CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
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Project Number
S1617

Project Title
Yes We Can: Optimizing the Chicken Soup Can

Abstract

Objectives/Goals
Optimize for cost the production and shipment of cans of 450 mL of uncondensed chicken noodle soup, looking at each step of the process to minimize cost with respect to several shapes (circular cylinder, rectangular prism, hexagonal prism, and triangular prism) and dimensions of cans and geometries of their placement in shipping crates.

Methods/Materials
Calculate the dimensions at which surface area will be a minimum for the given volume employing single- and multivariable applications of the Extreme Value Theorem. Analyze the two-dimensional geometry of aligning each shape into rectangular units, and derive formulas for their dimensions and wasted space. Measure the density of chicken soup as well as rough weight per square cm of steel using beaker and postal scale, then determine feasible configurations of cans for each shape into cartons. Divide shipping cost by maximum number of cans contained in one truckload to find approximate shipping cost per can for each shape. Combine results from production and shipping optimization to determine an overall most efficient can design (also considering structural stability based on force testing).

Results
Net cost advantage analysis (net cost = production + shipping, to 3 significant figures):
- cylinder: $.0553/can (surface area per can: 325 cm^2 ; # shipped per truck: 162,000)
- rectangular prism: $.0532/can (surface area per can: 352 cm^2 ; # shipped per truck: 211,968)
- hexagonal prism: $.0548/can (surface area per can: 336 cm^2 ; # shipped per truck: 176,640)
- triangular prism: $.0616/can (surface area per can: 384 cm^2 ; # shipped per truck: 160,650)

Conclusions/Discussion
The rectangular prism (cube) design is the most cost effective overall, although the circular cylinder and hexagonal prism are more efficient in the production stage. The structural stabilities of the cylinder and rectangular and hexagonal prisms were all similar, while the triangular prism was weaker, as well as being less efficient for both production and shipping. Other factors to consider if actually implementing the results of this project would include the cost and effort of modifying manufacturing machinery to accommodate new can designs, as well as marketing and supermarket perspectives.

Summary Statement
This project aimed to determine the optimal shape and dimensions of the chicken soup can based on the prices of production and shipping for various can shapes and packing configurations.

Help Received
Mother assisted in structural stability test process and measurements.