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Preparation and Study of Mechanical properties of Polymer Blends from Recycled Materials - Polymethylmethacryalate with Different Ratios of polyester and Shilajit

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Abstract

A group of materials that are considered waste or previously materials used was used in preparing a group of new samples, and it is important to get rid of such materials by reusing them in new and useful applications. A group of samples was prepared by mixing with a fixed percentage of polyester with different proportions of the dioctyl phthalate (DOP) which is available in large quantities and was used as an unused and waste substance in the petrochemical company in Basrah Governorate because this company stopped working for a long time, with percentages of the waste polymethyl methacrylate (ws. PMMA) and the shilajit was from the mountains of the Islamic Republic. Six groups (A-F) were prepared according to international specifications by direct mixing method between the materials. The results of the elongation study, Young's modulus, and stress showed very well and some unexpected properties, The highest elongation value in Group F sample 5 was 1.3%, and the highest value for Young's modulus was for Group D sample5 where the value was recorded 292.86Mpa, that added distinctive properties to polyester, which qualifies it for wide industrial uses that require strength and ductility at the same time. results that enable the use of these mixtures in multiple applications such as vehicle paints, construction, piping, protective coatings, composites, storage tanks, and ship materials, which require ductility properties, and high strength.

Keywords: polyester, dioctyl phthalate, shilajit, mechanical properties, and polymethyl methacrylate.

1. Introduction

preparation of Polymer blending [1,2] is a rapid and popular method for developing new polymeric composites with a desirable range of properties. The main advantage of this method is the simplicity of preparation and control properties by changing mix combinations. Miscibility plays a crucial role in controlling the properties of the final product [3,4]. This method is considered one of the generally accepted solutions, but it cannot be applied without good sorting of the plastic materials. Plasticizers are commonly used to improve the flexibility, toughness as well as extensibility of the prepared polymeric blends, which at the same time, reduces the melt flow of these blends. Some plasticizers reduce shear during blending steps in the polymer production process and improve the impact resistance of the final plastic film. [5-7]. PMMA is characterized by high crystalline polymer with high heat resistance and chemical resistance. Several studies have been presented that have been prepared for the preparation of the PMMA polymer recycling system, which usually contains a low volume of waste PMMA compared to other plastic materials such as polyethene. Ethylene and polypropylene. However, with the use of products containing PMMA, such as liquid crystal displays, the use of PMMA is increasing, and this will lead to an increase in ws.PMMA in the future [8]. Therefore, the preparation of compounds from ws.PMMA and

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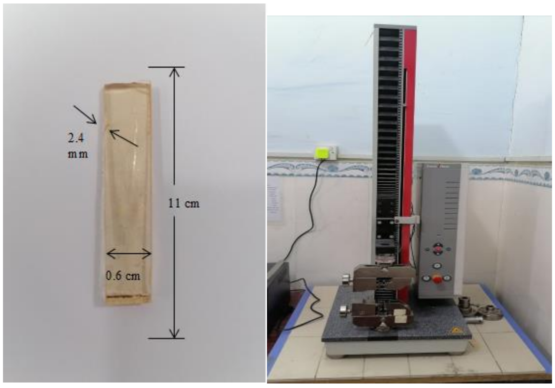
recycling techniques are considered. The treatment of wPMMA is a high research priority. Multiple methods have been used to recycle these materials. The first method is mechanical recycling, the second is chemical recycling (raw materials), and the third method is the use of incineration. The method of mechanical recycling is to convert the used polymer residues into secondary plastic materials [9-12]. Unsaturated polyester resins are used in many engineering applications, Polyester is the most produced thermoplastic polymer and has many applications, such as textile fibres and bottles [13].

