Testing to Determine a Molding Procedure for Spheres

Contents

Introduction

The sensor configuration uses IR sensors to read the deformation of a thin plastic dome. In order to improve the quality of this reading, the opacity of the domes needed to be increased and preferably reflect more light back to the sensor inside the dome

Determining a Molding Procedure with the use of Microspheres

To conserve the spheres, a molding process was needed that would keep the spheres only on the domes and not into the flat surrounding plastic which is not monitored by the sensors. In order to test different molding processes to achieve this objective, a substitute for the spheres had to be made as they were too expensive to waste on testing. The normal plastic is a green color. By adding some red dye to the liquid plastic, a purple color was made. The purple color was used to simulate plastic with spheres mixed in and the green color used as typical plastic without spheres.

Series 1:

Process:

To make the purple plastic the green base was made as normal. In a separate container a small amount of dry dye powder was mixed with a drop or two of water, just enough to moisten it and turn it clumpy. A small amount of this mix was then added to a portion of the liquid green plastic and stirred. The purple and green plastics were then placed in the vacuum chamber and vacuumed until no more bubbles appeared. The plastic was added to the molds by dripping it off the end of end of a screwdriver.

Tests:

The four different tests are described below. A summary of the layers are included in Table

A) Mix purple plastic outside molds, add varying amounts to mold divots, fill and cover divots with green plastic.
B) Place varying amounts of green plastic in divots, sprinkle unmixed dye particles on top, stir to mix, then fill and cover divots with green plastic
C) Place varying amounts of green plastic in divots, sprinkle unmixed dye particles on top, fill and cover divots with green plastic.
D) Place varying amounts of green plastic in divots, mix purple plastic outside molds, place small amount of purple plastic on top, fill and cover divots with green plastic.

Table 1

	Bottom of Divot	Layer 2	Top of Divot	Cover	Bumps
A	Purple	Green	n/a	Green	n/a
B	Purple (mix in)	Green	n/a	Green	n/a
C	Green	Dry dye	Green	Green	n/a
D	Green	Purple	Green	Green	n/a

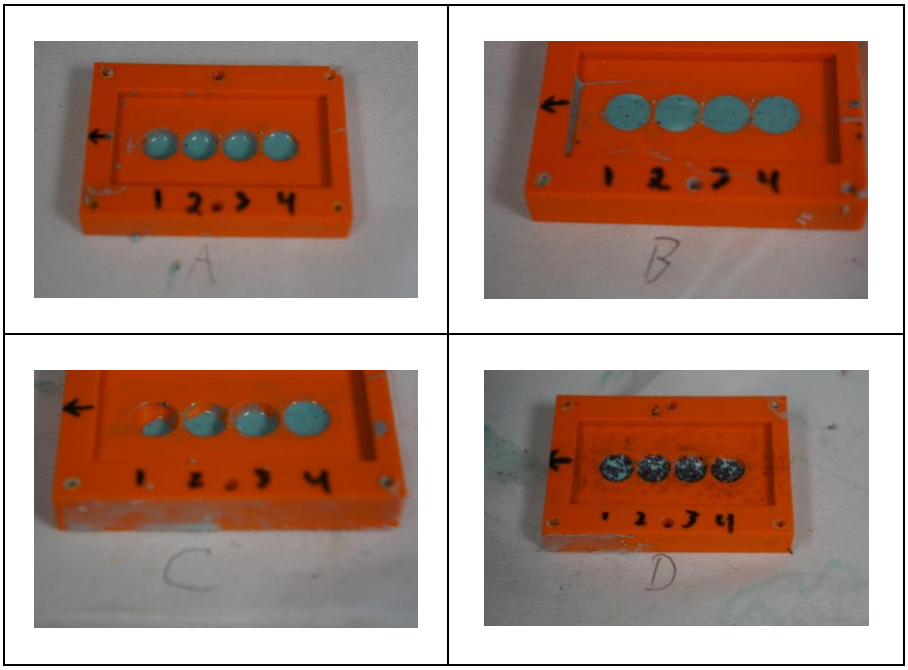
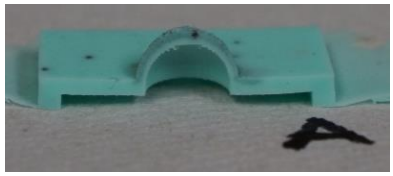
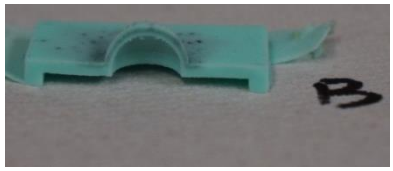
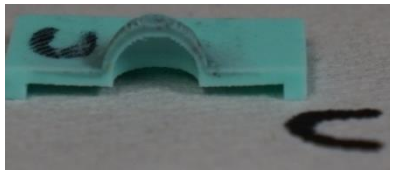
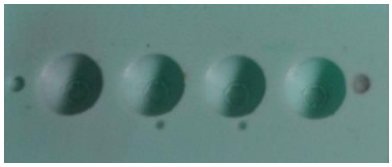
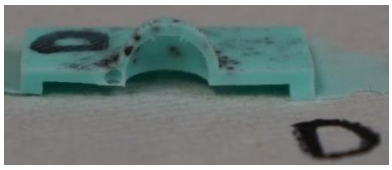
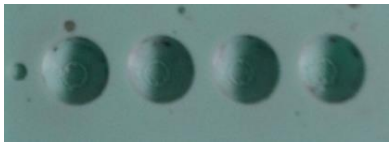


