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RESEARCH ON VIBRATION DAMPING ON COMPUTER POWER SUPPLY BOX MADE OF CASTERMID MATERIAL

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In this study, our aim is to eliminate disadvantages that occur due to vibration. Therefore it has been made of the power supply box castermid material. In this study used both experimental and finite element methods analysis. For this purpose, the effects of the power supply box made directly of castermid material and the power supply box made of metal on damping of the vibration and which one of them is more effective were investigated, and the results were compared by Finite Element Method (FEM) results. As a result, it has been concluded that the castermid box created less noise than existing box did and it has damped the vibration more.

Keywords: Polyamide, vibration, damping, frequency, FEM

INTRODUCTION

In order to prevent the noise, as well as other voices, it is required to decrease the vibrations which are the sources of noise. Passive noise control is implemented in many locations in order to realize that. Passive noise control is the method of decreasing the noise by using noise insulation materials [1]. About this issue, an implementation study has been carried out on noise control methods and noise maps [2]. The vibration effects of the roads and machines, and the parallel relationships between vehicle vibrations and human sensitivity were investigated [3].

In a work place where it has been determined that the level of noise is harmful for the employees, the decreases in level of noise have been determined via the methods of control of the noise from its source and prevention of noise radiation, and the efficiencies of the methods were discussed [4]. Vibrations have an important place in terms of human-machine relations. Since 1930, many researches have been carried out in order to determine the sensitivity of human box to vibrations [5]. Nowadays, the vibration is one of the mostly investigated ergonomic factors affecting the increasing the human health and business success. The effect of vibration is important both for human health and working comfort and for business productivity, quality, and labor safety [6]. The most important element to consider in projecting the vibrant machines is the determination of damping [7]. The objective in vibration measurements is the vibration frequency and vibration amplitude [8].Damping is an obvious event of engineering, and is an important factor in material-vibration control implementations [9]. The damping is efficient on amplitude and damages of the vibration [10]. The value at which the amplitude reaches its peak is named resonance frequency [11]. Analytic modal model was selected for measuring the FRF data, and estimation of FRF was executed by using any of modal parameters [12]. The measurement of vibration data is required in many domains in mechanic, aviation, automotive, and construction engineering. This data allows the structure and other mechanic systems to be modelled appropriately [13].

In this study, the production of the metal box of power supply used in desktop computers was executed by using castermid material in same dimensions. By performing the vibration measurements of existing metal box and produced castermid box, these measurements were compared. At the end of the measurements, it was observed that the box made of castermid has damped the vibration more than metal box has done, and the noise and voice severities were much less than existing boxes.

MATERIALS AND METHODS

In experimental modal analysis method, a force is implemented on system, and the response of that system to that force is measured. By using frequency behavior functions, the natural frequencies, mode types, and damping rates of the structures are determined [14]. A FRF is created between each of stimulation point and measurement point. All of the data obtained can be thought as matrix of the FRF. Each of rows indicates the answer point, while each of the columns indicates the stimulation point. In FRF graphics, the peak values can be shown as vibration resonance value and the frequency values belonging to each of the resonances [15].

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Castermid is a material from the polyamide group. Because of the cross-linked molecular structure of a material have superior properties. It has many uses in industry due to its high mechanical, physical and chemical properties.

In order to produce the power supply box in original dimensions (150 x 140 x 85 mm) from castermid material, firstly the required drawing was done with Solid works software by considering all the details and dimensions of metal box, and the final shape was given to material in solid modelling phase. After drawing and solid modelling, as seen in Figure 1, in harmony with the dimensions in technical drawing, the final shape was given to the product in CNC (Computer Numerical Control) by considering the ventilation and connection points.

