PLASTIC CASKET

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Abstract

Research into a plastic casket was conducted to verify that HDPE could be used to replace steel caskets to provide a cheaper high quality casket to reduce the cost of funerals. The study utilized Creo for the design and Ansys to determine the optimum structural requirements. The casket resembles a traditional casket, and will be made out of HDPE.

Introduction

This report will review the design goals specified to manufacture a casket out of plastic. The goal of this report is to walk through the design process that lead to the final design.

The study was used to determine if a casket could be feasibly manufactured with extrusion blow molding to produce a good part at a cheaper cost compared to the traditional caskets. The casket design had to be modified to allow for manufacturability with the extrusion blow molding process. The current cost of a casket is anywhere from $1000 to $10000 depending on the features of the casket [1]. This leaves a great deal of room for improvement on the current caskets.

The purpose of creating a casket out of plastics is to reduce the cost. The current casket designs are made out of 18 gauge sheet metal [2]. By switching from the current method to a High Density Polyethylene material the cost can be reduced by creating a casket that is lighter weight. The casket is also designed to be more robust and hold up for a longer period of time underground while maintaining a seal to prevent water from leaking into the coffin.

The part design is manufactured out of three components which will utilize several different assembly methods such as ultrasonically welding the upper and lower half of the bottom housing and assembling this to the lid via hinges. The casket is to be decorated with several different paint styles, internal decorations and different styles of handles.

Background and Product Specifications

Blow Molding

The extrusion blow molding process can be used to produce a wide range of products from 1000 gallon water tanks to small bottles. These parts can consist of bottles to packaging containers. This gives the ability to design a casket that can be manufactured with the extrusion blow molding process. The two categories for parts made from extrusion blow molding are packaging which includes bottles. The second category is industrial, which includes gas tanks to children’s toys.

The extrusion blow molding process is where a parison is extruded down. The mold than closes up on the parison and air is introduced into the parison to blow to form the part by forcing the plastic to the mold walls. The time that the plastic is forced against the molds walls it the cooling time of the blow molded part. Plastic is feed into the hopper of the machine and feed into the barrel where it is forced forward into the barrel by the screw which is used to move and shear heat the material as it moves forward. The barrel is encased in heater bands to assist in heating and melting of the material.

The material is extruded through the die which is composed of two separate pieces that consist of a die or ring which is the outer region of the die that forms the wall outer boundary of the parison. The mandrel or pin is the inner most portion of the die which forms the innermost portion of the parison.

Caskets

Caskets are used to display the dead at funerals and as a means to store them as their final resting place. Current caskets are usually made from steel and using plastic to replace the steel will result in a cheaper lighter weight product. The general size of caskets are 2133.6 mm long, 711.2 mm wide and 609.6 mm deep [3].

The design goals and specifications are as follows: first to provide a cheaper ascetically pleasing casket for families with little money, second to provide a waterproof casket, third to provide a durable casket that can accommodate the average person. Fourth the casket must withstand having a 317.515 kg load of an individual inside and is to withstand having a 907.1847 kg load on the outside of the casket. The casket is not to be exposed to elevated temperatures and will not be exposed to aggressive chemicals.
The material selected in this study was High Density Polyethylene (HDPE) because it is a cheap ($1.87/kg) and is a commonly available material that can be used in the extrusion blow molding process [4].

The higher molecular weight material was also chosen because it provides for better impact and strength compared to a low molecular weight grade of polyethylene. The casket doesn’t need to withstand a high amount of loading because they are usually placed into a concrete vault which supports the weight of the soil above. However it was determined that having a casket that could withstand the weight of the soil without needing a vault was a strong point. This was determined because the need for a casket that can be mass produced for the event of a disaster or catastrophe could prove to be valuable as an alternative market.

**Design Validation**

This section will discuss the design goals and specifications that were validated with research and the use of tools such as CAE and modeling software.

Some other considerations for why HDPE were chosen, because of its good chemical resistance. Since HDPE is a semi-crystalline material which has relatively good resistance to a variety of chemicals. The material properties that affect chemical resistance can not be affected by the part design and as a result is based on the material that is selected.

HDPE was also selected because it is a radially available material that has good impact strength and can withstand relatively high forces. If it is need it can have a glass filled added to improve on the strength of the material.

The weight reduction was determined by using Creo Parametric to determine the weight of the part by the density of the selected material. The part weight is to be reduced 10% of the original caskets.

The casket is to withstand 317.515 kg load of an individual inside and is to withstand having a 907.185 kg load on the outside of the casket. This was achieved by using Ansys Work Bench 14 which conducted the Failure Element Analysys. Creo Parametric 2.0 was used to model the rough and eventually final design.

The weight of the model was calculated with the use of Creo Parametric 2.0.

**Design Procedure**

The design process of the casket was conducted using Creo Parametric 2.0 and Ansys Work Bench 14. The modeling was done using Creo Parametric to come up with a general design that was pleasing and the manufacturability was proven the initial design went on to have further testing to prove or disprove that it could meet the requirements. The initial design was imported into Ansys Work Bench 14 to have Failure Element Analysys conducted on the product. Over eight iterations were developed from start to finish of the product.