More innovation in material recycling, in general, is also required to create more jobs. Stricter regulations in packaging manufacturing impose better recycling and stricter regulations on waste disposal that will pave the way toward a recycling economy[14,15]. Shilajit is a natural substance found mainly in the Himalayas. It was formed many centuries ago from the gradual decomposition of some plants through the action of microorganisms. It is in the form of black, yellow, or brown secretions. It is obtained from some types of rocks in several mountains. These compounds contain more than 85 minerals, as well as 60-80% of folic acid and benzoic acid in addition to humic acid, fatty acids, resins, rubber, carboxylic, and amino acids [16]. The study aims to address an environmental problem represented in the disposal of ws.PMMA and the second is the use of shilajit and waste plasticizers stored in the petrochemical company in Basra to improve some of the commercial polyester material by strengthening it by mixing materials in different proportions while continuing to stir continuously for 10 minutes. (B) Composite samples were prepared by the manual mixing method and cut according to ASTM standards. . With different percentages of Shlijiat stone powder and the addition of a percentage of DOP. The mechanical properties such as impact resistance, tensile strength, flexural strength, and stiffness were studied. Improvement in all properties was found at a 1-2 wt. % rate.

Instrumentation and method

the polyester used in this study was purchased as a basic material by (Henkel A.S.) company, Turkey, and polymethyl methacrylate (ws. PMMA) was washed, dried, crushed, and sieved using a 212(μm) sieve. shilajit was collected from the mountain of Islamic Mount of Iran and then dried under vacuum conditions at 50^0C for 4 hrs. before use, dioctyl phthalate (DOP) from the State Petrochemical Company/Basrah/Iraq, and all compounds were used as they are without purification. mechanical examination of sample tightening test by moulded samples by preparing rectangular - shape samples according to ASTM D638M [17], sample dimensions (length 110 mm, width 15 mm, height 4 mm) Elongation was tested at fracture, tensile strength, and bending, and examined using a German-made instrument (tensile) to measure tensile strength, flexibility, and pressure resistance, Figure 1. Showed the tensile strength test sample and mechanical properties measuring device (Tensile).

the samples were Prepared by adding polyester 2% of the weight for general purposes and weighing them in the plastic container, adding 0.2% of DOP weight and mixing for (10 min.), then adding different ratios of shilajit and ws.PMMA, table (1) shows weight ratios for all samples.



-a- b-

Fig 1: a-shows the tensile strength test sample.b-Shows mechanical properties measuring device (Tensile).

Table (1): shows the weight ratios of all samples.

Group Symbol	Number of Samples	% DOP	Shilajit %	% of ws. PMMA
A	1	0	0	0
	2	0	1	0
	3	0	3	0
	4	0	5	0
	5	0	7	0
B	1	0.2	0	0
	2	0.2	1	0
	3	0.2	3	0
	4	0.2	5	0
	5	0.2	7	0
C	1	0	0	0
	2	0	0	1
	3	0	0	3
	4	0	0	5
	5	0	0	7
D	1	0.2	0	0
	2	0.2	0	1
	3	0.2	0	3

	4	0.2	0	5
	5	0.2	0	7
E	1	0	0	0
	2	0	1	7
	3	0	3	5
	4	0	5	3
	5	0	7	1
F	1	0.2	0	0
	2	0.2	1	7
	3	0.2	3	5
	4	0.2	5	3
	5	0.2	7	1

3. Results and discussion

The mechanical properties were studied in this study and maximum elongation, and stress data in addition to Young's modulus of prepared models (A-F), all these results appear in tables (2-7).

By observing the outcome of the study of stress data and Young's modulus of groups (A, C, and E)and (B, D, and F) with different additive ratios of (DOP, Shilajit, and ws. PMMA) at room temperature, we noted that the linear zone is the flexible limit area of the prepared polyester with different additives as well as the expansion of the prepared polyester regularly occurs. the results show the highest strain of groups (A, C, and E) which consists of polyester blending with the Shilajit, and ws.PMMA in different proportions a without DOP and the highest strain was at 300Mpa for group C and the highest strain for the groups (B, D, and F) consisting of polyester blending, Shilajit and ws.PMMA and DOP were to group D at 200 Map. figures 2, and 3 show the results.

