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FABRICATING PROCESS AND MECHANICAL PROPERTIES OF ELASTOMERIC MOUNT

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ABSTRACT

This paper presents the fabricating process of elastomeric mount and their mechanical properties results. Four types of rubber were used to fabricate elastomeric mounts. They are from types of natural rubber (SMR CV-60), synthetic rubber, ekoprena and pureprena. SMR CV-60 is conventional rubber normal grade products from natural rubber. Synthetic rubber is rubber products from petroleum. Ekoprena and pureprena are advance rubber products from natural rubber. Before fabricate elastomeric mount, the rubber compound is designed based on actual mount such as shear modulus, hardness and static stiffness. A few processes have done to make the elastomeric mount such preparation of raw materials, mixing and curing process. Cured compound rubber and elastomeric mount were tested in the laboratory in order to determine their mechanical properties such as hardness, tensile strength, compression set, static stiffness and dynamic stiffness. The results from static tests showed that elastomeric mount from SMR CV-60 rubber, ekoprena and pureprena closed to actual mount except elastomeric mount from synthetic rubber.
Keywords: Elastomeric mount, rubber compound and mechanical properties.

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1. INTRODUCTION

To attenuate unwanted vibration from powertrain transfer to the body structure vehicle, the various isolator has been proposed and developed such as elastomeric mounts, hydraulic mounts, semi-active hydraulic mounts and active mounts. Elastomeric mount based on rubber has been used as isolator since 1930s, but hydraulic, semi-active and active were mounting based on the combination of rubber, fluid and electronic started during the early 1970s. Most vehicles use elastomeric mount as isolator to reduce vibration from powertrain to structure. This is due to the fact that, mounts based on the combination of rubber, fluid and electronic are more expensive, require higher maintenance and cause higher vehicle weight than elastomeric mount. In addition, properties of elastomeric mount including compactness, cost-effectiveness and low maintenance make it highly attractive for low price vehicle (Lee and Youn, 2004; Yu et al., 2001).

Most of the medium and small size passenger car use elastomeric mount as powertrain isolator because it is less expensive and allows the manufacturer to reduce the car price to cope with increasing demands of the market. In this paper, the fabricating process of elastomeric mount and their mechanical properties results are presented. The presentation began by designing rubber compound, followed by a few processes to form elastomeric mount, and finally presentation of mechanical properties results from elastomeric mount for four types of rubber.

2. METHODOLOGY

2.1 Designing Rubber Compound

Prior to designing rubber, compound, the actual elastomeric mount was tested to determine the static stiffness and hardness. Figure 1, shows the actual elastomeric mount and Table 1, show the dimension and mechanical properties from actual elastomeric mount.

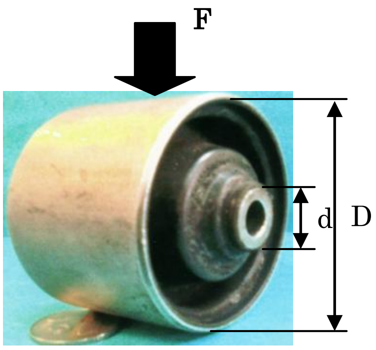

Fig. 1 Actual elastomeric mount

Table 1 Dimension and mechanical properties of actual elastomeric mount.

Property	Value
d	18 mm
D	67 mm
Length	49.5 mm
Load applied	313.92 N
Static stiffness	192.58 N/mm
Hardness	54 IRHD(N)
Shear modulus (from calculation)	0.3 MPa

The formulation to determine shear modulus is based on radial deformation of a bush (Lindley, 1984). The formula as below;

$$Bs = \frac{80\pi(D^2 + d^2)}{25(D^2 + d^2)\ln\left(\frac{D}{d}\right) - 9(D^2 + d^2)} \quad (1)$$

$$Bl = \frac{4\pi(D^2 + d^2)}{(D^2 + d^2)\ln\left(\frac{D}{d}\right) - (D^2 + d^2)} \quad (2)$$

$$B = Bs + \frac{0.15(Bl - Bs)L}{(D - d)} \quad (3)$$

$$Kr = \frac{F}{x} = BLG \quad (4)$$

Where *Bs* is the numerical factor short, *Bl* is the numerical factor long, *B* is the numerical factor, *Kr* is static stiffness, *L* is length, *F* is load applied, *x* is displacement and *G* is the shear modulus.