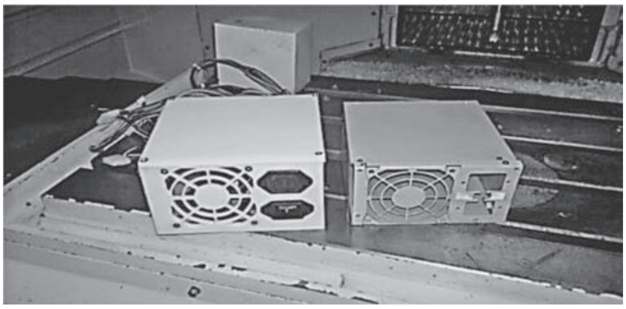

Figure 1 Power supply made of castermid material in CNC spline (left)

The softness of castermid material for processing in bench, its dimension accuracy, and the easiness in processing has brought important advantages.

The measurements were done with metal and castermid power supply box under same conditions. Then, the accelerometers were connected on 5 surfaces of the boxes (left and right sides, front and rear sides, and upper side), and measurements were done simultaneously. As shown in Figure 1 in order to prevent the vibrations due to interaction of the box with the floor, the foam material was placed between them.

The power supplies were operated together with their equipment ("Power Supply Tester" and power cable). By operating for 10 minutes before each of measurement, the power supplies were allowed to reach the regime.

Here, the power continuously stimulating the system was the operation of propeller. The system was stimulated from 1 point, and its responses were measured by accelerometers. By proportioning the force and acceleration values in FFT analyzer, the data were transformed from time medium into frequency medium, and the graphics were obtained through software.

First of all, the natural frequencies (resonance frequencies) were determined by using the frequency values corresponding to peak points of frequency behavior function. Then the damping rates were calculated from peak points of frequency behavior function. The resonance values belonging to power supply boxes are presented in Figures 5 - 8.

EXPERIMENTAL AND DISCUSSION

Modal finite element method (FEM) analysis of the power supply is obtained by the software ANSYS 16 program. Three-dimensional model and mesh form of the system shown in Figure 2.

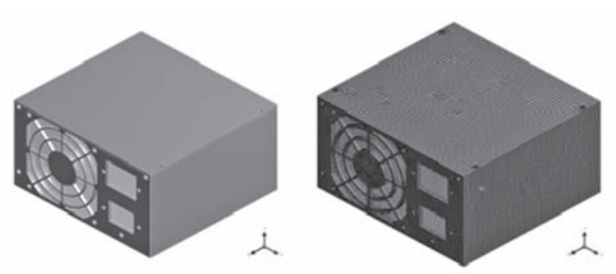

Figure 2 Three dimensional model and finite element analysis of the computer power supply

The power supply is fastened to the floor of the contact with the ground. Is composed of three - dimensional model mesh elements rectangles and triangles.

The system consists of a total of 218 576 nodes and 49 058 elements. Analysis software product, as a result of vibration parameters (frequency, mode) are compared with the measured size by experimental method.

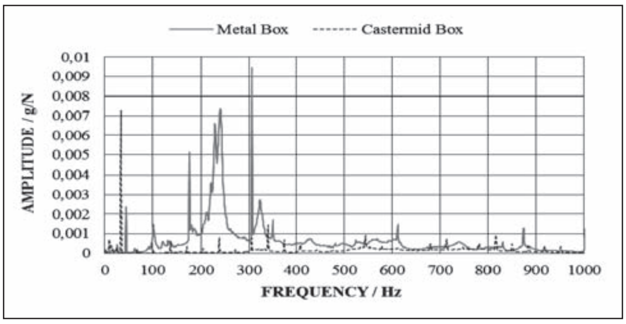

Figure 3 FRF measurements from top side of castermid and metal box

FRF graphic of the top side of castermid and metal box is seen in Figure 3. The metal box has achieved the highest amplitude value at 300 Hz. Since castermid box damped the vibration significantly in proportion to present box, its amplitudes are very low.