Table(2): Results of Polyester and Shilajit First Group (A)

Number of Samples	**δ_B(Mpa)**	**ε_M %**	**δ_M (Mpa)**	**Young Modulus (Mpa)**
1	73.0	1.2	73.0	60.833
2	29.7	0.7	29.8	42.57
3	96.5	1.0	97.1	97.1
4	63.1	0.9	63.8	70.88
5	41.8	0.8	41.8	52.25

Table(3): Results of DOP+ Polyester and Shilajit Second Group (B)

Number of Samples	δB(Mpa)	εM %	δM (Mpa)	Young Modules (Mpa)
1	73.0	1.2	73.0	60.833
2	72.6	0.6	72.6	121
3	136	0.7	136	194.28
4	61.4	0.5	62.2	124.4
5	109	0.6	112	186.66

Table(4): Results of Polyester +ws.PMMA Third Group (C)

Number of Samples	δB(Mpa)	εM %	δM (Mpa)	Young Modules (Mpa)
1	73.0	1.2	73.0	60.833
2	290	1.3	305	234
3	205	1.1	209	190
4	168	1.2	168	140
5	134	0.8	134	167

Table(5): Results of Polyester+ws.PMMA+DOP Fourth Group (D)

Number of Samples	δB(Mpa)	εM %	δM (Mpa)	Young Modules (Mpa)
1	73.0	1.2	73.0	60.833
2	125	0.7	131	187.14
3	129	0.8	130	162.5
4	146	1.0	146	146
5	200	0.7	205	292.85

Table(6): Results of Polyester+ws.PMMA+Shilajit Fifth Group (E)

Number of Samples	δB(Mpa)	εM %	δM (Mpa)	Young Modules (Mpa)
1	73.0	1.2	73.0	60.833
2	150	1.2	153	127.5
3	74.0	1.0	74.0	74
4	69.5	0.9	69.5	77.22
5	120	1.0	120	120

Table(7) Results of Polyester +Shilajit +ws.PMMA +DOP Sixth Group (F)

Number of Samples	δB(Mpa)	εM %	δM (Mpa)	Young Modules (Mpa)
1	73.0	1.2	73.0	60.833
2	133	0.9	133	147.77
3	96.2	0.9	100	111.11
4	123	0.8	126	157.5
5	139	1.3	139	106.92

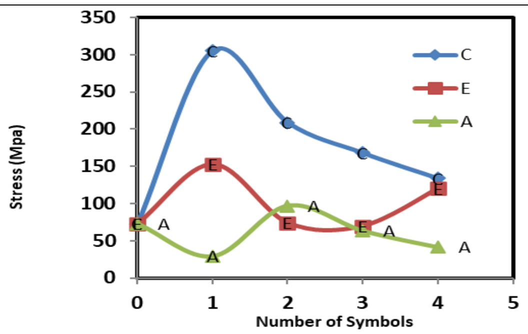


Fig. 2. Stress of polyester, Shilajit, and ws.PMMA(groups of A, C, and E).

Strees (Mpa)

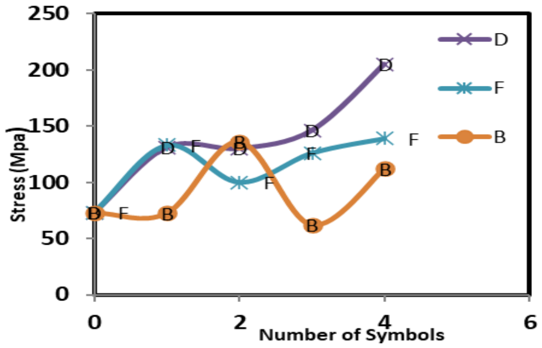


Fig.3. Stress of DOP, polyester, Shilajit and ws.PMMA(groups of D, F, and B).

By studying the impact of additive ratios on the elongation ratios of polyester and from Figures 4 and 5 we note that the highest elongation ratio of groups (A, C, and E) registered for group C at 1.3% with 1% addition while registering the highest elongation of groups (B, D, and F) for Group F at 1.3% with at 4% of the added Shilajit, Polyester is known to have low flexibility and high rigidity, and addition of Shilajit and ws. PMMA will fill the spaces between the polyester chains and reduce the movement of the chains and thus reducing elongation as they drop to the maximum when the ratio is 4%, while when adding DOP with the effect of the plasticized properties of DOP which appeared to be evident in the increased movement of polyester chains and the recording of elongation by a larger proportion.

