EFFECTS OF THICKNESS AND LOADING RATE ON MIXED MODE FRACTURE BEHAVIOR OF POLYCARBONATE

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ABSTRACT

In Generally structure are not experience to only tensile stress but also experience to shear and torsion stress which result leading to a mixed mode interacting. There are many service failures occurs when mixed mode stress subjected to tip of cracks. This type of Problems are always encountered in multiphase materials such as , Bridges, welding structures, aero plane adhesive joints, composite materials, and reinforced concrete structures etc. The goal of this work is Effects of thickness and loading rate on mixed mode fracture behavior of polycarbonate to determination of tearing energy and Universal shapes. through the EWF method the tearing energy is calculated which used for reducing stress 0n structure.

Index terms: *Mixed mode fracture(in plane tearing) , EWF , Tearing energy , Universal shape.*

I. Introduction

In daily life polycarbonate materials are using in many application like as construction of building, Medical instrument, automotive vehicle, safety device etc. In engineering the fracture fatigue failures are subjected. so calculating in- plane tearing energy of a ductile thin plate [4]. Whenever largest tensile stress following to straight line connecting the crack tips and perpendicular to cracks propagate were discussed in universal shapes formed by two interacting cracks [8].. There are many experimental studies which related to mechanical behavior of polycarbonate. such as Experimental Investigation on the EWF of mixed mode fracture of PC/ABS alloy [5]. Ductile fatigue crack propagation in polycarbonate.[14] and behavior of universal shapes repulsion and attraction between a pair of cracks in a plastic sheet[9].

The Goal of present studies is effects of thickness and loading rate on mixed mode behavior of polycarbonate We have used UTM machine for finding tearing energy and then after used scanning machine for Universal shape.

II. TEARING ENERGY

The energy is require for small change in area of surface during the crack propagation is called tearing energy.
In fracture mechanics energy dissipating is important in the reduce the damage cause during a collision. In many cause kinematic energy is dissipated by stretching, bending and tearing. in the energy dissipation there are two component are plastic deformation energy and tearing energy. The tearing energy is nothing but specific essential fracture work which in denoted by wt [5]

$W_{total} = W_p + W_t$

$= l^2twp + ltwt$

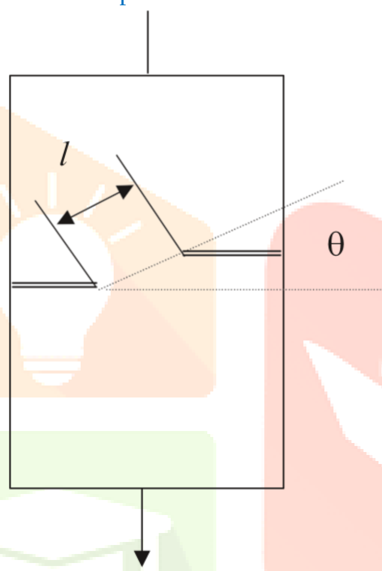
$= \beta lwp + wt$ (1)

Where l is ligament length, t is thickness of sheet, w total is total fracture work, wp = plastic deformation work, wt= tearing energy, β = plastic shape factor

III. EXPERIMENT

DENT specimen have used in the test. The Design of specimen is shown in Fig.1 and the dimensions are 150 mm × 50 mm and thickness is 0.8mm..laser device was used to produce artificial crack tips with various ligament lengths. Different loading angles were introduced with different values of θ are 0° to 90° increase with 10° .
there is DENT specimen of polycarbonate material ..Dent specimen shown in fig.1 where l = ligament length and θ = loading angle.

Figure 1 DENT specimen



[4]

All experiments were performed on the Universal testing machine. The loading rate was constant and failure specimen used to observe the crack tip deformation. The loads and displacements applied to the specimens were recorded automatically during the test. then we have create load vs. displacement graph. Show in the figure2

We can shows self similarity in load vs. displacement graph means ligament increasing with respect to load vs. displacement curve also increasing. Evaluated area under the curves for different ligament and various loading angle. We have finding good linearity of specific fracture work between ligament length show in fig 3.

