“LOW NOISE MIXER JAR”

PROJECT REFERENCE NO. : 37S1372

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Abstract:

In the present report, the possibility of manufacturing low noise mixer jar to reduce noise and disturbance is investigated. A comprehensive model of low noise mixer jar is developed by using sound absorbing materials and interpreting design of the existing model. The layers of the mixer jar are surrounded by sound absorbing materials which in turn absorb the vibration produced by the mixer jar when it is subjected to operation. The lid of the mixer jar is designed in such a way that it absorbs noise produced by the jar.

Introduction

A mixer is a kitchen utensil which uses a gear-driven mechanism to rotate a set of beaters in a bowl containing the food to be prepared. It automates the repetitive tasks of stirring, whisking or beating. When the beaters are replaced by a dough hook, a mixer may also be used to knead. A mixer may be a handheld mechanism known as an eggbeater, a handheld motorized beater, or a stand mixer. Stand mixers vary in size from small countertop models for home use to large capacity commercial machines. Stand mixers create the mixing action by rotating the mixing device vertically: planetary mixers, or by rotating the mixing container: spiral mixers. Mixers for the kitchen first came into use midway through the nineteenth century; the earliest were mechanical devices. The demand from commercial bakers for large-scale uniform mixing resulted in the development of the electric stand mixer. Smaller counter-top stand mixers for home kitchen use soon followed. When selecting a mixer, the purchaser should consider how the mixer will be used. Electric mixers with more speed options give the user more control over the development of the mixture.
Objective:

- To reduce the noise produced by the mixer jars, vacuum cleaners, washing machines and other household appliances.
- To understand the effect of noise of mixture jar.

Literature survey:

During the literature survey, we have gone through following information about the blenders and different available low noise mixers or grinders and different noise reducing techniques.

Vibration damping materials:

Vibration damping material is used to reduce or eliminate noise in industrial, electronic, structural and ergonomic applications caused by resonance and vibration. Sorbothane is a great solution for most any application and our visco-elastic polymer has been used in everything from small gadgets, protective footwear, the U.S. Airforce Memorial, the Space Shuttle and beyond.
What is damping?

Damping is the energy dissipation properties of a material or system under cyclical stress. It is the conversion of mechanical energy into thermal energy. The amount of energy dissipated is a measure of the material’s damping level.

How does vibration damping work?

Damping materials work by changing the natural vibration frequency of the vibrating surface and thereby lowering radiated noise and increasing the transmission loss of the material. Many applications and products are subject to vibration from internal, as well as external sources. The effect of this vibration can range in severity from an computer owner’s perception of the quality of their noisy hard drive to the actual failure of a mechanical system due to a high-cycle fatigue.

Do you have examples?

The examples mainly we can give are mixers and grinders, vacuum cleaners, electric motors etc. Thin metal parts and structures easily transmit noise when impacted or by natural resonance when excited by acoustic energy. This vibrating metal is also a common problem in many industrial and commercial applications and the problem is easily solved with the right vibration damping material.

What is the most common damping mechanism?

The most common damping mechanism used to address vibration (and noise) problems is viscoelastic damping. Viscoelastic means that the material exhibits both elastic and viscous behavior. An elastic material is one that stores energy during a load and all energy is returned when that load is removed. A viscous material doesn’t return any energy. All energy is lost as “pure damping” once the load is removed. A viscoelastic material therefore stores some of the energy during a load and then the remainder is released as heat.

How can Sorbothane help?

Sorbothane is a viscoelastic vibration damping material that combines shock absorption, good memory, vibration isolation and vibration damping characteristics into one solution. In addition, Sorbothane is a very effective acoustic damper and absorber. While many materials exhibit one of these characteristics, Sorbothane combines all of them in a stable material with a long fatigue life.
Effective control of noise and vibration, whatever the application, usually requires several techniques, each of which contributes to a quieter environment. For most applications, noise and vibration can be controlled using four methods:

1. Absorption
2. Use of barriers and enclosures
3. Structural damping

Although there is a certain degree of overlap in these classes, each method may yield a significant reduction in vibration and noise by proper analysis of the problem and application of the technique. The principles behind the use of absorptive materials and heavy mass barrier layers are generally understood, so this article will focus on the third and fourth methods, which deal with reducing structural vibration.

**Structural Damping:**

This control technique reduces both impact-generated and steady-state noises at their source. It dissipates vibrational energy in the structure before it can build up and radiate as sound. Damping, however, suppresses only resonant motion. Forced, nonresonant vibration is rarely attenuated by damping, although application of damping materials sometimes has that effect because it increases the stiffness and mass of a system.

