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RHEOLOGY OF PLASTICIZED POLYMER BASED ON SECONDARY ORGANIC MATERIALS**Behzod Farmanov**

Assistant professor,
Karshi Institute of Engineering and Economics,
Republic of Uzbekistan, Karshi
E-mail: behzod_9900@bk.ru

Sa'dulla Lutfullayev

Assistant professor,
Karshi Institute of Engineering and Economics,
Republic of Uzbekistan, Karshi

Abbos Mamatqulov

Graduate student,
Karshi Institute of Engineering and Economics,
Republic of Uzbekistan, Karshi

**РЕОЛОГИЯ ПЛАСТИФИЦИРОВАННЫХ ПОЛИМЕРОВ
НА ОСНОВЕ ВТОРИЧНЫХ ОРГАНИЧЕСКИХ МАТЕРИАЛОВ****Фарманов Бехзод Илхомович**

доцент,
Каршинского инженерно-экономического института,
Республика Узбекистан, г. Карши

Лутфуллаев Саъдулла Шукурович

доцент,
Каршинского инженерно-экономического института,
Республика Узбекистан, г. Карши

Маматкулов Аббос

магистрант,
Каршинского инженерно-экономического института,
Республика Узбекистан, г. Карши

ABSTRACT

This article explains the creation of a scientific basis for a convenient, cost-effective technology that allows the production of plasticized secondary polymer composite materials (PCM) by repeatedly recycling polymer waste that pollutes the environment. The practical significance of the research results lies in obtaining plasticized polymer waste from the secondary polymer processing industry, further improving their operational properties, increasing their service life, and obtaining materials with improved protective and decorative properties.

АННОТАЦИЯ

В этой статье объясняется созданием научной основы удобной, экономически эффективной технологии, позволяющей производить пластифицированные вторичные полимерные композиционные материалы (ПКМ) путем многократной переработки полимерных отходов, загрязняющих окружающую среду. Практическая значимость результатов исследований заключается в получении пластифицированных из вторичных полимерных отходов полимерперерабатывающей промышленности, дальнейшем улучшении их эксплуатационных свойств, увеличении срока службы, получении материалов с улучшенными защитными и декоративными свойствами.

Keywords: polyethylene, polypropylene, polyvinyl chloride (PVC), plasticizer, dioctyl phthalate, stabilizers, soap drain.

Ключевые слова: полиэтилен, полипропилен, поливинилхлорид (ПВХ), пластификатор, диоктилфталат, стабилизаторы, мыльный сток.

In our country, polymer wastes of different chemical composition and nature are mixed with polyvinyl chloride composition and during the processing of melted polymer mixtures during the production of plasticized secondary products, how it affects the physico-chemical, technological and operational properties of polymer composite materials is studied less. It is worth noting that in our republic, great attention is being paid to the implementation of scientifically based system of managing industrial facilities and environmental protection measures through the implementation of innovative technologies. The Action Strategy for the further development of the Republic of Uzbekistan defines important tasks aimed at "further accelerating the production of finished products with high added value on the basis of in-depth processing of local raw materials, changing the types of qualitatively new products and technologies".

We know that a certain amount of technological waste is generated during the production of all types of plastic products. In particular, processing polyvinyl chloride (PVC), which is part of the polyolefin family, and obtaining various polymer composite materials (PCM) produces various technological wastes. Unlike other thermoplastic polymers, polyethylene, polystyrene, and other polymers, PVC itself cannot be recycled without additives, as it undergoes destruction at a temperature of 140-150 °C. To correct this deficiency, various chemical additives are added to its composition. As a result, we will have the opportunity to obtain PCMs with the necessary properties in advance.

Currently, various methods of recycling polymer materials are used, including chemical, energetic, physical-mechanical (material) and others. As a result of chemical recycling, monomers are obtained or other components can be obtained from the composition. Implementation

of this method is labor-intensive and requires a large amount of secondary PVC [1; Page 43]

The problems in the processing and use of PVC waste are the correct selection of effective and economical methods of their use. The level and scope of the use of PVC waste depends to a large extent on the complexity of their secondary processing devices, especially on the degree to which the primary waste crushing methods do not change the physico-mechanical properties of the crushed waste.