Figure 1

Results:

Table 2

Conclusions:

All the molds were plain green plastic on the inside of the mold. We determined this was due to the viscosity of the plastic – when the tops of the molds were lowered in, a thin layer of green plastic sticks to the surface of the bumps on the top mold. For Series 2 we decided to run tests where we covered the bumps on the top mold with purple plastic before combining the two halves of the mold.

Series 2:

Tests:

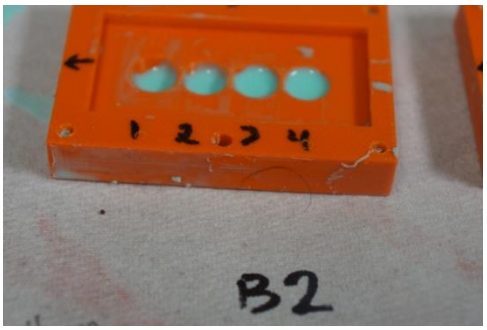
A) Place varying amounts of purple plastic in divots, fill and cover with green plastic, cover bumps on mold top with purple plastic.

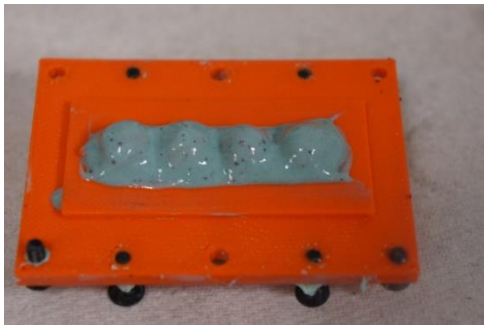
B) Place varying amounts of green plastic in divots, fill divots with purple plastic, cover with green plastic, cover bumps on mold top with purple plastic.

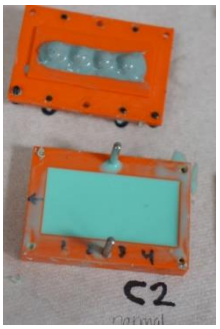
C) Fill and cover divots entirely with green plastic, cover bumps on mold top with purple plastic.

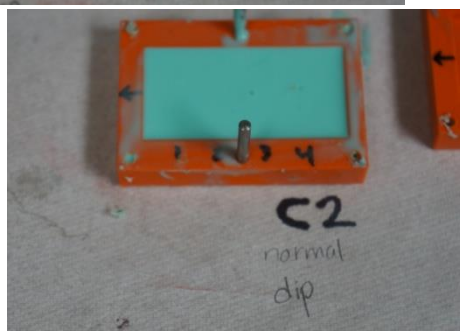
D) Place small varying amounts of green plastic in divots, then place a small amount of purple plastic in the divot but not enough to fill, then cover divots with green plastic, and cover bumps on mold top with purple plastic.

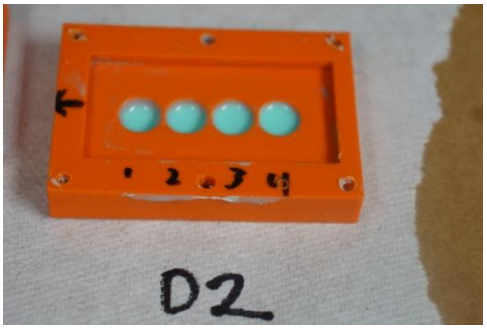
	Bottom of Divot	Layer 2	Top of Divot	Cover	Bumps
A2	Purple	Green	n/a	Green	Purple
B2	Green	Purple	n/a	Green	Purple
C2	Green	n/a	n/a	Green	Purple
D2	Green	Purple	Green	Green	Purple



