New Vibration Damping Plastic Alloys for Engine Parts

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ABSTRACT

New vibration damping plastic alloys were developed using blends of nylon-6 or polypropylene (PP) with modifiers and damping agent. The damping properties and stiffness were compared with commercially available nylon-6 and PP. As trials , we have attempted to make these plastic alloys construction of engine such as cylinder head cover and timing velt cover. These plastic alloys were molded into engine parts such as the front cover, rocker cover and timing belt cover. The purpose was to reduce the noise levels approximately 4.0 dB lower than that of aluminum covers. The newly developed plasitic alloy engine covers have great potential to reduce engine noise.

INTODUCTION

During the last two decades, the automotive industry in Japan showed remarkable progress and development. As the motorization grew, the development of sophiscated engineering plastics for the automotive industry has expanded the applications into areas generally reserved for metals. Up to this time, the reduction in vehicle weight for energy conservation has been a key goal for today's automotive design. This was being accomplished by replacing metal components with plastics and composites. Consequently, the strong demands to reduce the external noise penetrating through the vehicle have been increasing in addition to the existing demand for quietness.

Among the many sources of noise and vibration in a vehicle, the engine is a very significant one. Various means have been taken to lower its noise and vibration levels. As one means to achieve this reduction, the application of vibration damping (VD) plastics has been investigated and has already been adopted to engine composites described later. However, the replacing metal component with plastics has created need to find efficient means for further noise reduction. The necessity for absorbing vibrational energy occurs whenever a structural unit has the possibility of being excited mechanically or acoustically to vibration modes having very high amplitudes. Practical solutions to damping these vibrations usually involve application of high damping materials to selected areas. Frequently, these materials are polymers. The ability of a polymer to effectively dissipate energy as part of a structure can be related to its viscoelastic properties. When aiming to improve the vibration damping for the noise reduction, it is common to blend modifiers.

In the current state of plastics technology, it is difficult to satisfy the demand to improve the VD characteristic without reducing the stiffness. Aiming to meet both requirements, usually results in lowering the stiffness by blending damping agents in plastics. Therefore, in order to give excellent damping characteristic and stiffness together, we expect that the damping properties could be improved by blending with modifier if the plastic maintains a continuous matrix in heterogeneous blends.

In this paper, new VD alloys of modified nylon-6 or polypropylene (PP) and damping agent were studied. The damping properties and stiffness were compared with nylon-6 and PP. These plastic alloys were molded into engine parts such as the front cover, rocker cover and timing belt cover.

VIBRATION DAMPING AND VISCOELASTIC PROPERTIES OF PLASTICS

ABILITY OF PLASTICS TO DAMP VIBRATION

As shown in Fig.1, there are two types of noise generation; air borne sound and solid borne sound. There are four kinds of noise reduction; sound insulation, vibration isolation, sound absorption and vibration damping. In these noise reductions, vibration damping is the most effective to absorb the vibration energy occurs whenever a structural component is excited mechanically in the vibration mode having very high amplitude. Practical solutions to damping these vibrations usually involve application of high damping material as polymers. The vibration damping ability of polymeric materials