When determining the thermal stability of secondary PE, PP, PVC samples in a mixed state, since PVC is less resistant to heat than PVC, the temperature of the release of HCl as a result of its destruction was taken as a benchmark. Thermal stability, i.e. the time until the free release of HCl from the sample as a result of temperature (temperature 190 °C), was determined using the KEMCSÖTERMOSZTAT apparatus. In this case, the blue color of the "Kongo-krasniy" indicator paper indicates the free release time of HCl (GOST 14041-68).

The light fastness of the composites based on secondary polymer waste was determined visually, that is, the samples whose thermal stability was determined were monitored every 5 minutes, and the darkening of their color was considered as the time of light fastness.

The liquefaction and recrystallization temperatures of the investigated secondary PE, PP and PVC wastes were measured on a Differential Scanning Calorimeter device (DSC) according to method D 3417-99.

In the following experiments, the liquefaction temperatures of equal amounts of secondary PE, PP and PVC mixtures and their mixtures with plasticizers are presented.

The 1st experiment. Determination of liquefaction temperatures of secondary PE, PP and PVC mixtures obtained in equal amounts.

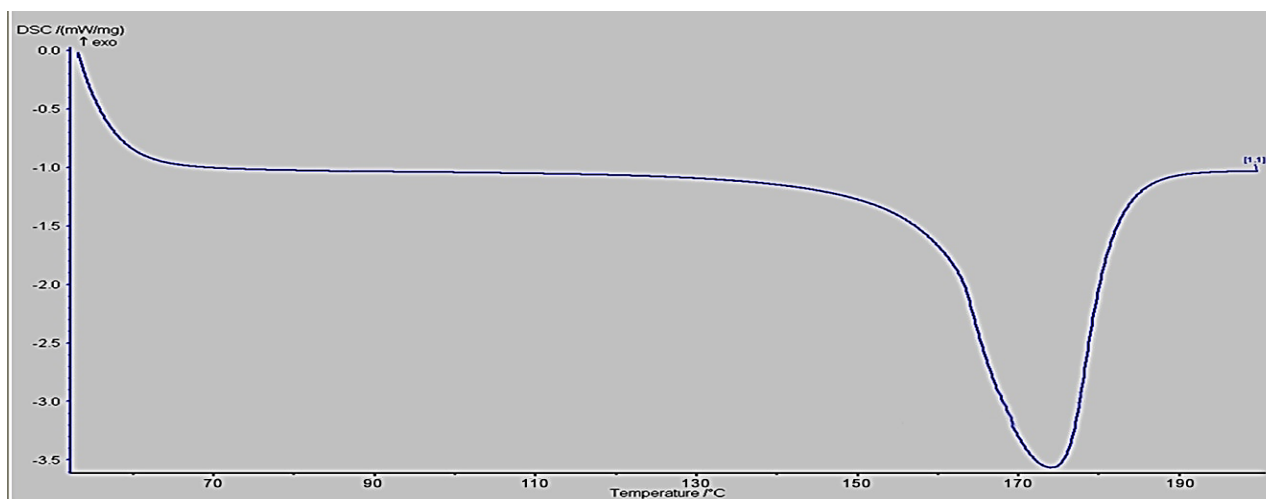


Figure 1. Liquefaction temperatures of secondary PE, PP and PVC mixtures obtained in equal amounts

Experiment 2. Determination of liquefaction temperatures of equal amounts of secondary PE, PP and PVC mixtures + plasticizer (1:0.1 m.p.)