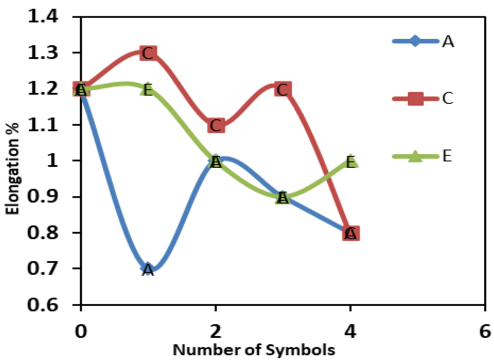


Fig.4. Elongation of polyester, Shilajit, and ws.PMMA(groups of A, C, and E).

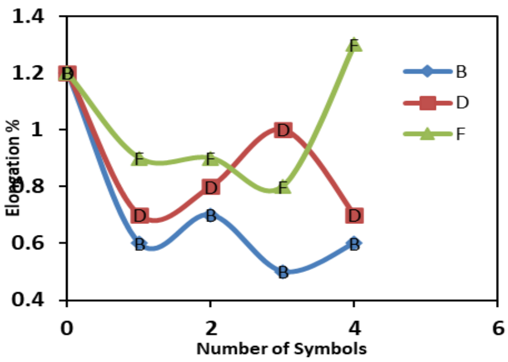


Fig.5. Elongation of DOP, polyester, Shilajit and ws.PMMA (groups of B, D, and F).

Young's modulus of the six prepared polymeric groups was studied which represents the linear modulus of elasticity ratio of stress to strain for the prepared materials for measurement. The Young's modulus registered 60.88 Mpa at the rate of adding 1% of the Shilajit, and ws.PMMA to the A Group, then it decreased to 42.5 Mpa at the rate of adding 2%. While Group C recorded an increase in Young's modulus at the add-on ratio of 2% of ws. PMMA and the value of 234 Mpa. It is possible to explain the increase in Young's modulus at the add-on ratio of 2% for the C group of the polyester mix, which is characterized by a lack of flexibility and great rigidity to the high-pressure force, as well as the decrease in Young's modulus at the add-on 5% of Shilajit for the A group, figures 6 and 7showed the results.

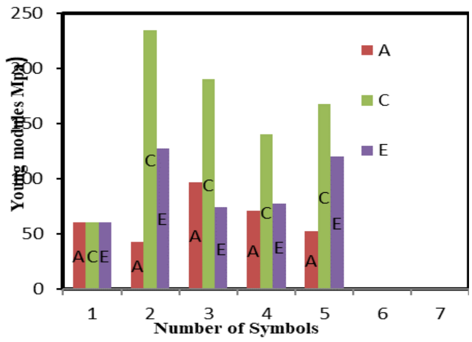


Fig. 6. Young's modulus of polyester, Shilajit, and ws.PMMA (groups of A, C, and E).

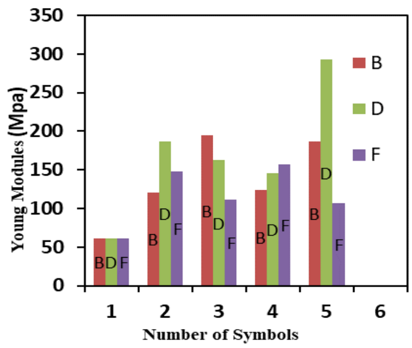


Fig .7. Young's modulus of DOP, polyester, Shilajit and ws.PMMA(groups of B, D, and F)..

Conclusion

By studying the mechanical properties of adding ws.PMMA and Shilajit residues with and without DOP and polyester, different results were shown, and we noted that the best results were obtained in the measurements of the group (F) in terms of the highest value of elongation as well as the Young Modules. Also, we conclude that adding Recycled Materials to polyester has a significant effect on the mechanical properties and that the percentage of (Group C, sample 2, was 305Mpa) of the additive was the best for the hardness of the polyester, while the percentage of (Group F, sample 5, was 1.3%) the best for the flexibility of the polymer.

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