Analysis of Various Waste Plastics Reactors: A Comparative Study

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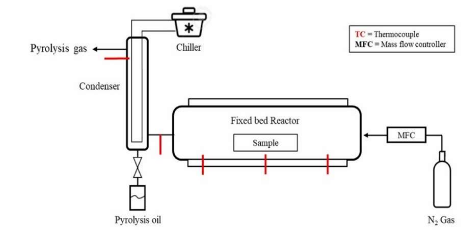
Abstract

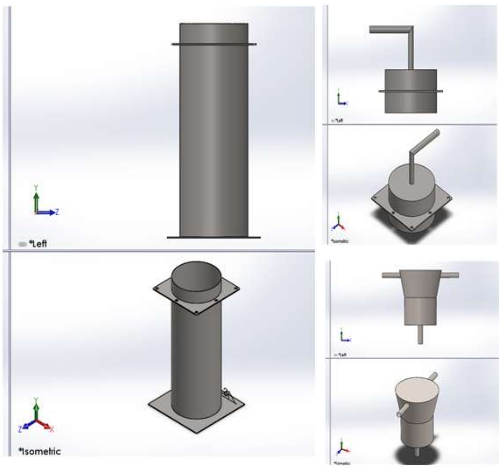
Managing waste plastics is one of the world's biggest environmental challenges. Because they havanto turn waste plastics into useful goods, thermal treatment techniques like pyrolysis and gasification have drawn a lot of attention among the different waste plastic management strategies. This research offers a comparison of several waste plastics reactors—such as rotary kilns, fluidized bed reactors, and fixed bed reactors—that are used in thermal treatment procedures. Reactor design, operating conditions, product yields, energy efficiency, and environmental effects are only a few of the important topics covered in the analysis. The study also assesses each reactor type's performance in terms of economic feasibility, process scalability, and product quality. This comparative analysis attempts to clarify the advantages and disadvantages of each reactor configuration by combining the body of current literature with empirical data, offering guidance for the choice and improvement of waste plastics treatment methods. The results of this study advance our knowledge of waste plastics management techniques and may help in the formulation of sustainable waste management policies.



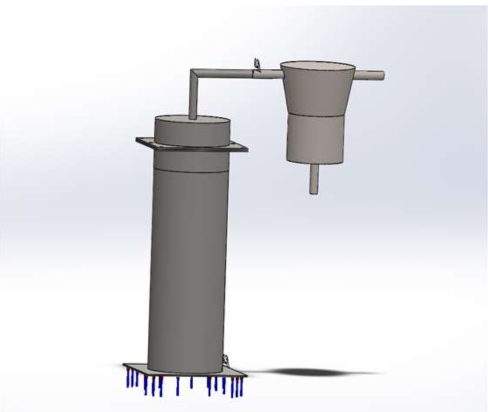
(b) Fixed-bed

Methodology

The main objective of the study is to create a design of the reactor that is going to use for experimental purposes. The SolidWorks is used to create the model on the analysis of the reactor which is going to use for the experiment. The whole study is consisting of the fixed bed reactors with cyclone separator for designing and analysis. The main moto is to study about the temperature that can withhold by the reactor for producing the pyro oil from the plastics. The Figures shows the model created for testing.

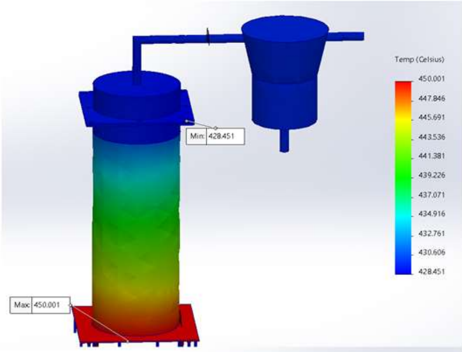


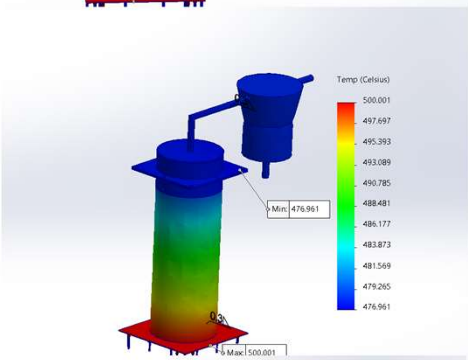
After the designing of the reactor analysis is done which is presented on the SolidWorks. We assume that there is no heat loss in our system. So that we can find the temperature withhold in our system. The temperature load of 450°C due to the reactor fills with the LDPE plastics. So that the pyro-vapor starts to produce at the temperature of 400°C.