A damping treatment consists of any material (or combination of materials) applied to a component to increase its ability to dissipate mechanical energy. It is most often useful when applied to a structure that is forced to vibrate at or near its natural (resonant) frequencies, is acted on by forces made up of many frequency components, is subject to impacts or other transient forces, or transmits vibration to noise-radiating surfaces.

Although all materials exhibit a certain amount of damping, many (steel, aluminum, magnesium and glass) have so little internal damping that their resonant behavior makes them effective sound radiators. By bringing structures of these materials into intimate contact with a highly damped, dynamically stiff material, it is possible to control these resonances.

Of the common damping materials in use, many are viscoelastic; that is, they are capable of storing strain energy when deformed, while dissipating a portion of this energy through hysteresis. Several types are available in sheet form. Some are adhesive in nature and others are enamel-like for use at high temperatures.
**Free-layer or extensional damping** is one of the simplest forms of material application. (See Figure 1.) The material is simply attached with a strong bonding agent to the surface of a structure. Alternatively, the material may be troweled onto the surface, or the structure may be dipped into a vat of heat-liquefied material that hardens upon cooling. Energy is dissipated as a result of extension and compression of the damping material under flexural stress from the base structure. Damping increases with damping layer thickness. Changing the composition of a damping material may also alter its effectiveness.

![Diagram of Damping Material](image)

_A free-layer damping system is the simplest form of damping material application. Energy is dissipated as a result of extension and compression of the material under flexural stress from the base structure._

An example of the effectiveness of an extensional damping treatment is shown in Figure 2. The curves represent five extensionally damped systems. In each case, the damping sheet is 3/16-inch thick, whereas the steel base layers are from 1/32- to ½-inch thick. From such data, it is possible to obtain the overall system loss factors (measure of energy dissipated per radian of vibration at resonance) and the resulting estimated “large” panel impact noise reduction—the reduction in noise level that results from damping a panel that is being struck many times per second. Large, in this case, means that the panel dimensions are equal to or greater than the bending wavelengths of the vibration being radiated as sound. The effect of temperature is clearly seen. The peak noise reduction for the ½-inch steel plate occurs at a lower temperature than for the 1/32-inch plate. More information on E-A-R’s extensive lines of energy control materials and on the company’s engineering/problem solving capabilities is available from E-A-R Specialty Composites.
Constrained-layer damping (CLD) systems are usually used for very stiff structures. (See Figure 3.) A “sandwich” is formed by laminating the base layer to the damping layer and adding a third constraining layer. When the system flexes during vibration, shear strains develop in the damping layer. Energy is lost through shear deformation, rather than extension, of the material.
System loss factors and estimated noise reductions for several CLD steel systems are shown in Figure 4. For a given base layer thickness, the values obtained are significantly higher than those in Figure 2, although the damping material properties and thickness are identical. Further, varying layer thickness ratios permits optimizing system loss factors for various temperatures without changing the material’s composition, Figure 5.

The constraint method is not critical as long as there is adequate surface-to-surface pressure. The layers may be bolted or riveted instead of glued into a sandwich and still provide optimum performance. Adhesives, if used, must have a high shear stiffness. Shear strains in the adhesive will reduce the strains in the damping layer, reducing its effectiveness.

Another advantage of CLD systems is that they can be used in harsh environments. The damping layer is totally covered by the top constraining layer, so it typically is not subject to abrasion or deterioration. This feature is a particular advantage in conveyor system applications or where steam cleaning is used, such as in food processing operations.

Structural damping, whether extensional or constrained-layer, provides an at-the-source solution to noise control problems. Further, it is not always necessary to use 100 percent panel coverage to achieve significant noise reductions. For example, 50 percent coverage will provide a noise reduction that is typically only 3 decibels (dB) less than for 100 percent coverage; 25 percent coverage is only 6 dB less. When properly used, damping can be as cost effective as it is acoustically effective.
Vibration Isolation

This method reduces the transmission of vibrational energy from one system to another. Common vibration isolators are steel springs, rubber pads or bellows. These devices are available in many shapes and are capable of isolating masses weighing from a few pounds to thousands of pounds.