Rubber compound was designed based on parts per hundred (PPH). In this study, four types of rubber were used to form elastomeric mount. They are from types of natural rubber (SMR CV-60), synthetic rubber, ekoprena and pureprena. SMR CV-60 is conventional rubber normal grade products from natural rubber. Synthetic rubber is rubber products from petroleum. Ekoprena and pureprena are advance rubber products of research and development by MRB to increase properties of natural rubber depended on conventional grade such as SMR CV-60. Ekoprena is commercial named for epoxidised natural rubber (ENR) which developed and commercial by MRB. It is a type of advance rubber, which is obtained from chemical changing through epoxidation of natural rubber latex. Pureprena is a new generation of deproteinized natural rubber (DPNR) which is produced by treating fresh natural latex with industrial enzyme, which hydrolyses all natural-occurring proteins in the latex into water-soluble forms. It contains about 96% rubber hydrocarbons compared to 93% in conventional grade such as SMR CV-60 (Mardec Berhad, 2012). Both ekoprena and pureprena are category as green material because their production using natural material, not as synthetic rubber, which products from petroleum based. The proposed development of ekoprena and pureprena is to produce natural rubber that have the same or overcome characteristic of synthetic rubber (Berita Getah, 2009). In this study, rubber compound were designed based on PPH which were added by a few of ingredient as follow in natural rubber engineering data sheet (EDS). The objective in this designing is to obtain the same static stiffness at the same load apply for all elastomer mounts after fabricated. In this study, the elastomeric mount is formed as easy as possible. Elastomeric mount in the form of the cylinder was selected. Figure 2, shows the elastomeric mount in the form of cylinder type and it dimension. Table 2 shows the ingredients were used in the design rubber compound.

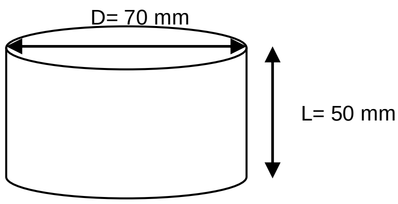

Fig. 2 Elastomeric mount in the form of cylinder type and their dimensions

Table 2 Ingredients of rubber compound

Properties
Rubber
Filler
Zinc oxide
Stearic acid
Santoflex
Permanax
Sulphur
CBS
TMTD

2.2 Mixing Ingredients and Curing Rubber Compound

2.2.1 Mixing Ingredients. Internal Mixer method was used to prepare masterbatch. The advantage using internal mixer is process is fast depending if using two roll mixer. However at the second state mixing, two roll mixers were used to mixing masterbatch, sulphur, CBS and TMTD. Figure 3, 4 and 5 show the ingredients preparation before mixing, internal mixer and two roll mixers.

Fig. 3 Ingredients preparation

Fig. 4. Internal mixer

Fig. 5 Two roll mixers

2.2.2 Curing Rubber Compound. Figure 6 shows the rubber compound after completed process using two roll mixers. Before curing rubber compound, two process need to be done to form elastomeric mount in form cylinder was shown in Figure 2. The first process was that rubber compound must determine it curing time. This curing time was determined by rheometer test. After curing time was determined, the rubber compound was cured in the form of piece proposed for hardness, tensile strength and compression set tests. The final processes were rubber compound were cured to form elastomeric mount in form cylinder. Figure 7, shows rubber compound were cured in the form of the piece, and Figure 8, shows elastomeric mount was cured of rubber compound.

Fig. 6 Rubber compound

Fig. 7 Cured rubber compound for hardness test

Fig. 8 Elastomeric mount

2.3 Mechanical Testing

Four type rubber compounds were cured in the form of hardness, tensile strength, compression set while elastomeric mount were tested to determine static stiffness and dynamic stiffness. Hardness, tensile strength, compression set were tested followed the standards ISO 48, ASTM D412 and ISO 815 respectively. Static stiffness and dynamic stiffness were tested followed the standard JIS K6385-1997.

3. Result and Discussion

Figure 9 shows the graph static stiffness of elastomeric mount. The graph shows the static stiffness of elastomeric mount by using difference carbon black. There are three different percent carbon black that are unfilled, 20% and 45%. By observation from the static stiffness, graph shows that the elastomeric mounts which contain carbon black about 45%, they have high static stiffness then the elastomeric mounts contain less carbon black. Observation from this graph shows that elastomeric mount contain carbon black about 20% has static stiffness close to actual elastomeric mount except synthetic rubber. However to get the static stiffness from synthetic elastomeric mount close to actual elastomeric mount, carbon black need to be reduced by 10% from original contain and it maybe more or less depend on applied load.

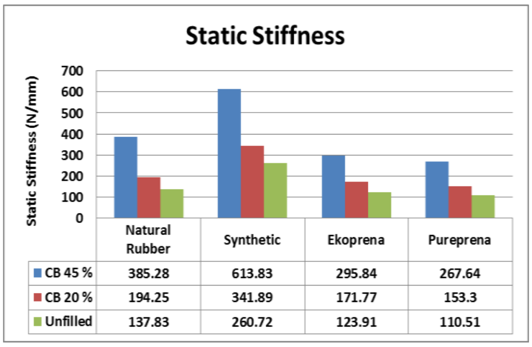

Fig. 9 Graph static stiffness for four types of elastomeric mounts

CONCLUSION

A few processes were presented to fabricate elastomeric mount and form of test-piece. The result from static tests showed that elastomeric mount from SMR CV-60 rubber, ekoprena and pureprena closed to actual mount except elastomeric mount from synthetic rubber. However to get the static stiffness from synthetic elastomeric mount close to actual elastomeric mount, carbon black need to be reduced by 10% from original contain and it maybe more or less depend on applied load.

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