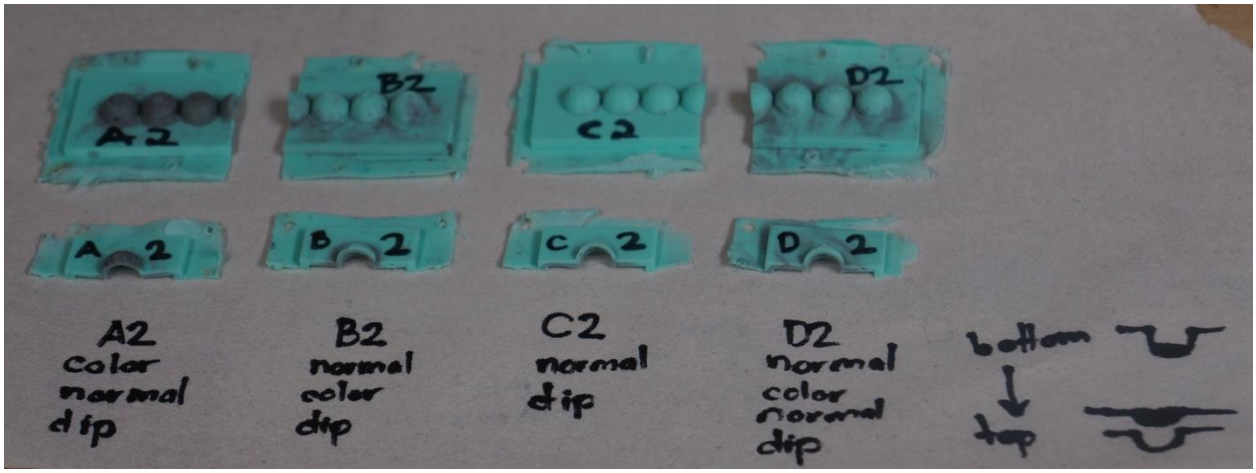


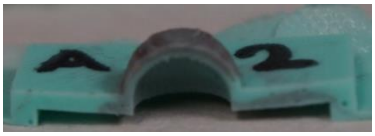


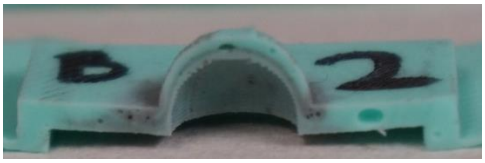


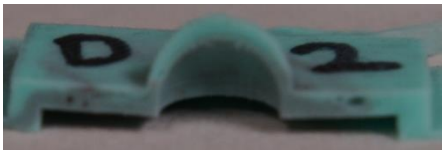


Results:









Conclusions:

This molding process worked well. We decided to run a third series of tests to see how the amount of plastic placed on the bumps on the top half of the mold affects the results.

Series 3:

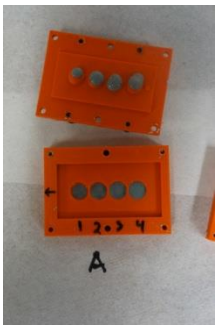
Tests:

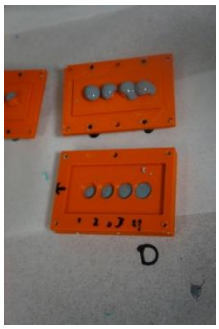
A) Fill divots with varying amounts of purple plastic, fill and cover with green plastic, cover bumps with varying amounts of purple plastic. Smallest amount of divot purple aligns with smallest amount of bump purple.

B) Fill divots with varying amounts of purple plastic, fill and cover with green plastic, cover bumps with varying amounts of purple plastic. Smallest amount of divot purple aligns with largest amount of bump purple.

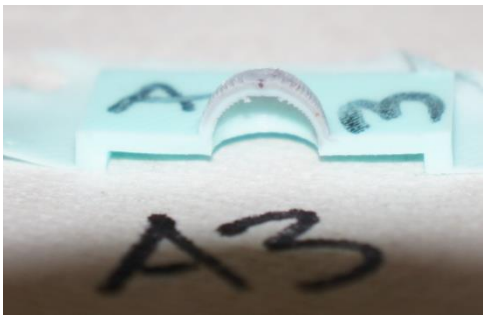
C) Fill divots with varying amounts of purple plastic, fill and cover with green plastic, cover bumps all with small amount of purple plastic.

