tire chip floors regarding restoration. Fig.4 shows some results of this test. The figure indicates that the distortion of the tire chip floor is smaller than that of the EPDM floor, and that restoration is clearly faster with the former floor than with the latter. Accordingly, a tire chip floor is assumed to be restored to the original condition quickly after the application and removal of a load that can be expected in vehicle use.

All this results indicate that a tire chip floor has a quality equal or superior to that of an EPDM floor; and that rubber chips made by crushing old tires, as organic waste materials, can be used for elastic floors without any problems.

○ Reduction of In-Vehicle Noise

We conducted a test by running an actual vehicle, and its results confirm that use of rubber as floor filling can subdue in-vehicle noise.

The conventional floor structure is formed by plastering the mixture of a light clayey mineral aggregate and an epoxy-based binder. Compared to this structure, the tire chip floor structure has the following effects in subduing noise:

1) The tire chip floor structure reduces the level of in-vehicle noise by approx. 5 dB.

2) The floor structure is more effective in attenuation. Therefore, passengers perceive less noise when passing another train or in a tunnel.

○ Conclusion

Trains are superior to other transportations in

terms of energy saving and punctuality. With the further urbanization and aging of the society, demand will grow for the development of technologies to make trains more friendly to people and the environment.

The present study represents part of our company's long-standing efforts to develop vehicle technologies friendly to people. We think that in conducting this study, we succeeded in developing a technology to offer new products that reduces the level of in-vehicle noise, thereby meeting this need in the "age of ecology." We are confident about the future of technology for noise control, and we are eager to make further studies in this field.