Experimentation and Analysis of an Automatic Can/Plastic Bottle Crusher Machine

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Abstract

This paper describes about the experimentation of can or plastic bottle crusher machine and analysis of mechanism used in machine. Hence in this the knowledge of analysis is necessary, and by analysis of various parts the quality and life of machine can be increased and improved. Overall, for experimentation this machine involves processes like design, fabrication, analysis and assembling of different components etc. From this the knowledge of all the parameters like design, fabrication and analysis etc. will get increase but most important the knowledge of analysis, the use of Ansys-Workbench Software is increasing day by day to determine the parameters like stress, strain, deflection etc. for safe design and long durability.

Keywords: Analysis, Deflection, Materials, Material Properties, Strengths, Stresses

I. INTRODUCTION

The purpose of this paper is to understand the fundamental knowledge of Analysis and Design. In this, analysis is carried out to determine the maximum stress induced in machine, failure occurs, deflection in machine etc. In this to carry out the analysis the knowledge of material is important aspect because the stresses and deflections such parameters are change accordingly of the material. In this analysis is done by using software Ansys-Workbench, determine the total deflection, maximum stress induced etc. To carry out the analysis number of steps has been followed such as modeling of machine, material properties assigning to the components, meshing, applying boundary conditions about the fixed point, applying pressure of 1104 psi on the surface of slider, by using all this determination of stresses has been done. In this, along with analysis and design some electronic components are used for fabrication of this machine to make this automatic one.

II. STRUCTURAL ANALYSIS

Material Data: In this, a material property has been assigned for improving life of components used.

Mild steel

Table - 1
Mild Steel > Isotropic Elasticity

Temperature F	*Young's Modulus psi*	*Poisson's Ratio*
-	*2.9733e+007*	*0.29*

Structural Steel

Table - 2
Structural Steel > Constants

Density	*0.2836 lbm in^-3*
Coefficient of Thermal Expansion	*6.6667e-006 F^-1*
Specific Heat	*0.10366 BTU lbm^-1 F^-1*
Thermal Conductivity	*8.0917e-004 BTU s^-1 in^-1 F^-1*
Resistivity	*8.5235 ohm cmil in^-1*

Table – 3
Structural Steel > Compressive Ultimate Strength

Compressive Ultimate Strength psi	*0*

Table - 4
Structural Steel > Compressive Yield Strength

Compressive Yield Strength psi	36259

Table – 5
Structural Steel > Tensile Yield Strength

Tensile Yield Strength Psi	36259

Table – 6
Structural Steel > Tensile Ultimate Strength

Tensile Ultimate Strength psi	66717

Table - 7
Structural Steel > Alternating Stress

Alternating Stress psi	Cycles	Mean Stress psi
5.8001e+005	10	0
4.1002e+005	20	0
2.7499e+005	50	0
2.0494e+005	100	0
1.5505e+005	200	0
63962	2000	0
38000	10000	0
31038	20000	0
20015	1.e+005	0
16534	2.e+005	0
12502	1.e+006	0

Table - 8
Structural Steel > Strain-Life Parameters

Strength Coefficient psi	Strength Exponent	Ductility Coefficient	Ductility Exponent	Cyclic Strength Coefficient psi	Cyclic Strain Hardening Exponent
1.3343e+005	-0.106	0.213	-0.47	1.4504e+005	0.2

Table - 9
Structural Steel > Relative Permeability

Relative Permeability	10000

Table - 10
Structural Steel > Isotropic Elasticity

Temperature F	Young's Modulus psi	Poisson's Ratio
-	2.9008e+007	0.3

A. MESH

In this a tetrahedron type meshing is used. Simply meshing means to divide the single element into a number of elements to determine a stresses at every point of that single element so at which point the failure of part takes place can be determine easily. The meshing of modeling of machine is shown in figure below.

