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Existence of liquid silicone rubber material by addition of fiber particles for mobile phone body

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ABSTRACT:
Liquid silicone rubber which acts like a polymer, the project work is used to design and fabricate mobile phone body (display & back panel). In this method, the liquid silicone rubber material is placed in an outer die. The inner die is then closed and pressure is applied until the material is shaped into the desired design. Liquid silicone rubber mobile phone body (display & back panel) are put under a lot of pressure for a long duration in the dies up to 24hrs. After the newly shaped liquid silicone rubber is removed from the die. Developed scrap material is cleaned up to get desired shape of the die.
Keywords - Liquid Silicone Rubber, Hardener, Fiber particles and Poly Lactic Acid.

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I. INTRODUCTION:

Liquid silicone rubber mobile phone body (display & back panel) is prepared by using poly lactic acid dies. It consists of inner die and outer die. Liquid silicone rubber mobile phone body dies are printed by 3D printing machine using poly lactic acid (PLA) material. It consists of extruder part and platform part to print the required material at adjusted temperatures. Platform temperature varies from (20°C to 60°C) and extruder temperature varies from (180°C to 230°C) [1-3].

Poly lactic acid (PLA) material is a thermoplastic and bio-active or biodegradable. It is derived from renewable resources such as corn starch. Used in e-tobacco industry. Poly lactic acid material as better strength, hardness and resistance power. In 3D printing poly lactic acid material gives the exact shape of desired material according to the dimensions [4-5].

We had considered **fiber scrap particles** taken from optical shop and chosen 75microns, 150microns both combination gives less than <75microns powder. Considered 80% of LSR, 5% fiber scrap and hardener 15% so that, we get the desired shape of the mobile phone display & back panel die [6-7].

II. EXPERIMENTAL WORK:

2.1. Design of Mobile Phone Display Inner & Outer Die in Parametric 3.0v:

Consider a sample mobile dimension for the design of mobile phone body (display). We selected NOKIA mobile and taken the dimensions using vernier caliper. Used PTC (Parametric) 3.0v software to design the mobile phone body (display) as per dimensions. Select the front view and sketch. It consisting of two dies, display inner die & outer die. Display inner die dimension are length & width = 110mm*45mm, Extruded height 6mm. And also we consider a base part to support inner die with length & width= 130mm*60mm, Extruded height 5mm. Select the front view and drawn the key pad length & width = 43mm*42mm, from bottom we have taken 7mm distance and sides distance are 1.5 mm, Extruded height 1mm. Select the front view and drawn the display length & width =30mm*30mm, from key pad taken 20mm distance and from sides taken 7.5mm and from top taken 10mm, Extruded height 1mm. Select the front view and drawn the outer die dimensions are length & width= 112mm*47mm, Intruded height 8mm. And also we consider a base part to support outer layer with length & width= 130mm*60mm, Extruded height 13mm. After the design of mobile pouch in PTC 3.0v software convert the file into STL (Stereo - lithography) format.

Fig: 2.1. Mobile Display Inner & Outer Die.

Fig: 2.1. PLA Inner & Outer Die.

2.2. Design of Mobile Phone Back Panel Inner & Outer Die in Parametric 3.0v:

Used PTC (Parametric) 3.0v software to design the mobile phone body (back panel) as per dimensions. Select the front view and sketch. It consists of two dies, back panel inner die & outer die. Back panel inner die dimensions are length & width =112mm*47mm, Extruded height 6mm. And also we consider a base part to support inner die with length & width= 130mm*60mm, Extruded height 5mm. Select the front view and drawn the camera length & width = 27mm*10mm, from sides taken distance 18.5mm and from top taken 5mm and from bottom taken 97mm distance, Extruded height 1mm. Select the top view and drawn flash light length & width = 9mm*4.4mm, Hear phones radius are 4.4mm and charger radius are 3mm, Extruded height 1mm. Back panel outer die dimensions are length & width= 115mm*51mm, Intruded height 9mm. And also we consider a base part to support outer die with length & width= 130mm*60mm, Extruded height 14mm. After the design of mobile phone body (back panel) in PTC Creo 3.0v software convert the file into STL (Stereo-lithography) format.

Fig: 2.2. Mobile Back Panel Inner & Outer Die.

Fig: 2.2. PLA Inner & Outer Die.

2.3. Preparation of Mobile Phone Body (Display & Back panel) using Poly Lactic Acid (PLA) Material in 3d Printer:

Open the file with flash 3d printer to print the design as per the dimensions. Place the design on platform adjust it to center by using x, y, z directions. Set the platform temperature as 85°C and extruder temperature as 220°C. At this temperature the material is flexible and printed without any damage. As per the dimensions both inner & outer dies are printed.

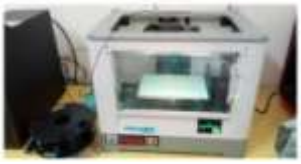

Fig: 2.3. Dreamer 3D Printing Machine.

III. MATERIALS AND METHODS:

3.1. Preparation of Mobile Display & Back Panel by Liquid Silicone Rubber with Hardener using PLA dies:

Consider a liquid silicone rubber, hardener for the preparation of mobile phone body (display & back panel). Taken 95, 90 & 85% of liquid silicone rubber and 5, 10 & 15% of hardener stirs slowly both them for 10-15mins in a beaker. After stirring both the materials, avoid the air bubbles while pouring into the die. Press the inner &outer die tightly to get the thickness of the mobile phone display. Keep a side for 24hrs so that, Pouch get the shape of the prepared die. After 24hrs remove the outer die slowly without any damage of the material. Finally, Mobile display & back panel is prepared as per the dimensions. Weight of the mobile display & back panel is 16grams.

Fig**: 3.1.** LSR Mobile Display & Back panel.