An automobile suspension is a good example of damped isolation. Shock absorbers dissipate energy by pumping a fluid through orifices that offer a predetermined resistance to high-velocity flow. Many isolation systems use elastomeric materials to provide both the spring force and damping. Some rubbers are capable of achieving useful damping at certain frequencies, although at low frequencies most exhibit loss factors less than 0.2, or roughly 10 percent of critical damping. At resonance, when a system dissipates the same amount of energy per radian as it stores, it is said to be critically damped. Loss factor is equal to the percentage of critical damping divided by 50.
One way to compare the behavior of various isolators is to measure their transmissibility. Typical transmissibility curves, as shown in Figure 6, compare the vibrational acceleration response of materials used in isolation applications. As the damping in a material increases, the system amplification response can be minimized at or near the natural frequency. This can be especially beneficial in applications such as stepper motors, which must run through a variety of frequencies, or those applications that frequently go through a startup or slowdown as part of the operation cycle. In applications with little or no damping, amplification can reach as high as 23 dB, which would be a magnification factor of 14.2.

Uncontrolled resonant motion in a device’s isolation mounts can have results ranging from acceptable to catastrophic, depending on the operational properties of the components involved. Undamped mounts have internal resonances that conduct considerable high-frequency vibrational energy from the machine to the support. The large forces developed at and near resonance can easily damage internal components or even tear a device from its mounting.

**Conclusions:**

The bottom line in noise and vibration control, as in virtually all other engineering efforts, is cost-effectiveness, which translates into achieving workable, inexpensive solutions to complex problems. Maximum advantages of reducing noise and vibration at the source can
be realized by careful planning, thoughtful design, and proper choice of materials and structures specifically engineered for the task.

This technological state of the art in damping materials and systems is such that it is possible to design products that operate more quietly, with less vibration and greater precision, without being necessarily more expensive or difficult to build.

**Damping materials:**

Damping products can reduce or eliminate ring, vibration and noise of sheet metal wherever it is found. Typical applications include:

**Easy-To-Apply Materials That Take the “Ring” Out**

Thin metal parts and structures easily transmit noise when impacted or by natural resonance when excited by acoustic energy. Vibrating or resonating metal is a common noise problem in industrial and commercial environments and one that OEM’s must often take into consideration.

These types of noise problems are often easily solved by applying damping material to these metal surfaces. Damping materials work by changing the natural vibration frequency of the vibrating surface and thereby lowering radiated noise and increasing the transmission loss of the material. INC offers two very effective products, INC Damping Compound and INC Vibration Damping Sheets, that convert ordinary sheet metal into damped metal greatly reducing the tendency to transmit noise and vibration.

**Adhesive Damping Sheets • Spray-On Damping Compound**

Damping Materials effectively reduces the resonant vibration of sheet metal panels that radiate noise. They also reduce the loudness and duration caused by random impact noises when panels are struck.

**Vibration Damping Sheets**

There are two types of vibration damping sheets they are as follows

**D-305 type of sheets:**

**Product features:**

INC D-305 Damping Pad is a filled asphaltic mastic acoustical sheet material designed for cost-effective vibration damping. Model D-305 contains a pressure-sensitive adhesive on one
side which is protected by an easily strippable release liner. D-305 will withstand temperatures up to 400°F (204°C) which permits passage through paint ovens without blistering or sliding down vertical surfaces.

Properties:

- Available in 35” x 53” sheets
- Density = 102 LB per ft³
- Temperature Range of -30°F to 400°F
- Meets UL 94 flammability rating and is self-extinguishing
- Loss factor of .05 at 250 Hz on 20 gauge steel
- Can be painted
- D-305 is easily cut with a knife or ordinary scissors and applies easily to solid non-porous surfaces such as sheet metal and on other steel objects.

D-306 type of sheets:

Product features:

INC D-306 Damping Pad consists of high density PVC vinyl acoustical sheet material designed for vibration damping. Model D-306 contains a pressure-sensitive adhesive on one side which is protected by an easily strippable release liner.

Properties:

- Available in 54” x 58” sheets
- Resistant to a wide range of chemicals
- Easily cleaned
- Density = 105 LB per ft³
- Temperature Range of 0°F to 225°F
- Meets UL 94 flammability rating and is self-extinguishing
- Loss factor of .04 at 1000Hz on 20 gauge steel

These materials can be slit, punched, or die-cut into parts to meet your specifications. The adhesive is a high performance, permanent acrylic adhesive which exhibits high tack for easy installation resulting in 100% contact for maximum damping effectiveness. Maximum vibration reduction is achieved because the adhesive is an integral part of the sound deadener.
VIBRATION DAMPING COMPOUND

DC-10 properties:

