AUTOMATED CAPPING OF LIQUID STORAGE BOTTLES IN FOOD INDUSTRY

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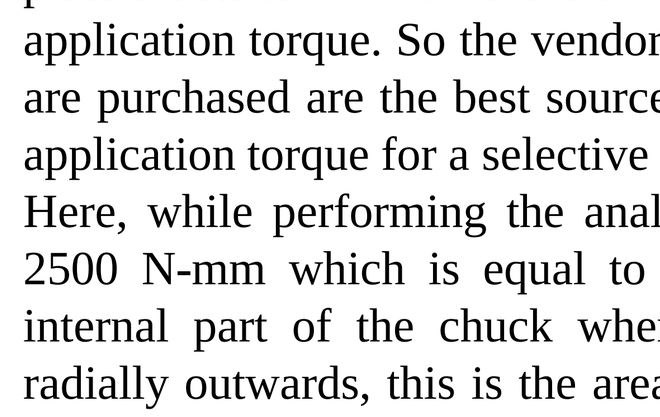
ABSTRACT

The high speed automated production systems are employed nowadays to achieve improved quality of manufacturing accuracy with improvised and high production rates. This paper introduces a new design for the chucks which are used for capping the liquid bottles for food and beverage industry. This new chuck is designed for multi -functional purposes which reduce the time for changing the chuck if caps of different diameters are used. The power transmission to the chucks is delivered by using "Hysteresis magnetic type clutches", for controlling and achieving smooth constant torque. The specialty of these clutches is that it offers smooth disengagement without jerks and bumps that increase its wear life compared to other ordinary clutches. The deformation and stress in the component are studied by performing the computer-aided structural analysis. With the analysis maximum deformation and maximum stress can be found out and the factor of safety can be calculated.

ANALYSIS

The application torque is a dependent variable; it depends on the type and size of caps and bottles used. Both glass bottles and plastic bottles with different diameters of the neck have different application torque. So the vendors from whom the caps and bottles are purchased are the best source to gain the knowledge of proper application torque for a selective cap and bottle.

Here, while performing the analysis we introduced the torque of 2500 N-mm which is equal to 22 inch-lbs. it is applied in the internal part of the chuck where torque is experienced, it acts radially outwards, this is the area where the stresses are acted and deformation takes place. In this paper, the position and value of maximum stress and maximum deformation of the designed component is found out. Then the factor of safety is determined. This value would tell how safe the product is. Another force of 400 N-mm (3.5 inch-lbs) is applied to press the cap downward for capping. This force is acting in the upward direction as a result of an application of force.



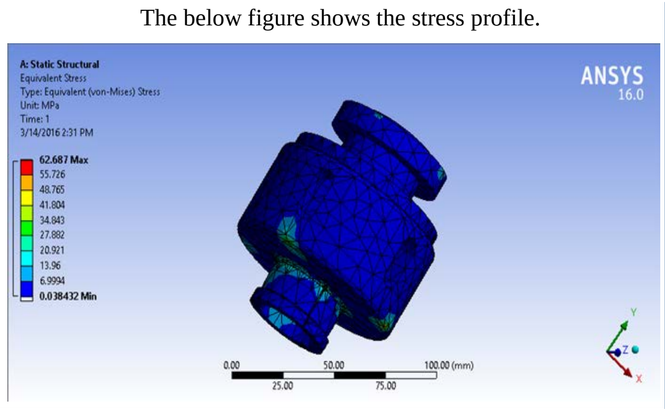
This picture shows total deformation profile in the chuck when forces are applied

$$f.o.s = \frac{material\ yeild\ stress}{maximum\ stress}$$

Yield stress= 355 MPa
Maximum stress= 62.68 MPa

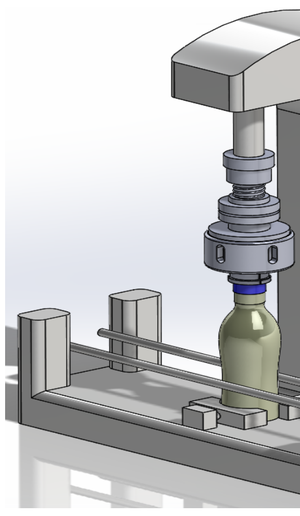
The chuck design is safe with a safety factor more 2.

The below figure shows the stress profile.

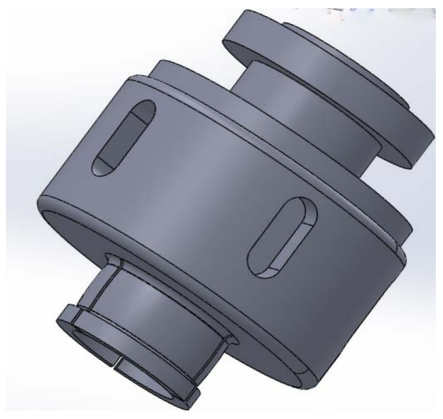


METHODOLOGY

The automated technology of capping the water bottle caps is one of the concerns of many manufacturers in food and beverages industries, because of several reasons like leakage, safety and hygiene.



AUTOMATED CAPPING MACHINE SYESTEM



CHUCK OF THE CAPPING MACHINE

To study the process of the automated capping system, the overall assembly of all components is shown in the figure-1. The figure is just for general idea and understanding of the production line.

The chuck here introduced is made of structural steel. The jaws of the chuck are designed in such a way that It can hold from 28 mm diameter cap to 38 mm diameter cap. The jaws offer a firm grip and hold the cap perfectly until the capping is done. There are made small slits on the chuck for heat dissipation whenever overloading occurs. Chuck is shown in figure-2.

To make sure that the closure is properly capped, the correct amount of torque is required. Otherwise, sealing could be too tight or too loose both of these conditions are undesirable. Therefore, the application of torque can be managed by using the hysteresis magnetic controlled chuck. The measurement of application torque and removal torque is important to find and has to be precise, for this torque measuring devices such as automated torque testers are utilized.

The designing was done in Solidworks. And it was imported to Ansys for static structural analysis.

Conclusion

A newly designed chuck introduced in this paper is reliable to be used in the automated capping machine. Computer-aided analysis is performed on it. And the results obtained from the analysis prove that the design is safe.