Table 1: Parameters of LSR with HARDENER:

Sl. No	LSR (%)	HARDENER (%)
1	95	5
2	90	10
3	85	15

3.2. Preparation of Mobile Display & Back panel by Liquid Silicone Rubber, Hardener with Fibre scrap using PLA dies:

Consider a liquid silicone rubber, hardener for the preparation of mobile display. Taken 90, 80 & 70% of liquid silicone rubber and 5, 10 & 15% of hardener and also mixed fiber scrap (<75microns) of 5, 10 & 15% and stir slowly for 10-15mins in a beaker. After stirring the materials, avoid the air bubbles while pouring into the die. Press the inner & outer die tightly to get the thickness of the mobile display. Keep a side for 24hrs so that, mobile display gets the shape of the prepared die. After 24hrs remove the outer die slowly without any damage of the material. Finally, Mobile display & back panel is prepared as per the dimensions. Weight of the mobile display & back panel is 18grams.

Fig: 3.2. Mobile display & back panel.

Table 2: Parameters of LSR & HARDENER with FIBER:

S. No	LSR (%)	HARDENER (%)	FIBER (%)
1	90	5	5
2	80	10	10
3	70	15	15

3.4. Mechanical Test:

Hardness Test:

In hardness test Shore-A hardness tester is conducted as per the ASTM D2240. To measure the polymer (or) rubber materials we use Shore-A hardness tester.

Fig**: 3.4.** Shore-A Hardness Tester.

Tensile Test:

In tensile test the equipment used is Universal Testing Machine (UTM) UTE-60, MCS and SI: 170/0507.

Fig: 3.4. Universal Testing Machine (UTM).

IV. RESULTS AND DISCUSSIONS:

Table 3: Tensile and Hardness test samples with effect of LSR + Hardener:

Sl. No	LSR+ Hardener	Thickness	Hardness	Tensile stress(N/mm^2)	Elongation (mm)
Sample1	95% + 5%	1.5mm	42.33	0.689	85
Sample2	90% + 10%	2.0mm	42.67	0.794	60
Sample3	85% + 15%	2.5mm	45.67	1.428	50

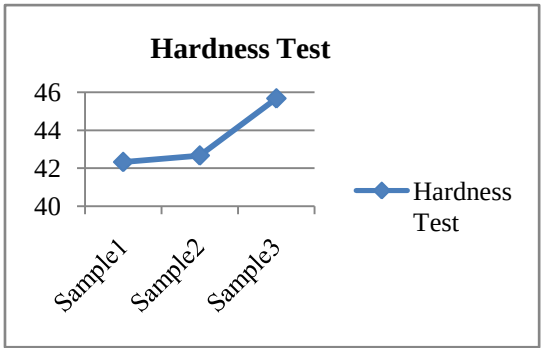

Fig: Graph shows the Hardness Test samples with effect of LSR + Hardener.

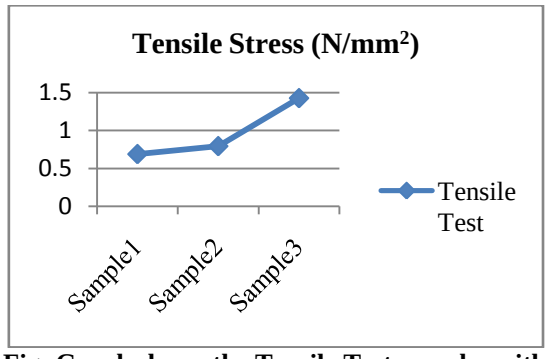

Fig: Graph shows the Tensile Test samples with effect of LSR + Hardener.

Table 4: Tensile and Hardness test samples with effect of fiber particles:

Sl. No	LSR + Hardener + Fiber	Thickness	Hardness	Tensile stress(N/mm^2)	Elongation (mm)
Sample1	95% + 5%	1.5mm	40.00	0.500	66
Sample2	90% + 10%	2.0mm	45.67	1.240	45
Sample3	85% + 15%	2.5mm	46.00	1.451	40

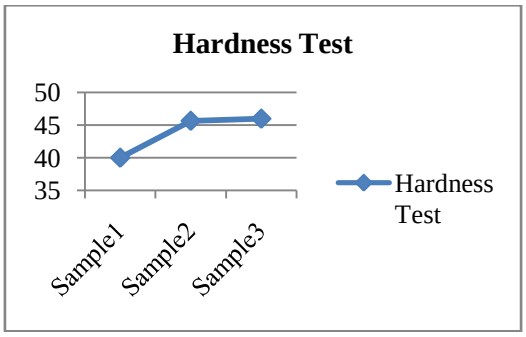

Fig: Graph shows the Hardness Test samples with effect of LSR + Hardener + Fiber.

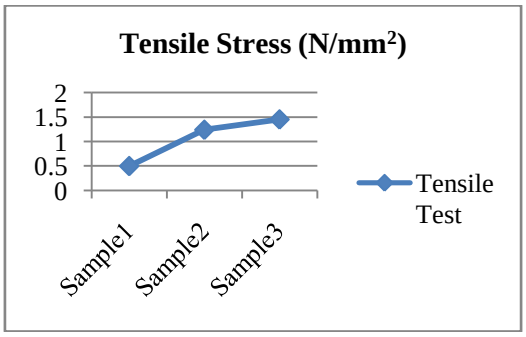

Fig: Graph shows the Tensile Test samples with effect of LSR + Hardener + Fiber.

V. CONCLUSION:

It's seems that the hardness and tensile strength samples with composition of liquid silicone rubber, hardener with fiber particles are better than the samples with composition of liquid silicone rubber with hardener. We also observed that the samples thickness 2mm & 2.5mm in liquid silicone rubber, hardener with fiber particles have better strengths.

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