

# M2.3 - Process Design for Recycling HDPE in Product Manufacturing

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## Problem Statement

- Post-consumer High-Density Polyethylene is a major cause of pollution that threatens the environment.
- The goal of this project is to design a process that will use post-consumer HDPE in product design and manufacturing.
- The process should be completed in a short time and allow individuals with minimum training and knowledge the ability to utilize it.



## Process Considerations

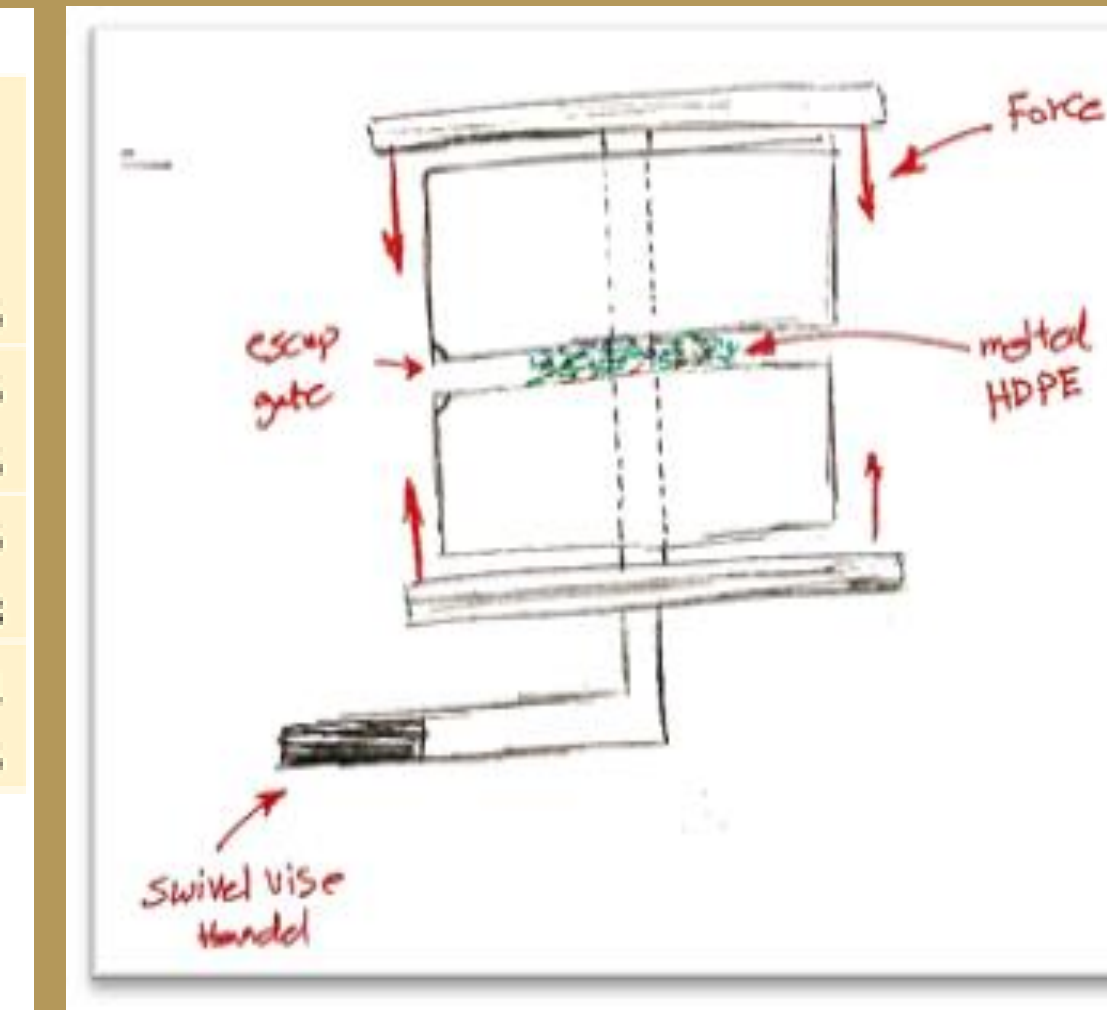
- Some crucial details required for the product manufacturing process are:
- HDPE should be collected, cleaned and shredded before starting the process.
- An ideal shred size of 0.5"x 0.5" will shorten the melting time.
- Recommended HDPE is Milk Jugs and bottle caps.
- The heating source must be maintained at a temperature within 400°F - 500°F.
- Wear the appropriate PPE. Heat gloves must be worn throughout the whole process.
- Melting the material while inside the mold gives a good surface finish of the product and reduces handling.