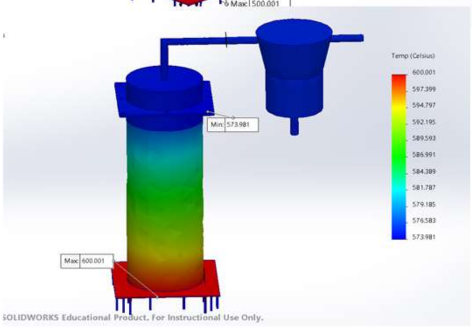


Variant	Temperature	Input materials	Melting Temperature	Temperature of pyrolysis
I	450	LDPE	110°C	250-380
II	500	HDPE and PP	131°C and 168-176°C	390-500
III	600	Mixed(un sorted)	Depends on mixing	380-525

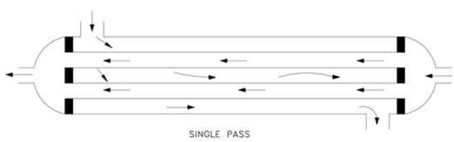
The below figures represents the temperature outcome from the temperature given above in the table

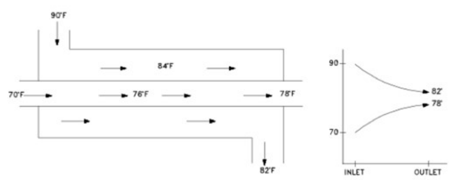




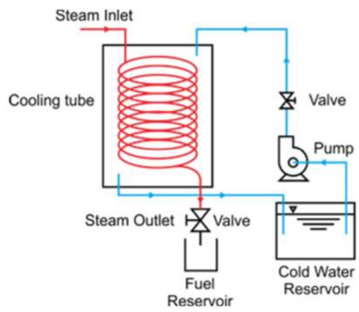


The designing of the reactor analysis is done, The condenser system in now being designed .A condenser is a device where steam condenses, and latent heat of evaporation released by the steam is absorbed by cooling water. The main parameters that determine the operating mode of the condenser are cooling water flow rate, cooling water temperature, heat exchange area, steam flow into the condenser. Fro an efficient condenser a combination of the following types was designed :





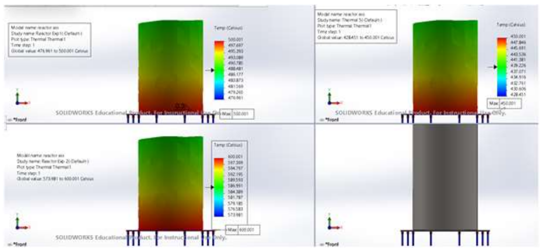
The figures below shows the final design iteration and how the condenser system will look.



The inlet temperature of the condenser is 300 °C, while the temperature of the cooling fluid is kept constant in the temperature range of 15 °C - 20 °C .The working parameters and the results are given in the table below.

Properties	Inner pipe	Annulus
Inlet temperature (Tin)	300°C	30°C
Outlet temperature (Tout)	35°C	20°C
Mass flow (kg/s)	0.01	0.38

Results



The working temperature of the Reactor at different Temperature distribution. The entire plastic pyrolysis system for producing the pyro-oil from the LDPE has successfully verified by the designing and the analysis using SolidWorks. As per the data from the different analysis and the research articles clearly states that this type and this model can be work perfectly for the experimental purposes to do as lab experiments. The places of the temperature drops are clearly shown in this study of analysis and for the conder using theoretical calculations the temperature difference was found for the designed system.



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