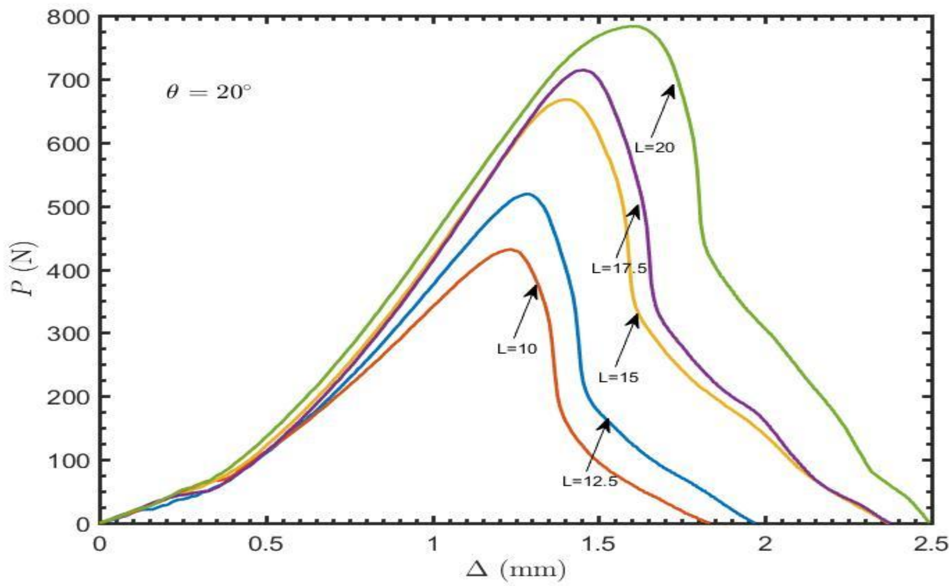


Figure 2 Load vs. displacement

In fig.2 shows load vs. displacement graph for θ = 20° for different ligament lengths l = 10mm,12.5mm,15mm,17.5mm,20mm