## Concept Selection

Melting the HDPE while inside the mold was the concept the team has selected and developed. For the purpose of our project which requires a simplified process for product manufacturing this concept worked best.

Selection Criteria	Weight	Concepts							
		Injector Concept		Extruder Screw Concept		Press Handle Concept		Melting inside the mold concept	
		Rating	Weighted Score	Rating	Weighted Score	Rating	Weighted Score	Rating	Weighted Score
Ease of Handling	15%	2	0.3	2	0.3	4	0.6	5	0.75
Ease of Use	15%	1	0.15	3	0.45	3	0.45	5	0.75
Minimum Postprocessing	5%	5	0.25	5	0.25	1	0.05	3	0.15
Safety	15%	3	0.45	3	0.45	3	0.45	3	0.45
Process Time	20%	3	0.6	2	0.4	2	0.4	4	0.8
Ease of Manufacturing	20%	2	0.4	1	0.2	1	0.2	5	1
Ease of Maintenance	10%	1	0.1	1	0.1	1	0.1	5	0.5
Total Score		2.25		2.15		2.25		4.4	
Rank		2		4		3		1	
Continue?		NO		NO		NO		Develop	



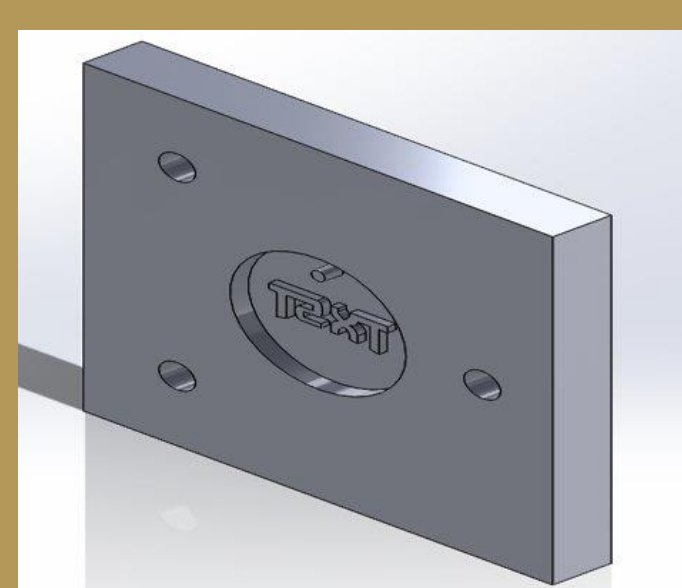
## Product Manufacturing Process

- Preheat the oven with the molds inside for 5 minutes.
- Spray mold with release agent and add shredded HDPE.
- Allow HDPE to melt for 5 minutes.
- Using the spatula arrange melted material in the mold and add mor HDPE.
- Repeat step until mold is full and HDPE is melted.
- Remove Mold from the oven, align it and press it using the vertical press.
- Allow to cool down for 5 minutes, and still wearing heat gloves remove the product from the mold.
- Remove excess material and perform minimum postprocessing if necessary.

