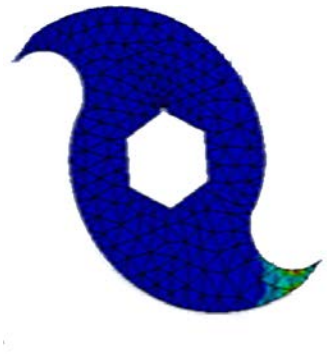

Figure 6. Stress on the blade by static structural method

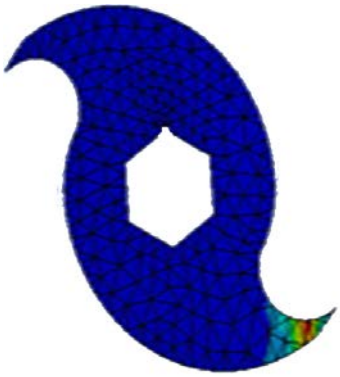

Figure 7. Strain on the blade by static structural method

The above figures are the result obtained by the static structural analyzing method using the software. The stress acts on the tip of the cutting edge at a small range. Thus, the strain on the blade is much less as shown in the figure which is obtained by the hardened properties of the blade material. This strain value is much more reduced by hardening method and chrome plating processes. The following figure shows the deformation of the blade which is comparatively reduced by increasing the properties of the blade. This results in the life span of the blade.

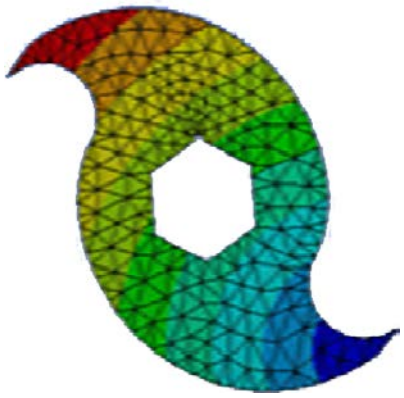

Figure 8. Total Deformation by the static structural method

9. Fabrication Process

9.1 Laser Cutting

Laser cutting is mainly a thermal process in which a focused laser beam is used to melt material in a localized area.[12] The laser optics and CNC (computer numerical control) are used to direct the material or the laser beam generated. The focused laser beam is directed at the material, which then either melts, burns, vaporizes away, or is blown away by a jet of gas, leaving an edge with a high-quality surface finish. The CO_2 laser which is capable of cutting, boring, and engraving, this is used to cut the typical edges if the shredder blade. The reason of Laser cutting done to this that, when the blade undergoes other machining processes, the material properties tend to change. This also results in the reduction of wear resistance. But when the blade is being cut by the Laser cutting method, the property of the material of blade remains unchanged.

Figure 9. Laser Cutting Operation

9.2 Polygonal Turning Operation

Turning is a machining process in which a cutting tool, typically a non-rotary tool bit describes a helix tool path by moving more or less linearly while the work piece rotates. There are many turning operations in lathe. The method we used in our project is a polygonal turning in which non-circular forms are machined without interrupting the rotation of the raw material.

Figure 10. Turning of Our Shaft

9.3 Surface Grinding

Surface grinding which is the most common of the grinding operations. It is a finishing process that uses a rotating abrasive wheel to smooth the flat surface of metallic or non-metallic materials. This will also attain a desired surface for a functional purpose. Here the surface grinding is done to the shredder blade which removes the oxide layer on the surface of the blade which avoids the rusting of the iron used. This grinding operation also removes the impurities on the work piece surface.

9.4 Welding

Welding is a material joining process which produces coalescence of materials by heating them to suitable temperatures with or without the application of pressure or by the application of pressure alone, and with or without the use of filler material. Here in this machine welding is used for making permanent joints between the shaft and the shredder blade. Arc welding is a type of welding that is used with a welding power supply to create an electric arc between an electrode and the shredder to melt the metals at the welding point.

10. Shredding Process

The shredding process which is the type of cutting down the scrap by running the blade at a fixed speed which is being run by the motor which is coupled with the reduction motor. But it is hard to cut down the plastic directly by the shredder blades with small serrated edges. From the time of invention of the shredding process the scrap such as plastic is being processed by some treatment to bring down the strength of the plastic to the level of being cut-down easily. The following are the processes carried out before shredding process: Incineration, Autoclaving, Shredding. But the process of incineration and autoclaving reduces the quality of the product that is to be shredded. In order to reduce the variation in quality during the shredding process, the serrated edges made with increased surface area and hard tool steel. The thickness of the blade is not more than 5mm. Thus, the shredded pieces that are obtained after shredding are less than or equal to 5mm thickness.

Since these pieces are equal to or less than 5mm in size, there is no need to treat the products with heat, which do not reduce the quality of the material. Thus, these pieces can be directly fed into the injection moulding machine. This doesn't use high temperature on the products, which result in a good quality product after the moulding process. This process enables to use the recycled product many times than before since the grade doesn't very much.

11. Conclusion

The plastic shredder machine is widely used in industries for the plastic waste management. By using this plastic shredding machine, the overall costing of recycling process gets reduced. The new design of the blade that is shown above increases the efficiency of the plastic shredding. The life time of this design of the blade is much higher than the previous designs of blades that is being used currently. In recycling process of plastic, waste required low energy due to compact form of plastic waste. This new design of blade reduces the process time considerably than the other blades. As this blade has more resistance against the deformation and principal stresses than the previous designs, this serves as a better part in the shredder machine.

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Biography

Student pursuing his Bachelor of Engineering in Department of Mechanical Engineering from Rajalakshmi Engineering College, Chennai, Tamil Nadu, India. He has published papers titled Design and Fabrication of Ferromagnetic Suspension for Automobiles and Design and Optimization of Plastic Shredder Blade in journals and has presented them in difference conferences held at Kingston Engineering College, Vellore, India and Anna University, Chennai, India respectively. He has done internships in Brakes India Pvt. Ltd and Nokia Communications and Networks, India. He has been a part of the Baja team of his college. He was the Captain of Suspension Subsystem of his college Baja Team named "Redline Racing" which was placed 6th position in 2018. His research interests include manufacturing, simulation, optimization, automotive, and designing. He is an active member of IIW, SAE.