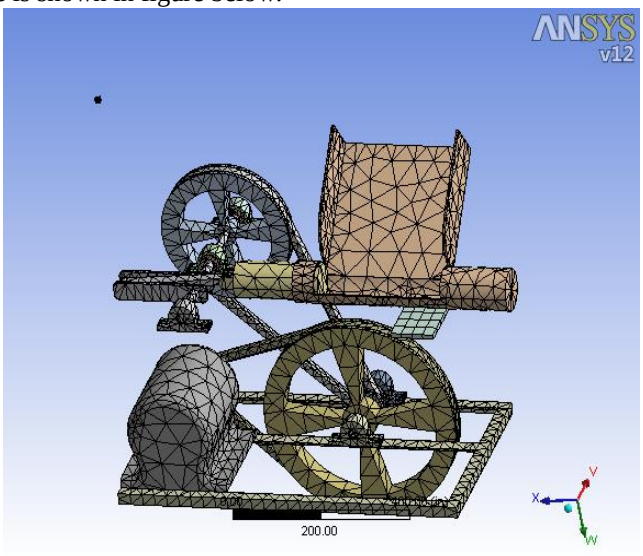

Fig. 1: Meshing of the Model

B. TOTAL DEFORMATION

In this, a static structural analysis has been done to determine the total deformation of machine and where it takes place. The following figure shows the static structural analysis for total deformation.

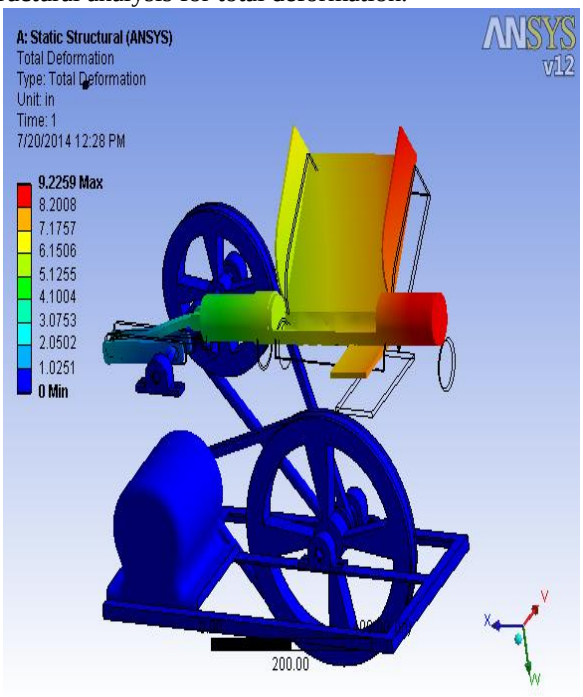

Fig. 2: Analysis for Total Deformation

C. EQUIVALENT STRESS

An analysis is done to determine the equivalent principle (Von-Mises) stress. To determine this stress there are number of parameters has to be considered such as material properties like young's modulus, poisons ratio, yield strength (Compressive and Tensile), Ultimate stresses etc.

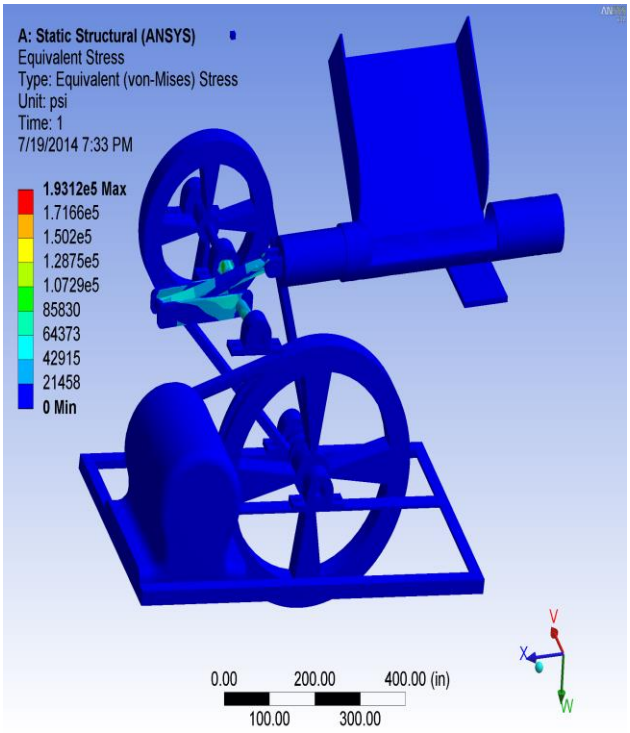

Fig. 3: Analysis for Equivalent Stress

III. EXPERIMENTAL RESULTS

The machine fabricated on the basis of design and analysis of different components is shown in figure below. This machine is made automatic by using some electronic components such as Sensors, Micro-Controller, IC's etc.