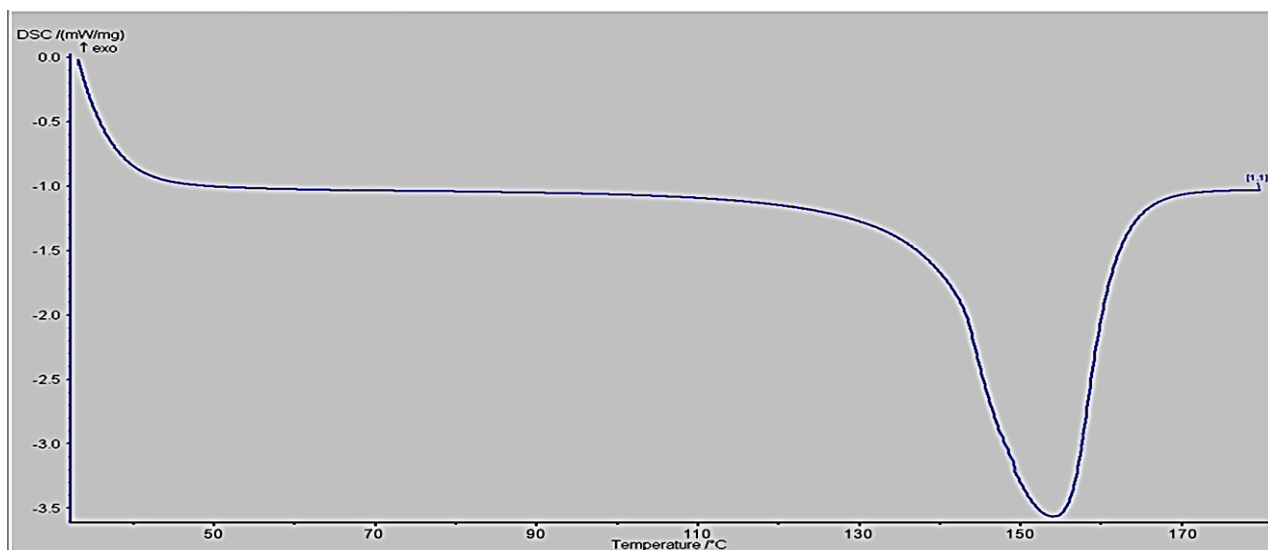


Figure 2. Liquefaction temperatures of equal amounts of secondary PE, PP and PVC mixtures + plasticizer (1:0.1 m.p.)

Experiment 3. Determination of liquefaction temperatures of equal amounts of secondary PE, PP and PVC mixtures + plasticizer (1:0.3 m.p.).

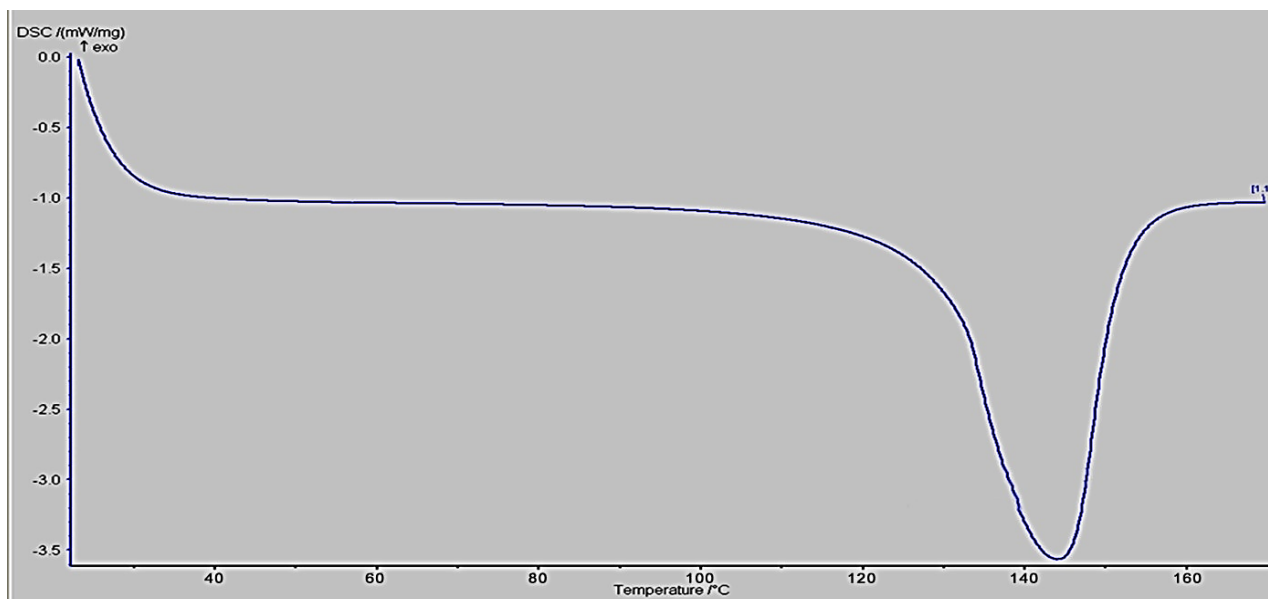


Figure 3. Liquefaction temperatures of equal amounts of secondary PE, PP and PVC mixtures + plasticizer (1:0.3 m.p.)