There were several setbacks encountered with the design mainly with manufacturing a casket out of HDPE that could withstand a 317.515 kg load of an individual inside the casket and the effect of the load on the handles and mounts. There were also some setbacks to have the casket withstand having a 907.1845 kg load on the outside of the casket. This affected the wall thickness of the part because it had to be increased and the design had to be modified to withstand the 907.185 kg load on the casket in the event that no concrete vault was used.

The design was created by reverse engineering the current caskets and modifying the general design to be manufactured with the extrusion blow molding process. This was achieved by looking at how the extrusion blow molding process works and modifying the design until it could meet the requirements to be produced with the extrusion blow molding process. Initial the lower housing of the casket was to be manufactured as one component but after reviewing the design it was determined that the design could no longer work with the extrusion blow molding process because the material would be stretched too far and thinning of the wall would result.

The ease of manufacture was modified to be completed with the least amount of operations. This was achieved by revising the assembly method with the newly modified part design. It was determined that the parts need to be hot plate or gun welded together and the hinges need to be riveted together.

**Presentation of Data**

This section will describe the finalized design and the specifications that were met.
Figure 1: Equivalent Stress Under 4535.92 kg Load

Displayed in Figure 1 is the resulting stress from a 4535.92 kg load on the casket was 66.778 MPa. This load was well above the 907.185 kg which proved that the casket was able to withstand this load without failing. The boundary conditions in this were from a 4535.92 kg load on the top of the casket. The bottom of the casket was fixed support.

Figure 2: Total Deformation Under 4535.92 kg Load

Figure 2 represents the total deformation in the casket from the 4535.92 kg load. It can be seen that the casket deforms 0.20 mm. This indicates that a good design was achieved and a proper material was selected.

Figure 3: Equivalent Stress Under 317.515 kg Load

Displayed in Figure 3 is the result of the 317.515 kg load. The boundary conditions for this loading had a distributed 317.515 kg load facing upward on the handles while the bottom of the casket was fixed. This represented that there was a lot of force on the connection points where the handles are attached to the support brackets. There is a resulting stress of 2361.7 MPa on the casket.

Figure 4: Total Deformation Under 317.515 kg Load

The Figure 4 displays the total deformation from the 317.515 kg distributed load on the handles which indicates that there was a resulting deformation of 11.909 mm of total deformation in the casket base. This could be improved by modifying the design even more and possible selecting a stronger material to withstand the forces. The casket is however able to withstand the weight of an average individual but if it is to meet the criteria set a design modification has to be implemented.
Figure 5: Overall Dimension of Casket

Figure 5 displays the overall dimension of the casket which has a height of 838.2 mm and a width of 762 mm and a length of 2184.4 mm.

Figure 6: Final Design of Bottom Component

Figure 6 displays the modified design which had the addition of kiss offs from the original design. The analysis on Ansys showed that improved strength was required to improve the strength to achieve the design goals.

Figure 7: Mounting Bracket Exterior

Figures 7 and 8 display the fastening brackets for the handle which were designed to improve the strength of the joint where the handle is attached to the plastic housing. These were added when Ansys proved that there was not enough strength to withstand the design requirements.

Figure 8: Mounting Bracket Interior

Reducing the weight of the current casket is a concern because some of the steel caskets are currently weigh from 45.359 kg to 136.078 kg [5]. The weight of the HDPE casket is 45 kg which is a great reduction in weight. This reduction in weight can reduce transportation costs of the casket to the funeral home.

Mold

The design of the casket requires requires three molds, one to produce the lid, one to produce the outer shell of the lower housing and the inside shell of the lower housing. The two molds that produce the parts for the lower housing will produce two parts at one time due to the design shape of the bottom. The components for the lower housing will be assembled to each other by hot plate welding. This is the cheapest form of welding and it will be easily accommodated for use on the flat surface of the upper and lower housing. The lower portion of the base will have the mounting brackets which the handle is attached to properly.
support the weight of the casket. This is accomplished by drilling holes into the HDPE lower base parts than riveting two mounting brackets one on the inside of the casket one on the outside which are permanently fixed to each other by the rivets.

The lid of the casket will be produce by a single mold but requires no additional secondary welding operations to weld other components together. The lid and the base will be connected to each other with brass or chrome plated hinges. This will proved a good solid mount for the lid and the base but it requires a secondary operation to attach the two components together.

**Conclusion**

The design of the part was proven to meet most of the design specification. The loading specifications were applied to duplicate actual situations that part will experience in the application.

The distributed loading cases shown were appropriate because the distributed load was an exact representation of the actual loads experienced during the product life cycle. It was proven that the one of the load requirements was met however the secondary load on the handles was not. This could be met by increasing the size of the mounting brackets to distribute the load throughout the base of the part without it pulling through the plastic. This would allow the casket to withstand a 317.515 kg load on the handles.

The parts are designed to withstand water and prevent it from leaking inside of the casket with the use of an O-ring or a gasket. This will prevent the part leaking during the rainy season.

The cost reduction of the part would be greatly improved because of the cheaper material, and less labor costs and expected demand would reduce the cost for the consumer.

**References**