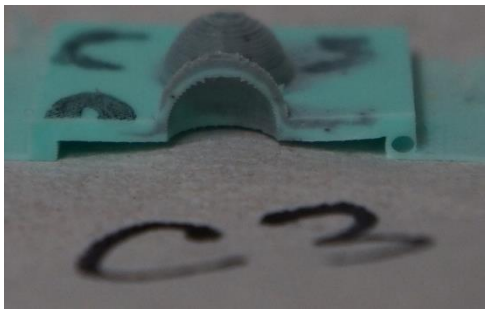
D) Fill divots with varying amounts of purple plastic, fill and cover with green plastic, cover bumps all with large amount of purple plastic.

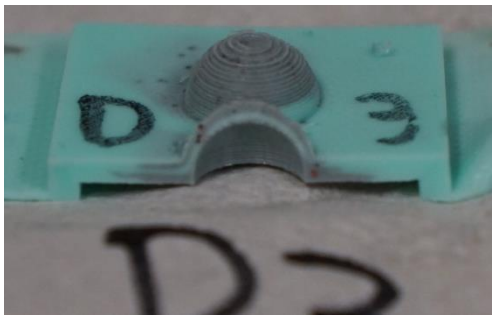




Results:







Conclusions:

Stuff stuff

Yadda

Series 4

Bottom of concave to top
A: spheres, green, sphere dip
B: Green, sphere dip
C: Sphere, green (NO dip)
D: All green

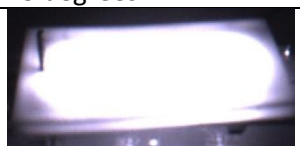
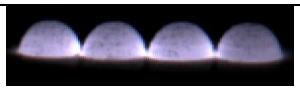
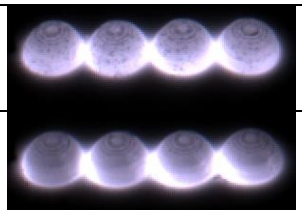
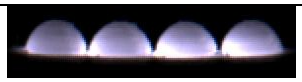
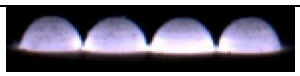
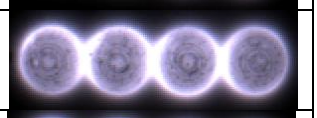
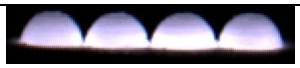
Table 3

Table 4

			
A	B	C	D

Table 5

	0 degrees	45 degrees	90 degrees
A, default Camera values			
A, calibrated camera values			
B, calibrated camera values			
C, calibrated camera values			
D, calibrated camera values			

Series 5:

A: Spheres, Green, Dome dip

B: Green, Spheres, Dome Dip

C: Spheres, Green

D: Green

Table 6

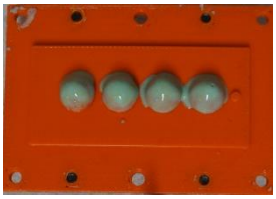
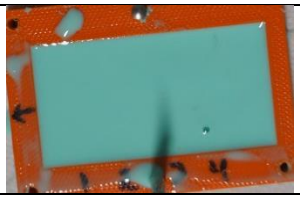
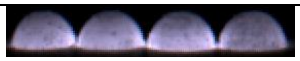
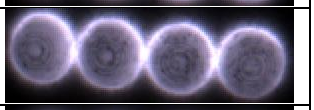
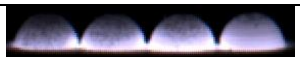
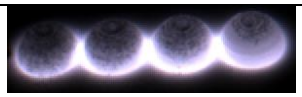
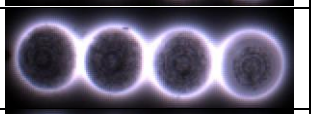
	Base, before Fill	Domes	Finished Molds
A5			
B5	 		
C5			
D5			

Table 7

	0 degrees	45 degrees	90 degrees
A5			
B5			
C5			
D5			

Series 6

A: Settling Check
B: Sphere, Green, Dip
Yellow Spheres
Upsidedown
C: Sphere, Green, Dip
Green Spheres
D: Sphere, Green, Dip
Green Spheres
Upsidedown