- Available 5 gallon containers (56.25 LBS)
- Light Tan color
- Resistant to water, solvents, acids & corrosive gases
- Average curing time of 4 to 24 hours at room temperature
- Density = 105 LB per ft³
- Temperature range of 0° F to 225° F
- Meets ASTM E162 Class I fire rating
- Waterbased Non-Toxic and odorless
- VOC per EPA Method #24 = 0 LBS / Gallon
- Loss factor of .066 at 200Hz on 20 gauge steel
- Protect From Freezing
- Painting is recommended for outdoor use

DC-10 product features:

DC-10 is a visco-elastic sprayable liquid sound damping compound used to reduce noise radiated by vibration or shock excited metal surfaces, suitable for use virtually anywhere such surfaces are found. Ideal for architectural and mechanical equipment applications such as treating ducts, mixing boxes, sound-proof doors, and metal partitions- especially in the new construction field where it is mandatory to use non-combustible or nonsmoker generating materials to meet local fire codes and ordinances.

Conclusion of literature survey:-

With this survey, we went for synthetic rubber over other different vibration damping materials due to the availability of the material and its properties of vibration reduction which in turn reduces noise.

Construction and Mechanical operation:-

Construction:

The blending container can be made of glass, plastic, stainless steel, or porcelain, and often has graduated markings for approximate measuring purposes. In cases where the blades are removable, the container should have an o-ring or gasket between the body of the container and the base to seal the container and prevent the contents from leaking. The blending
container is generally shaped in a way that encourages material to circulate through the blades, rather than simply spinning around.

The container rests upon a base that contains a motor for turning the blade assembly and has controls on its surface. Most modern blenders offer a number of possible speeds. Low-powered blenders require the addition of some liquid to operate correctly. In these blenders, the liquid helps move the solids around the jar, bringing them in contact with the blades. The blades create a whirlpool effect which moves solids from top to bottom, ensuring even contact with the blade. This creates a homogeneous mixture. High-powered blenders are capable of milling grains and crushing ice without such assistance.

The hand-held immersion blender has no container of its own, but instead has a mixing head with rotating blades that can be immersed in a container. Immersion blenders are convenient for homogenizing volumes that are too large to fit in the bowl of a stationary blender or, as in the case of soups, are too hot to be safely poured into the bowl.

Some of the functions of blenders have been taken over by food processors. In particular, thicker mixtures such as mayonnaise and hummus are conveniently made in food processors.

**Mechanical operation:**

A blender consists of housing, motor, blades, and food container. A fan-cooled electric motor is secured into the housing by way of vibration dampers, and a small output shaft penetrates the upper housing and meshes with the blade assembly. Usually, a small rubber washer provides a seal around the output shaft to prevent liquid from entering the motor. Most blenders today have multiple speeds. As a typical blender has no gearbox, the multiple speeds are often implemented using a universal motor with multiple stator windings and/or multitapped stator windings; in a blender with electromechanical controls, the button (or other electrical switching device or position) for each different speed connects a different stator winding/tap or combination thereof. Each different combination of energized windings produces a different torque from the motor, which yields a different equilibrium speed in balance against the drag (resistance to rotation) of the blade assembly in contact with the material inside the food container.
Design:

Here during the design we have done a ANSYS analysis on the “mixer jar” and we chose the “Synthetic rubber” over other vibration damping materials. so

Fig 7.1.1: modal analysis of steel jar:

Fig 7.1.2 modal analysis of steel jar:
Fig: 7.1.3 modal analysis of steel

Fig: 7.1.4 meshing of steel jar:
Fig.7.1.5 applying displacement on lines:

Fig.7.1.6 modal analysis of synthetic rubber:
**Calculation and Results**

**Calculation:**

8.1.1 Mixer jar dimensions:

Top diameter = 120 mm  
Bottom diameter = 80 mm  
Depth = 120 mm  
Thickness = 2 mm  
Density = $7820 \times 10^{-9} \text{ kg/mm}^3$

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Synthetic rubber dimensions:

Top diameter = 120 mm  
Bottom diameter = 80 mm  
Depth = 120 mm  
Thickness = 4 mm  
Density = $1200 \times 10^{-9} \text{ kg/mm}^3$

**Table no8.1.2: index of data sets on results file:**

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**Results:**

Table no 8.2.1: Working Analysis(weight 100 gms)

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Fig no:8.2.1:graph of noise vs time(weight 100gms)
### Table no: 8.2.2: Working analysis (200 gms)

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### Fig 8.2.2: Graph of noise vs time (weight 200 gms)

![Graph of noise vs time](image-url)
Fig: 8.2.3: Bar chart of noise vs weight

[Bar chart showing noise levels in decibels (dB) for different weights (100gm and 200gm). The chart compares 'existing' and 'modified' conditions.]