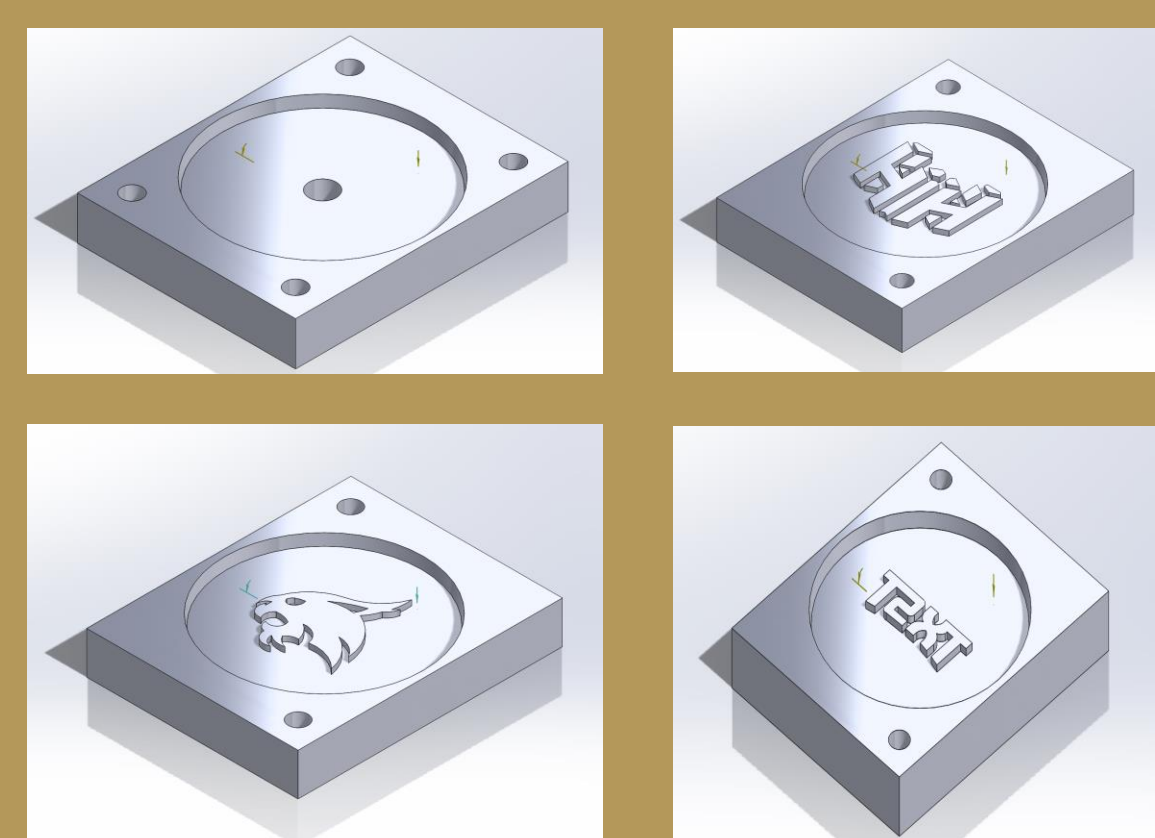


## Final Designs

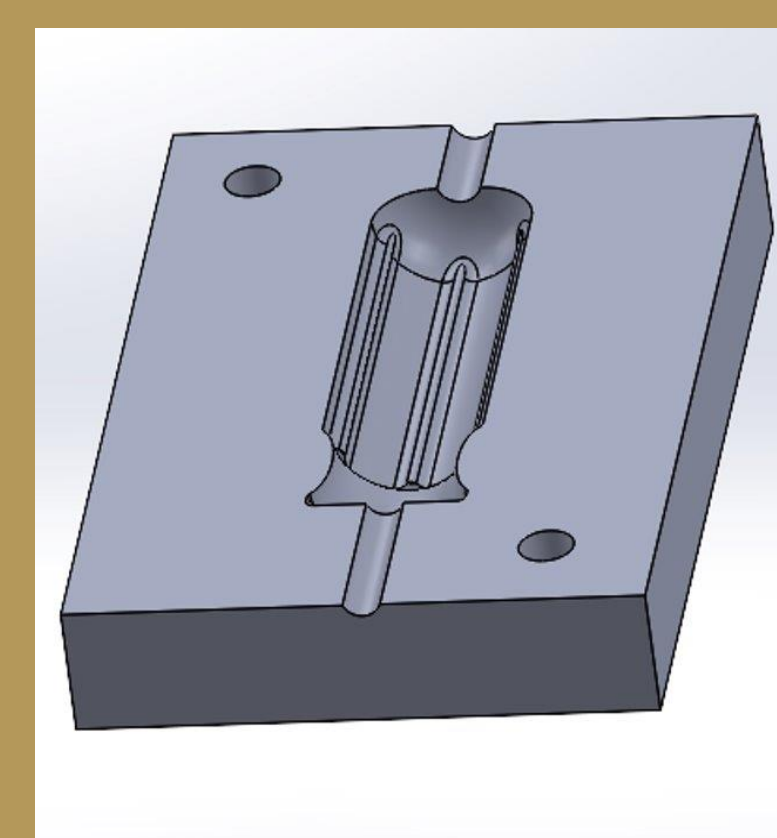
Keychain



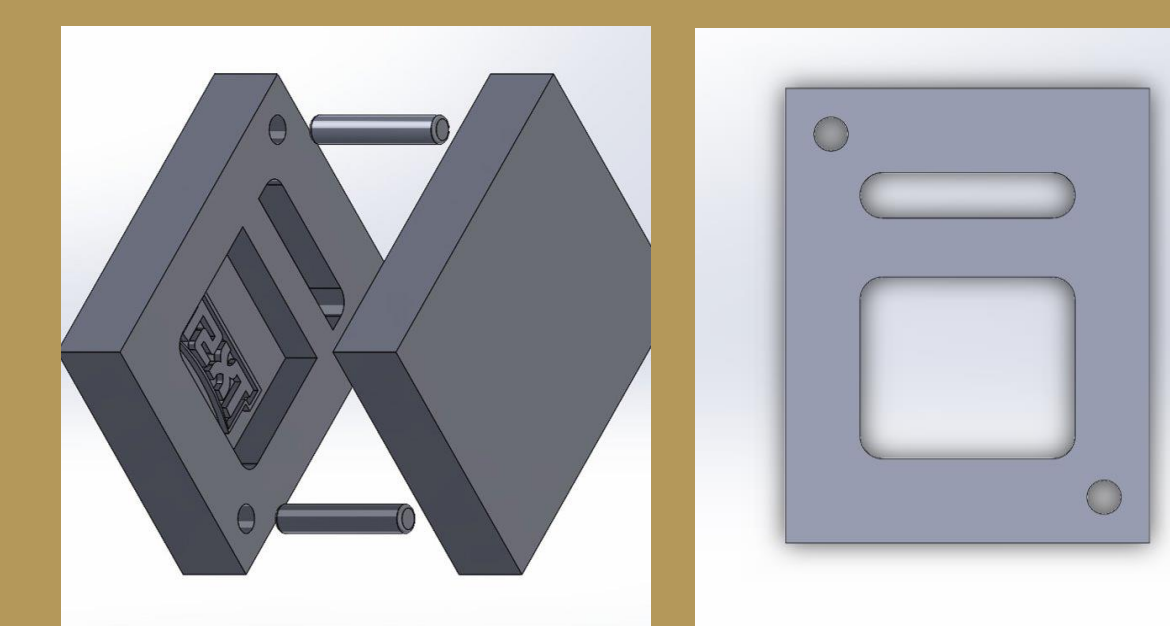
Cup Coaster



Screwdriver

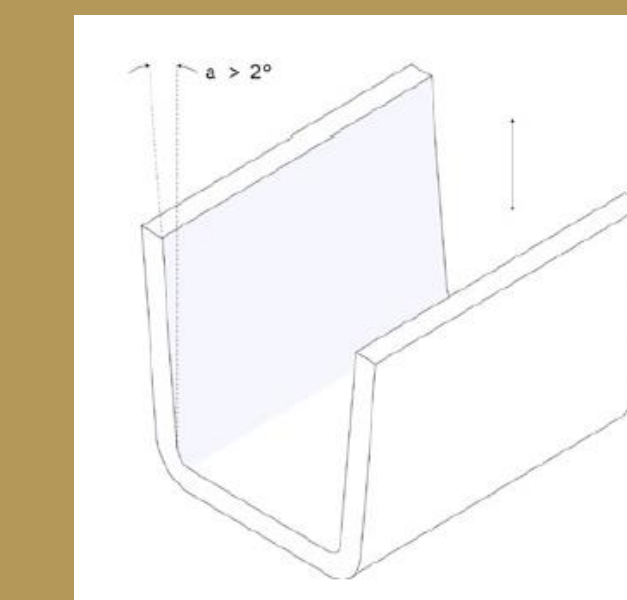


Cell Phone Holder



## Mold Manufacturing

- The team used CAD software to design the molds in the sketching environment.
- Adding a draft angle of 1° was important for smooth release.
- MasterCam was used to program the parts for machining.
- Setting up the appropriate feed rates, spindle speed, and stepovers for the tools was crucial in machining the molds.
- The 3/8, 1/4, 1/8, and the 1/16 endmills were the main tools used in machining the molds.