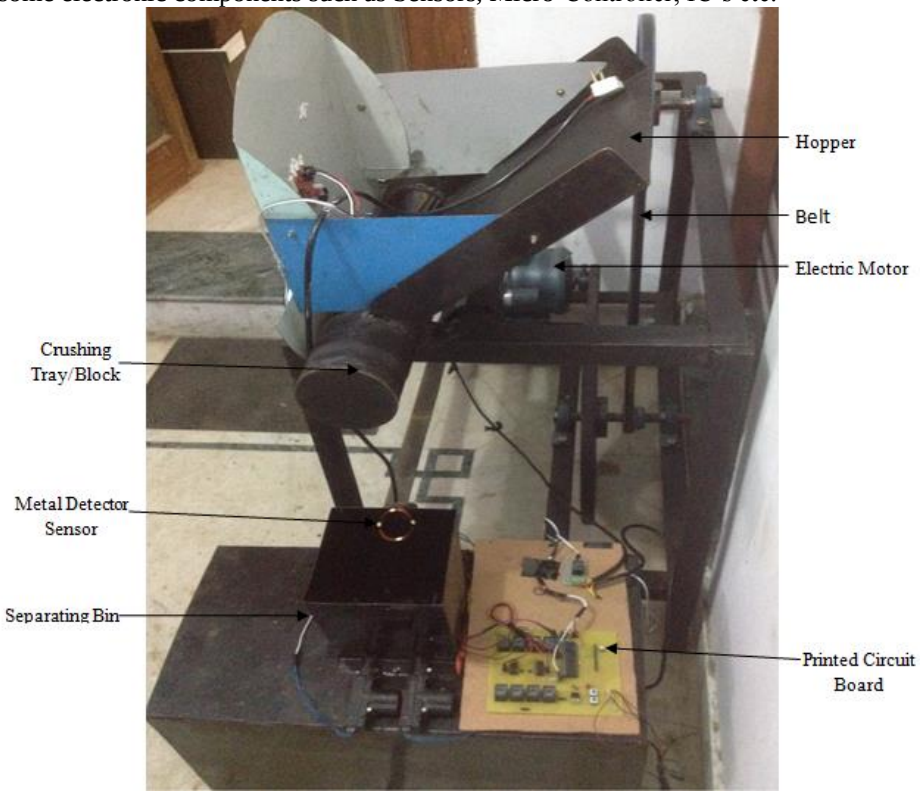

Fig. 4: Experimental Set Up

For experiment, the following specimen of Cans and Plastic Bottles are considered,
Dimensions of Soda Can-500 ml

Diameter, D = 65 mm
Length, L = 168 mm

Dimensions of Plastic bottle-500 ml
Diameter, D = 58 mm
Length, L = 206 mm
The following tables show the comparison between uncrushed and crushed cans as well as plastic bottles.

Table – 11
Reduction in Volume of Cans after Crushing

Sr. No.	*Time required*	*Original Length (mm)*	*Crushed Length (mm)*	*Original Volume (mm^3)*	*Crushed Volume (mm^3)*	*Reduction in Volume (%)*
1.	*1.25*	*168*	*38*	*557.47×10^3*	*126.09×10^3*	*77.38*
2.	*1.25*	*168*	*37*	*557.47×10^3*	*122.77×10^3*	*77.97*
3.	*1.3*	*168*	*38*	*557.47×10^3*	*126.09×10^3*	*77.38*
4.	*1.25*	*168*	*38*	*557.47×10^3*	*126.09×10^3*	*77.38*
5.	*1.25*	*168*	*37*	*557.47×10^3*	*122.77×10^3*	*77.97*

To determine the Reduction in Volume in percentage, = [(V - v)/ V] × 100
V – Original Volume
v – Crushed Volume.

Table – 12
Reduction in Volume of Plastic bottles after Crushing

Sr. No.	Time required	Original Length (mm)	Crushed Length (mm)	Original Volume (mm^3)	Crushed Volume (mm^3)	Reduction in Volume (%)
1.	1.6	206	58	544.26×10^3	153.24×10^3	71.84
2.	1.65	206	62	544.26×10^3	163.80×10^3	70.00
3.	1.6	206	63	544.26×10^3	166.45×10^3	69.5
4.	1.65	206	63	544.26×10^3	166.45×10^3	69.5
5.	1.7	206	60	544.26×10^3	158.52×10^3	70.87

IV. CONCLUSION

In this, thus we determined where does the maximum stress and total deformation occurs in the machine by using ansys workbench software as well as by using this machine the volume of Cans and Plastic bottles can be reduce up to a seventy percent. By analysis of machine components most efficient and durable machine can be manufactured. By Analysis of machine it is concluded that the machine is safe through design point of view.

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