Investigation of Mechanical Behaviors of Laminated AL-PET Composites

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Abstract: *Laminated composites ,which are manufactured with Aluminum(Al) and Polyethylene terephthalate (PET), are widely used in electrical cables sector in recent times. Aluminum which is commonly used with copper for the aim of preventing magnetic effects, here is used with PET while PET covering it. In this work composite materials were manufactured while the thickness of aluminum keeping constant, PET's thickness was changed four times. For these manufactured composite materials it's specified that the tension and fracture strengths and these materials weights. Furthermore depending on the ratios, experiment samples' mechanical behaviours were examined.*

Key words: *Aluminum, Polyethylene terephthalate, Composite, Package, Tension, Fracture.*

INTRODUCTION

Polymers are widely used in the sectors like food and electric. The reasons behind that are they don't react with food and electric, their insulation capability and their lightness [1]. Although they have these important advantages, there exists disadvantages because of material characterics. Between these disadvantages material resistance becomes first [2-3]. However in some cases plastic materials are used for increasing resistance capability. Plastics are used for improving mechanical behaviours of some products having less mechanical behaviours than them as laminated or mixture in composite materials. [4-6]. Aluminum is one of the fundamental raw materials with copper used for manufacturing of cable and conductors. In the manufacture of cables, aluminum and polyster lamination are used for outside cover of cable. Aluminum foil provides high reflectivity and protects the cable from electromagnetic effects. Polyester film provides electrical insulation and gives the structure high strength [7]. When material strength, thermal conductivity and formability of aluminum are considered, they can be easily used with plastics[8]. As it's easy to manufacture of aluminum in plate shape, they are widely used because of their good electrical properties [9]. For overcoming disadvantages, composite materials which are composed of aluminum and plastics, bring together both of aluminum's and plastics' best properties as new materials to compensate for requirements. When it's examined in these materials weight and resistance relation, it's aimed that forming materials to become light and useful. These composite materials could be fiber provided or in plate shape.

In this work it was examined that material thickness of Aluminum and PET lamination how affected the manufactured product's mechanical behaviours. For this purpose while keeping aluminum's thickness constant, PET thickness was changed and 4 different thicknesses of composite materials were obtained and 10 different measurements were done. For these manufactured composite materials it's specified that the tension and fracture strengths and these materials weights and thicknesses. Furthermore depending on the ratios, experiment samples' mechanical behaviours were examined.

MATERIAL

Technical properties of aluminum which is used for forming composite materials were demonstrated in Table 1.

Parameter	Specification	Measured Value
Total Thickness	9 mic (+/- 8 %)	9 mic
Weight in grams	24.4 gr/sqm (+ / - 8 %)	25 gr/sqm
Tension Strength (MD)	Min. 25 N/mm^2	107 N/mm^2
Fracture Elongation (MD)	Min. 4 %	5 %

Table:1-Technical properties of aluminum

Technical properties of PET which is used for forming laminated composite materials were demonstrated in Table 2.

Parameter	Specification
Total Thickness	12 mic (+/- 8 %)
Weight	16,8 gr/sqm (+ / - 8 %)
Tension Strength (MD)	Min.150 N/mm^2
Fracture Elongation (MD)	Min. 80 %
Thermal Shrinkage (150 ºC / 30 min.)	MD < 1,8 TD < 0,5
Dielektric Force	>250 KV/mm
Melting Point	>200 ºC
Water Suction	< 0,5 %
Density	1,4 gr/cm³

Table:2-Technical properties of Polyethylene terephthalate (PET)

METHOD

PET and Al combined with different thicknesses to form laminated composite materials.These experiment samples' weight ratios are given in Table 3.

Sample 1	Sample 2	Sample 3	Sample 4
9mm Al+12mm PET	9mm Al+15mm PET	9mm Al+23mm PET	9mm Al+36mm PET

Table:3- Experiment samples' thicknesses

Forming experiment samples were changed with various mass ratios to obtain interval layer materials. For obtaining experiment samples from formed plates, by taking account of ASTM 882 standard, plate was cut in tension sample dimensions. For specifying tension and fracture strengths, samples were pulled with100mm/min.

Here the experiment samples' views were demonstrated. (Figure 1)

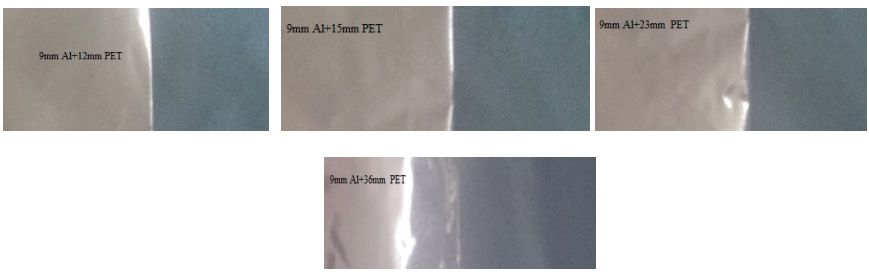

Figure:1- Experiment sample's views

RESULTS

Layered Composite materials' samples ,which are formed by adding alloy materials in various ratios, were examined as the experiment results in table 4.

Test Specimens	TOTAL THİCKNESS (mm)	WEIGHT (gr/sqm)	TENSİON STRENGTH (N/mm^2)	FRACTURE ELONGATION (mm)
9 ALU / 12 PET	22,1	43,45	109,8	55,8
9 ALU / 15 PET	25,3	47,91	111	66,3
9 ALU / 23 PET	33,55	58,767	119,4	110
9 ALU / 36 PET	45,8	76,97	126,5	117,6

Table:4-Experiment results

CONCLUSIONS

In these formed experiment samples, Al thickness kept constant and with the increasing thickness value of PET, fracture elongation also increased. This situation occured because of PET's chemical and physical structure and PET amount in the composite materials as unit area. Moreover when PET increased in the composite materials as unit area, there existed a rise in the tension strength of material too. Finally in these formed Al-PET composite materials when PET amount increased, the mechanical properties of them improved.

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