ENGR-527/727 Advanced Mechanics of Materials

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Final Design Project

The consumption of soft drinks in America is enormous. The number of cans used every year is over 80,000,000,000. The majority of beer cans soft drink cans are made of aluminum. Other metal materials such as steel and tin are employed by the food industry and chemical industry respectively. In 1994, 3.1 million tons of aluminum waste was generated: aluminum containers and packaging, such as soft drink and beer cans, contributed 2.1 million tons. Thus, it is important to address this contemporary issue. Metal materials are nonrenewable natural resources thus, they are limited in supply, nonetheless, it is possible to recycle the majority of cans. From canned food to soda and aerosol cans, all metal cans including aluminum and steel are recyclable. According to the American and Iron Steel Institute, more than 90% of the co-products from the steelmaking process are reused or recycled.

The goal of this project is to Design a machine to crush soft-drink and beer cans. The crusher would be used in homes or restaurants as an aid to recycling efforts. It could be operated either by hand or electrically.

- The can-crusher must satisfy the following specifications:
- It should crush the cans to approximately 20% of their original volume.
- The operating force must be well within the limits of human strength.
- The can-crusher must withstand many cycles of operation without yielding, bending or fatigue failure of any of its elements.
- The can-crusher must be designed with the intent to convey an environmentally responsible attitude, which will be reflected by the selection of materials and fabrication process.

Specific steps to complete:

1. Draw all the assembly and detail drawings for manufacturing the machine.
2. Do a complete stress and strain analysis for each machine element involved. Identify and analyze the critical positions and locations, and plot all the results.
3. Do an analysis to select the proper materials, and dimensions for each machine element.
4. Conduct mechanical tests such as tension, bending, and fatigue to validate your results.
5. If Finite Element Analysis is employed, include a convergence analysis
6. Where appropriate perform an optimization analysis.
7. Perform the kinematic analysis of the mechanism if appropriate, and plot all the results.
8. Do the animation of your machine for the full range of motion. You could use for this purpose MATLAB, Solidworks or any other commercial software.
9. Elaborate a professional report.

Report

The report is a very well written report. The report must content and address the following sections.

1. **Title Page**. Name of the course, students and the Instructor.
2. **Abstract**. The report should start with an abstract of approximately 100 words, summarizing the objective, contents, results, and conclusions of the report.
3. **Table of Content.** List major topic headings, and page number where each topic begins.
4. **Nomenclature.** Prepare the reader for a trip through the mathematical development.
5. **Introduction**. The introduction section provides some background information on the overall design. This section is based on your literature review (Journals, Library, Internet, trade magazines, etc.).
6. **Develop of Engineering Specifications.**
   Clearly define the engineering specifications and the design criteria that defines the problem (taken from the customer requirements, engineering standards, and background research). In addition, incorporate the justification for the specifications and the metrics for its evaluation.
7. **Synthesis (Concept Generation and Selection)**. Explain the processes utilized to generate the alternative conceptual designs. Describe the process of evaluation and selection alternative designs.
8. **Design Analysis and Optimization.** This is performed using mathematical models to calculate the stress, deflection at critical locations along with kinematic and dynamic analysis. This stage also consist in selecting appropriate materials and evaluating safety and failure of the design.
9. **Conclusions**. Report your experience and findings in the realization of this project. Did the project meet the objective? Compare the engineering specifications to final design specifications. Highlight the unique features that you have added to your design.
10. **References**. List all the references. Use the standard method
11. **Appendix**. Use this to store details of your work that are not necessarily for the reader's understanding and would interrupt the flow of thought if they were included in previous sections.