Determination of Avg. Barcol Hardness by Varying Percentage of E-Glass Fiber in Epoxy Composites

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Abstract— The aim of the study is to predict the avg. Barcol Hardness No. of the composite material and to see the change in avg. Barcol Hardness no. of the specimen by changing percentage of E-Glass fiber in Epoxy resin. There were five specimens each for 5% E-Glass Fiber and 10% E-Glass fiber with 1% Araldite Hardener. To determine the average Barcol Hardness No. the test method used was ASTM D 2583. The dimension of specimen was 50 mm length, 50 mm width and 6 mm thickness.

***Keywords*:** Avgerage Barcol Hardness, E-glass fiber, Fabricated parts

I. INTRODUCTION

Barcol hardness is a method that a hardness value obtained by measuring the resistance to penetration of a sharp steel point under a spring load. The instrument, called the Barcol impresser, gives a direct reading on a 0 to 100 scale. The hardness value is often used as a measure of the degree of cure of a composite. ASTM D2583 Barcol Hardness test method is used to determine the hardness of both reinforced and non-reinforced rigid plastics. The specimen is placed under the indenter of the Barcol hardness tester and a uniform pressure is applied to the specimen until the dial indication reaches a maximum. The depth of the penetration is converted into absolute Barcol numbers. Barcol hardness values are also used to determine degree of cure of resin. Resin is considered cured when it has a hardness value greater than or equal to 90% of the surface hardness value. The Impresser is best suited for testing homogenous materials. Materials of granular, fibrous or coarse structure will produce a wide variation in hardness readings because of the small diameter of the indenter point. For accurate readings, material should be at least 1/32" thick and large enough for a minimum distance of 1/8"in any direction from the indenter point to the edge of the specimen. The testing area should be smooth and free from mechanical damage. Simply exert pressure against the instrument to drive the spring-loaded indenter point onto the material. The indenter point must be perpendicular to the surface being tested. On very soft metals, the highest reading should be used since cold flow permits the spring-loaded indenter point to continue penetration. The Impresser is a convenient tool for testing the hardness of aluminum, aluminum alloys, copper, brass and other materials including plastics and fiber glass. The instrument is designed for use on fabricated parts and assemblies as well as on raw stock.

II. MATERIALS

The specimen was made from E-Glass fiber with Epoxy resin and Araldite Hardener.

III. PREPARATION OF MATERIALS

In this experiment E-Glass fiber was cut with the scissor in desired dimensions after that viscosity of epoxy resin was checked which should be 5 to 15 Pa-s at 25° C. The room temp. Where preparation of specimen taking place was at 25° C. Next step was mixing of the epoxy resin and hardener. The specimen was made by Hand Lay Up technique. After making specimen by Hand Lay Up technique now it is compressed in Hand Compression Moulding Machine. By doing so the specimen is compressed at a temperature of 120° C. Due to this compression the hardness and toughness of the specimen is increased and it also help in making specimen flat. Hand compression moulding decrease the curing time of composite. It is left on machine upto the time it is cooled on machine. Then it is unloaded from the machine with safety. Then the specimen is left for further curing. When it is cured specimen is cut into desired dimension required for a particular test.

IV. DIMENSIONS OF SPECIMEN

Length	50 mm
Width	50 mm
Thickness	6 mm

V. EXPERIMENTAL PROCEDURE

This test method covers the determination of indentation hardness of both reinforced and non reinforced rigid plastics using a Barcol Impresser, Model No. 934-1 and Model No. 935. A material's surface hardness is determined through the use of a Barcol Impresser. The relative depth of penetration of the Impresser's indenter provides a comparative measure of the material's hardness. The Model No. 934–1 and Model No. 935 Barcol Impressers are designated for use. Within the range of hardness measured by these Impressers the Model No. 934-1 is used for measuring harder materials and the Model No. 935 is used for measuring softer materials. The Barcol Impresser is portable and therefore suitable for testing the hardness of fabricated parts and individual test specimens for production control purposes. Before proceeding with this test method, reference should be made to the specification of the material being tested. Any test specimen preparation, conditioning, dimensions, or testing parameters or combination thereof covered in the relevant ASTM materials specification shall take precedence over those mentioned in this test method. If there are no relevant ASTM material specifications, then the default conditions apply.

Fig. 5.1: Barcol Hardness Tester

VI. RESULTS AND DISCUSSIONS

A. Barcol Hardness Test for 5% E-Glass Fiber

Sample No.	Barcol Hardness No.
1	22
2	27
3	23
4	25
5	28

Table6.1 Barcol Hardness No. for 5% E-Glass Fiber.

Mean of Sample = $\frac{22+27+23+25+28}{5} = 25$

Variance = $\frac{(22-25)2 + (27-25)2 + (23-25)2 + (25-25)2 + (28-25)2}{5} = 6.5$

Standard Deviation = $\sqrt{6.5} = 2.5495$

Mean	25
Variance	6.5
Standard Deviation	2.5495

B. Barcol Hardness Test for 10% E-Glass Fiber

Sample No.	Barcol Hardness No.
1	29
2	37
3	31
4	38
5	35

Table 6.2 Barcol Hardness No. for 10% E-Glass Fiber.

Mean of Sample = $\frac{29+37+31+38+35}{5} = 34$

Variance = $\frac{(29-34)2 + (37-34)2 + (31-34)2 + (38-34)2 + (35-34)2}{5} = 12$

Standard Deviation = $\sqrt{12} = 3.4641$

Mean	34
Variance	12
Standard Deviation	3.4641

VII. CONCLUSIONS

The present work deals with the preparation of E-Glass fiber reinforced epoxy composite. The mechanical behavior of the composite lead to the following conclusions:

(1) The successful fabrications of a new class of epoxy based composites reinforced with E-Glass fibers have been done.
(2) It has been observed from this work that the average Barcol Hardness No. for 10% E-Glass fiber is 34 which is greater than the average Barcol Hardness No. for 5% E-Glass fiber is 25.
(3) It is concluded that as the percentage of E –Glass fiber is increasing the average Barcol Hardness No. for specimen is also increasing.

VIII. REFERENCES

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