Table 8

	Before Fill	Domes	Finished Molds
A6			
B6			
C6			
D6			

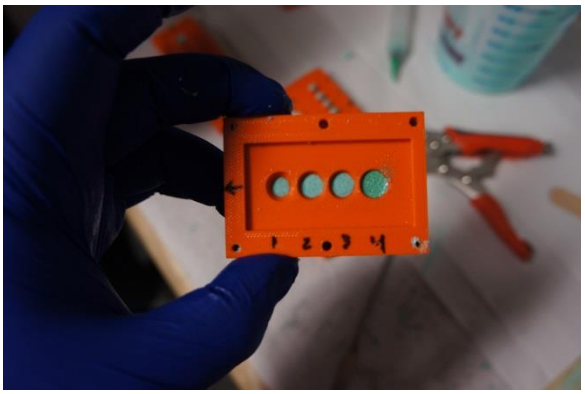
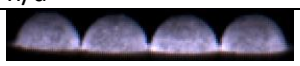
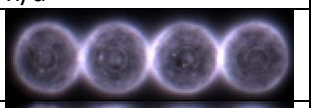
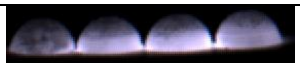
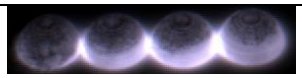
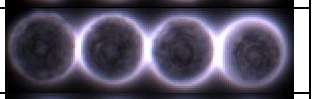
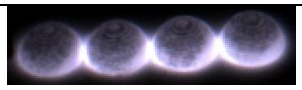
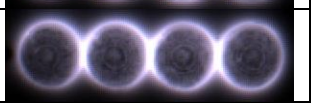


Table 9

	0 degrees	45 degrees	90 degrees
A6	n/a	n/a	n/a
B6			
C6			
D6			

Series 7:

A: White
B: Black
C: Green
D: Green

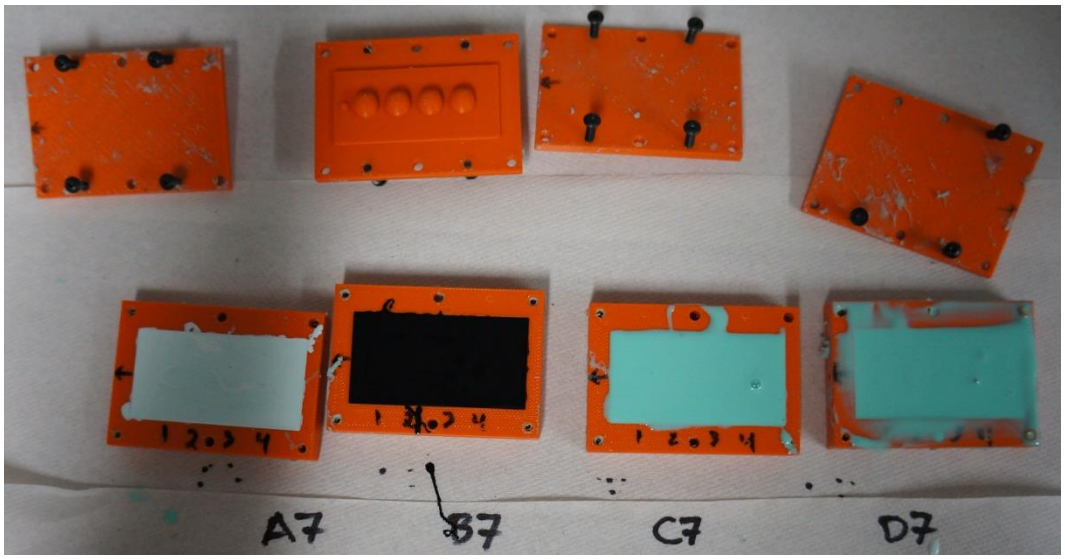
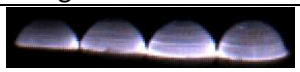


Table 10

	0 degrees	45 degrees	90 degrees
A7			
B7			
C7			
D7			

Series 8:

A1,2: Green Spheres 1: Sphere, Green, Dip

Plastic: 7.110g-2.575g

Spheres: 0.760g

A3,4: Green Spheres 2: Sphere, Green, Dip

Plastic: 6.950g-2.575g

Spheres: 1.418g

B1,2. Green Spheres 3, Sphere, Green, Dip

Plastic: Green Spheres 2

Spheres: 0.881g

B3,4. Green Spheres 3, Sphere, Green, Dip

Plastic: Green Spheres 2

Spheres: 0.881g + more sprinkled on top before filled

C: Black

Plastic: 6.724g-2.575g

Pigment: 3/10 ml/cc

D: White

Plastic: 6.877g-2.575g

Pigment: 3/10 ml/cc

Table 11

	Before Fill	Domes	Finished Molds
A6			
B6			
C6		n/a	
D6		n/a	