In Figure 4 the FRF graphic taken from rear sides of castermid and metal boxes is seen. Castermid has shown

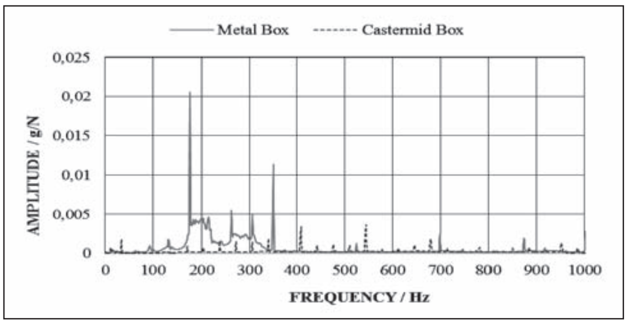

Figure 4 FRF measurements from rear side of castermid and metal box

the best damping performance at this side. In frequencies, where the amplitudes of metal box increased, amplitudes of castermid box were seen to not increase. Vibration damping is absolutely successful at this side.

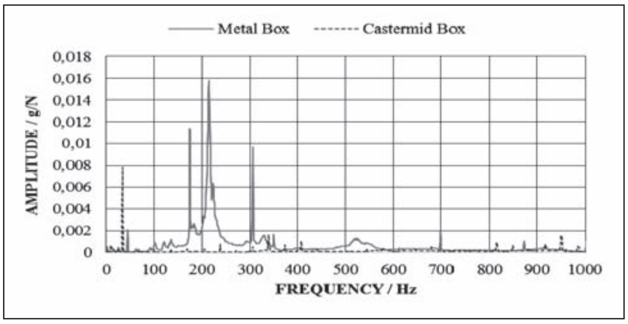

Figure 5 FRF measurements from left side of castermid and metal box

FRF graphic taken from left side of castermid and metal boxes is seen in Figure 5. In frequencies, where the amplitudes of metal box reached the maximum values, castermid box has taken minimum values.

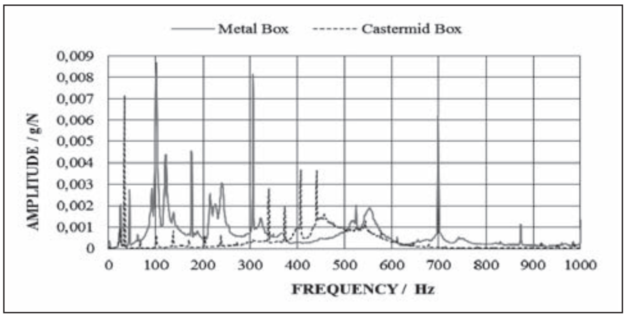

Figure 6 FRF measurements from right side of castermid and metal box

In Figure 6 the FRF graphic taken from right sides of castermid and metal boxes is seen. At this side, the amplitudes of metal box are higher than those of castermid box. A graphic different from the graphics obtained from other sides has been obtained. Amplitudes of castermid box showed increased after 300 Hz. between 300 and 500 Hz, the damping of castermid box was not as good as in other sides.

FRF graphic taken from front side of castermid and metal boxes is seen in Figure 7. Metal box has taken its max amplitude value at 300 Hz. For castermid box,

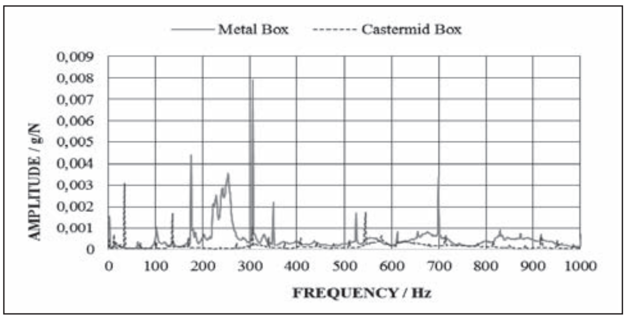

Figure 7 FRF measurements from front side of castermid and metal box

damping at this side is very good. Amplitude values were lower than those of metal box.

As it can be understood from FRF graphics above, it was observed that the castermid power supply has significantly decreased the vibrations on the box during operation. While the peak vibration metal box occurred between 80 - 350 Hz range, the vibration amplitude observed on castermid box was approximately at 40 Hz. The metal box entered into resonance for 4 times in 80 - 350 Hz range. But the castermid box entered into resonance for once at 40 Hz.