- Adding small details requires a smaller tool which requires lowers feed rate thus increasing the machining time.
- Ground dowel pins/bolts and nuts were used for mold alignment.



## Finished Products

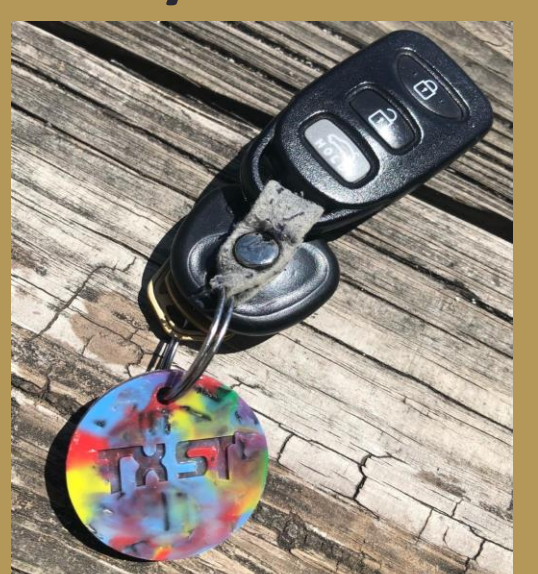
Screwdriver



Coaster



Keychain



Cellphone Holder



## Acknowledgements

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- **Texas State University** - Special thanks to Dr. Austin Talley for his guidance and expertise throughout the project. We would also like to thank Mr. Ivey for his support and help in manufacturing process. Lastly, Texas State University for providing the facilities and a supportive learning environment.