Thermoform Materials Test Report
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2/9/18

Introduction

My team plans to create vacuum-formed plastic tile molds by machining a mold negative out of craft foam and thermoforming over it with ABS plastic. However, most types of foam melt at the temperatures reached during thermoforming. The objective of this test was to determine the optimal combination of foam and protective coating to use when creating a mold negative. This test was done with the help of the Arborloo team, who provided the insulation foam samples.

Experimental Procedure

Materials:
2.5 x 2.5 x 5 inch piece of open-cell styrofoam (2)
2 x 3 x 4 inch piece of smoothfoam styrofoam (2)
2 x 2 x 2 inch piece of foam insulation board (2)
2 x 2 x 5 inch piece of foam insulation board (1)
JB weld metallic epoxy
Plasti-dip coating
Plaster of Paris
Bondo
Petroleum Jelly
0.125 x 27 x 27 inch sheet of ABS

Test Equipment:
Vacuum Former

Procedure:

1. Coated one sample of open-cell styrofoam with Bondo and the other with Plaster of Paris
2. Coated one sample of smoothfoam styrofoam with Bondo and the other with Plaster of Paris
3. Coated one sample of insulation board with plasti-dip and the other with epoxy.
4. Allowed all samples to dry for their recommended periods of time.
5. Placed ABS sheet in vacuum former and began the heating process.
6. Coated all samples in a thin layer of petroleum jelly to make it easier to remove samples from the plastic.
7. Placed all 7 samples on the vacuum former base as shown in figure 1.
8. Lowered ABS onto the samples and allowed to cool.
9. Removed ABS from the vacuum former.
10. Removed samples from plastic and inspected results.

Results

The results of this test indicated that the best candidate for thermoforming is the combination of the foam insulation board and the metallic epoxy coating. This sample suffered no apparent degradation from the heat of the plastic and was easily removed from the plastic.

The smoothfoam had visibly melted from the heat despite the bondo and plaster coatings. The tops of both smoothfoam samples were caved inwards and had separated from their coatings.

The open-cell styrofoam fared better than the smoothfoam, in that it had less apparent distortion. However, there were noticeable gaps that formed in the coatings, and around these gaps the open-cell foam melted and warped.

The foam insulation board sample that was coated with epoxy maintained its shape with no warping and was easily removed from the plastic. The sample that was coated in plasti-dip, however, developed gaps in the coating and melted to the ABS and broke when being removed from the plastic. The insulation board sample with no coating also melted to the plastic and broke on removal.

The insulation board also showed an interesting property in that the samples that experienced melting released gas, causing the ABS to bubble upwards, as shown in the figure below. This is important, as it indicates that any gaps in the coating of the insulation board could cause undesirable bubbling in the mold.

Plaster of Paris was easy to apply to the smoothfoam in an even coat, but was difficult to use with the open-cell foam, which kept absorbing the liquid into its porous surface. Bondo proved very difficult to work with for both samples, due to its texture, quick hardening time, and strong smell. Epoxy appeared to give the smoothest coating, with the additional benefit of being able to sand it smooth. The plasti-dip appeared to leave small pores and openings in the coating.

Overall, foam insulation board with an epoxy coating proved to be the most likely candidate for this application. Further testing may be done with a 1/16th inch piece of ABS, or with a spray primer for foam in order to achieve better smoothness.

1. Uncoated foam insulation board
2. Bondo/Open-cell foam
3. Epoxy/foam insulation board
4. Plaster/Open-cell foam
5. Plaster/smoothfoam
6. Bondo/smoothfoam
7. Plasti-dip/foam insulation board

Thermoforming

Bubbles from off-gassing foam indicated by arrows

Samples after testing