The natural frequency of castermid box was lower than metal box's natural frequency. For this reason, the castermid box enters into resonance at lower frequency values. Depending on material properties, metal box enters into 4 mode. This leads to more voice and noise.

It has been determined that the metal power supply boxes used in PC cases damage the system due to vibration as a result of working medium and conditions. The leading one among these damages is the accumulation of dusts in medium in cooling fan within the metal box and consequently decrease in working space, leading to the vibration in box and the noise.

The main problem in accumulation of dusts around is the occurrence of magnetic field due to metal box. It was determined from values obtained as a result experimental modal analysis that the power supply box, which was produced from castermid material for insulation purpose in order to prevent the occurrence of magnetic field, didn't accumulate the peripheral dusts as much as metal box did, and the castermid box led to significant damping by preventing the transmission of vibration of fan operation to the box. These values are presented in Table 1.

The values in Table 1 were obtained by taking square roots of mean of squares of vibration values for each surface. According to these values, it is seen that the vibration significantly decreases in castermid box, so the damping is pretty good.

Table 1 **Mean vibration values obtained from metal and castermid power supply boxes**

Point	Metal Box / grms	Castermid Box / grms	Change in level / %
Left side	0,03	0,00656	78,13
Top side	0,02	0,00617	69,15
Right side	0,02	0,01	50,00
Rear side	0,03	0,00635	78,83
Front side	0,01	0,00428	57,20

Since the material of power supply produced has natural insulation and damping property, the most important advantages were determined to be no necessity of any grounding in system, absence of problems based on electric leakage, prevention of damage of vibration-based noise on operating parts and human health, lower costs, lightness, and easiness of processing.

The results from FEM analysis show that the natural frequency for all the different modes occurs between

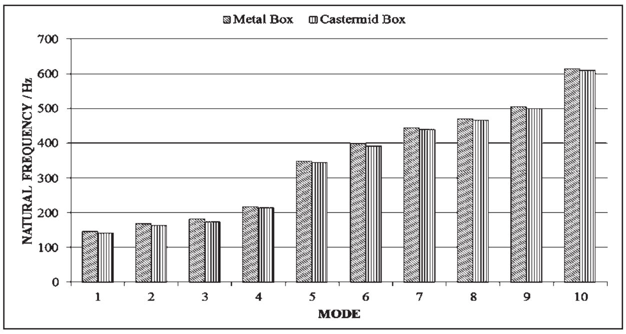

Figure 8 Obtained finite element analysis a result of the frequency - mode in the graph.

140 and 600 Hz. These are shown in Figure 8. Natural frequency of the system is usually referred as the resonance frequency. Natural frequency of the damping system will be lower. Natural frequency of the computer power supply box made of castermid is always less than that of made of metal as shown in Figure 8.

It can be concluded that the vibration of the computer power supply box made of metal is more than the box made of castermid.

CONCLUSIONS

In this study, the damping of the vibration of power supply box used in computed cases has been examined. Different from present metal box, a power supply box was manufactured from castermid material. Since castermid box damped the vibration better than metal box did, its amplitude values were seen to be lower in FRF graphics obtained as a result of experimental modal analysis. In FEM analysis, natural frequencies of castermid box were found to be lower than those of metal box.

As a result, it has been determined that power supply box made of castermid material damped the vibration better than present box did, and that it decreased the sound and noise originating from vibration. Besides that, it has been determined that the power supply box made of castermid material had some advantages. These advantages are listed below;

It has been determined that power supply box made of castermid material didn't collect the dusts from the medium as much as metal case did. The damages that vibration creates on hard disc and other hardware parts were minimized. There is no need for grounding that is required when metal case is used. The noise that disturbs working people doesn't occur at disturbing level. Power supply box made of castermid material has significant advantages because of its easy workability and absence of mounting problems. Its production is faster and cheaper than the production of metal box.

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