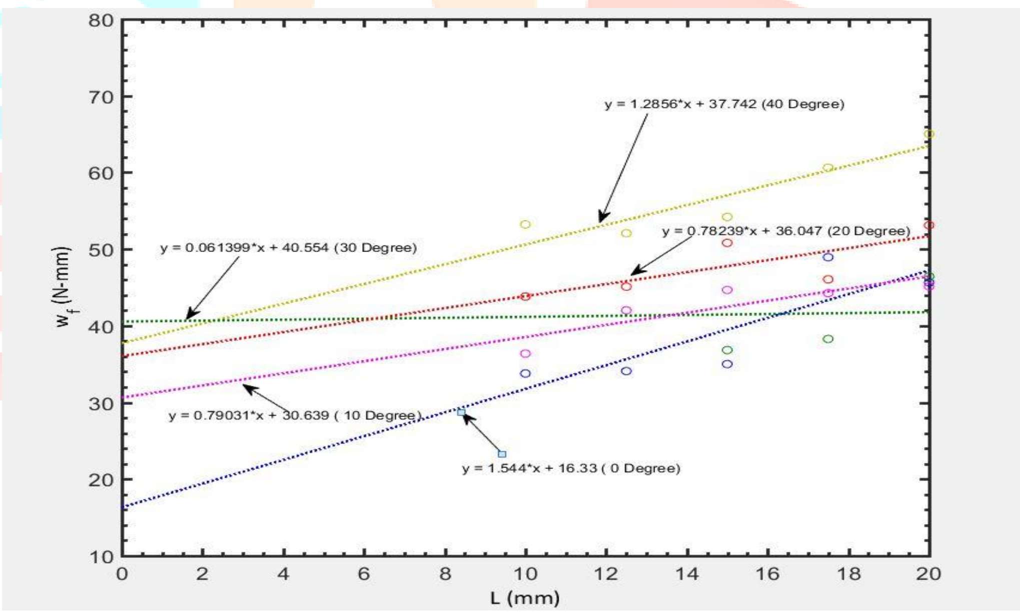


Figure 3. W_f vs Ligament

IV. RESULT AND DISCUSSION

Shown in fig 3 .whenever the ligament lengths is extrapolated that time we can easily find the tearing energy from the above graph. In fig 3. shows when l = 0 for θ = 20° ,tearing energy W_e = 36.047 kj/mm and βwp = 0.7824. Shown in table1 when loading angle θ = 0° to 40° tearing energy continuously increasing then after θ = 60° suddenly decreasing and after that its highly increasing .

t=0.8mm

θ	wf L=10mm	wf L=12.5 mm	wf L=15mm	wf L=17.5mm	wf L=20mm	wekj/mm^2	βwp

0°	37.70	34.09	35	48.94	45.65	16.82	1.231
10°	36.38	42.02	44.67	44.25	45.13	30.63	0.7903
20°	43.82	45.09	50.81	46.05	53.12	36.047	0.7824
30°	43.81	42.01	36.83	38.28	46.43	40.55	0.0614
40°	53.22	52.06	54.19	60.61	65.02	37.74	1.285
50°	38.79	35.52	43.82	42.68	42.96	31.44	0.620
60°	26.37	27.44	26.38	30.83	35.38	16.43	0.8566
70°	38.81	29.03	23.39	23.23	25.64	47.30	-1.2854
80°	34.94	27.51	27.53	20.68	15.20	52.96	-1.8524
90°	41.89	32.22	23.76	28.22	21.07	56.82	-1.8257

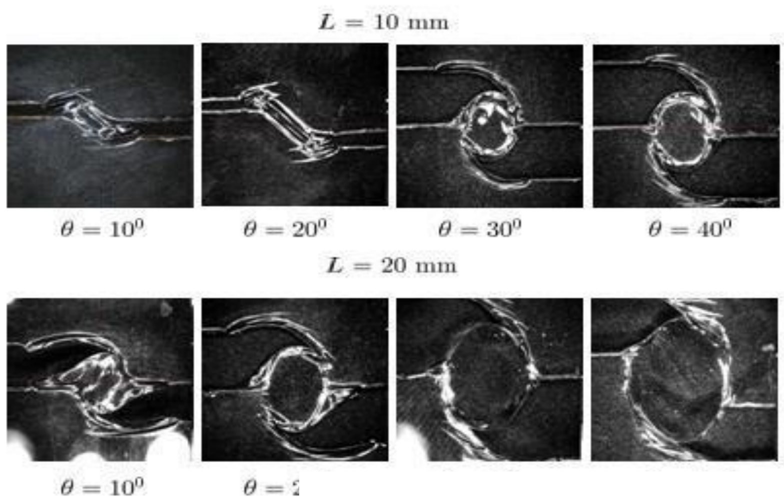
Table 1. Tearing energy for different ligament and various loading angle

from the result of table we can say that whenever θ increasing the value of tearing energy also increasing shown in table1.tearing energy and loading angle θ which indicated convex value which say that the value of tearing energy is not constant

V. UNIVERSAL SHAPES

Now we have used failure specimen for the finding the universal shape. we have used scanning machine and specimen put on the desk board of machine near the auxiliary camera then after zooming for the scanning the cracks propagation and finally capture the photo. During the propagation of cracks we show that where two cracks pass each other square root shape begins shown in fig 5. Two cracks propagate approximately straight way until they pass to each other and then after they curve and square root shape generate . figure 5. also indicate that the l/d ratio is constant for loading angle θ = 0° to 40° and various ligament lengths so we can say that universal shapes formed by two interacting cracks in polycarbonate material.

Figure 5. Universal shapes



CONCLUSION

After the study presented here, we can conclude that the tearing energy w_e is not a material constant and which is not independed geometry of specimen for polycarbonate material

Universal shapes formed by two interacting cracks in mixed mode for polycarbonate material which suggests that a geometric model into the dynamics..

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