

Plastic Chipper Shredder

Team Members

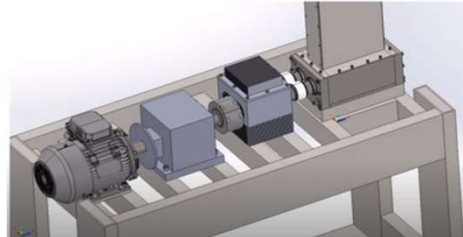
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Slide Clips and Highlights

What is it that we're making?

The Plastic Material Recovery Grinder is tool that we propose to serve as a chipper washer unit for the diversion of #5 Polypropylene plastic trays from the college's Terrace dining facility.

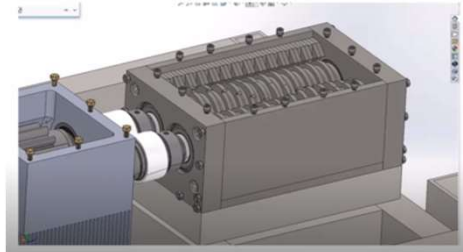
Final Assembly Product



What Is the Usage?

- Just like recycling plastic, a shredder is easily recyclable and makes recycling easier
- It clears a lot of clutter in homes like old toys, bottles, and other broken plastic tools.
- Since plastic is made from harmful gases, chemicals and oils, shredding also preserves the environment.

Chipper Component



How Does It Work?

- A 5.50 hp 1,175 rpm, 268 in-lb AC motor with drive an opposing dual shaft chipper unit, shearing the plastic into 1/2 inch by 1/2 inch sized plastic chips.
- The trays will be washed in the Terrace wash bay then loaded vertically into the chipper.
- The chips will exit into a 32-gallon recycling can.
- The material will be loaded into a dumpster and sold to Buffalo Polymer Processors Inc. in Holland, NY, approximately one hour and fifteen minutes away from campus.

Results

OUTPUTS			
Determined the 4340 OQT 700 Steel and 304 SS to be Ductile, as Percent Elongation for the materials exceeds 3% each.			
N_f factor of safety_MST_Ductile_Repeated_4340_hex_shaft	4 factor	the MST factor of safety, "N". Selected for repeated load, therefore N=4.	
$\tau_{max_shear_MST_torion_4340_hex_shaft_overload}$	2600 psi	the allowable shear stress for the 4340 hex shafts according to MST.	
$\tau_{max_torion_4340_hex_shaft_overload}$	6300 psi	the maximum shear stress on the 4340 hex shaft possible under overload conditions "after" the stress concentration is applied.	
$\tau_{max_torion_4340_transfer_box_shaft}$	15346 psi	the maximum shear stress on the 4340 transfer box shaft "after" the stress concentration is applied.	
The (1) shear stress on the driver hex shaft in overload is below the allowable shear stress for the hex shaft in torsion as determined by MST. Therefore the design is safe.			
N_f factor of safety_MST_Impact_304_SS_blades	6 factor	the MST factor of safety, "N". Selected for impact/block loading, therefore N=6.	
$\tau_{max_shear_MST_torion_304_SS_blade_overload}$	2600 psi	the allowable shear stress for the 304 SS blades according to MST.	
$\tau_{max_torion_304_SS_blade_30m_overload}$	434 psi	the maximum shear stress on the 304 SS blade teeth possible under overload conditions "after" the stress concentration is applied.	
$\tau_{max_torion_304_SS_blade_30m_overload}$	2388 psi	the maximum shear stress on the 304 SS blade teeth possible under overload conditions "after" the stress concentration is applied.	
The (1) shear stress on the blade teeth & blade hex bore in overload is below the allowable shear stress for the hex shaft in torsion as determined by MST. Therefore the design is safe.			
$\tau_{1_4340_OQT_700_hex_shafts}$	6979 psi	the estimated actual (adjusted) allowable endurance strength capacity of the 4340 OQT 700 hex shafts.	
$\tau_{max_bending_4340_hex_shaft_overload}$	6434 psi	the maximum bending stress on the hex shaft possible under overload conditions "after" the stress concentration is applied.	
$\tau_{1_4340_OQT_700_transfer_box_shaft}$	4387 psi	the estimated actual (adjusted) allowable endurance strength capacity of the 4340 OQT 700 gpr transfer box shafts.	
$\tau_{max_bending_transfer_box_shaft}$	34132 psi	the maximum bending stress on the transfer box shaft "after" the stress concentration is applied.	
The (1) bending stress on the driver hex shaft in overload is below the allowable bending stress for the hex shaft in bending as determined by Endurance Strength Guidelines (as predicted failure).			
$ADT_degrees_per_inch_maximum_allowable$	0.650 °/in	the maximum allowable angle of twist in degrees per inch	
$angle_of_twist_degrees_maximum_allowable$	0.331 °	the maximum allowable angle of twist in degrees	
$length_of_twist_overload$	0.248 in	the angle of twist of the driver side hex shaft under theoretical overload conditions	
The ADT on the driver hex shaft in overload is below the allowable ADT for the hex shaft in torsion as determined by Table Guidelines (as page 218 of "Applied Strength of Materials 2013-2016").			

Intermediate Calculations

$D_{rounded_groove}$	1.067	
r_{rd_groove}	0.00485	
$K_t_circip_Torsion$	2.50	torsion stress concentration factor for the groove at the end of the shaft
$K_t_circip_Bending$	2.50	bending stress concentration factor for the groove at the end of the shaft
$K_t_greatest_Torsion$	2.50	the greatest stress concentration on the shaft in regards to torsion
$K_t_greatest_Bending$	2.50	the greatest stress concentration on the shaft in regards to bending
$180 \div 3.1416$	57.29577951 °/radian	conversion factor
$T_{min_required_for_input_driver_hex_shaft}$	822.10 lb-in	the minimum torque required to turn over the driver hex shaft
$C_{loss_factor_per_stage}$	0.96 decimal	the percent loss of torque per individual gear stage due to friction, convert
$C_{loss_factor_transfer_set}$	0.96	
$T_{min_required_for_input_driver_hex_shaft}$	838.87 lb-in	the minimum torque required to turn over the driver hex shaft
$T_{design_overload_capacity_input_driver_hex_shaft}$	1098.93 lb-in	the torque required to turn over the driver hex shaft plus 31% overload cap
$Number_of_gear_stages_required$	2 stages	The estimated number of gear reduction stages required to reach the min
$Transfer_stage_2_torque_output_min_required$	2197.85 lb-in	
$Transfer_stage_3_torque_input_min_required$	2555.64 lb-in	
$Gear_Stage_2_torque_output_min_required$	2555.64 lb-in	
$Gear_Stage_2_torque_input_min_required$	2687.80 lb-in	