Experiment 4. Determination of liquefaction temperatures of equal amounts of secondary PE, PP and PVC mixtures + plasticizer (1:0.5 m.p.).

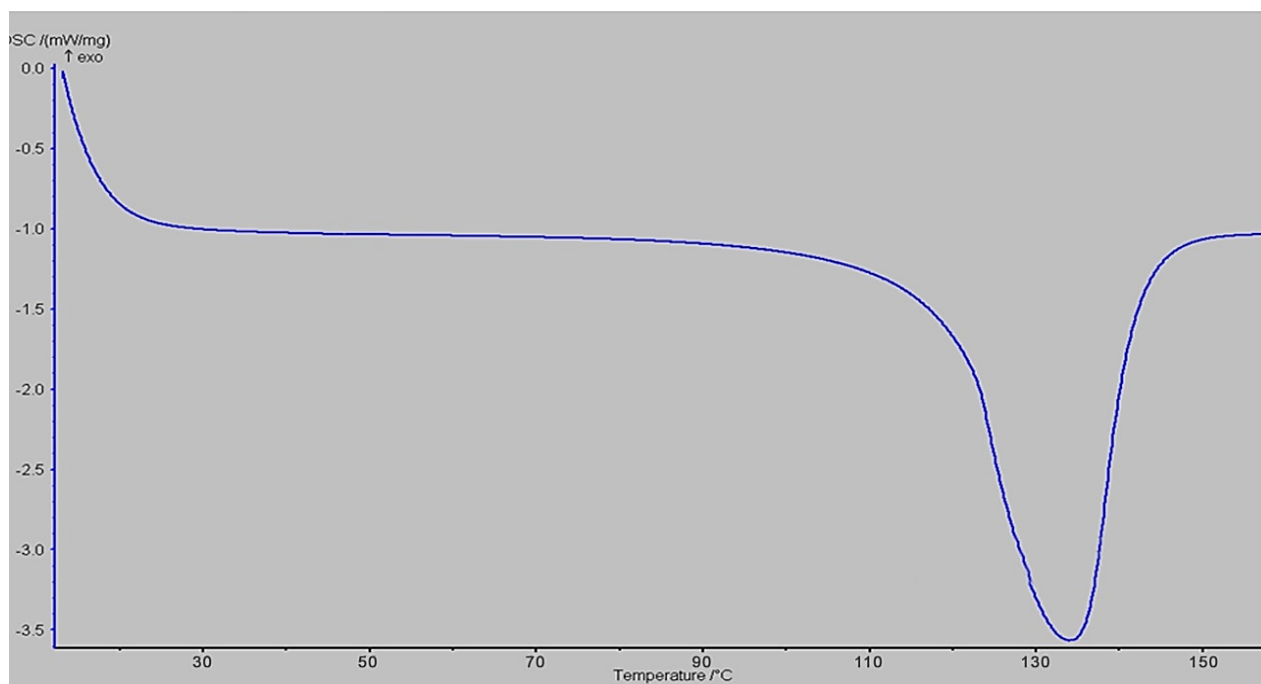


Figure 4. Liquefaction temperatures of equal amounts of secondary PE, PP and PVC mixtures + plasticizer (1:0.5 m.p.)

The experimental test results are presented in Table 1 below:

Table 1.

Liquefaction and recrystallization temperatures of polymers

Names of polymers	Liquefaction temperature, °C	Recrystallization temperature, °C
Granule P-Y342	130	122
Secondary PE	128	121,1
PE + plasticizer; 1 : 0,1	122,2	117,9
PE + plasticizer; 1 : 0,3	115,5	112,5
PE + plasticizer; 1 : 0,5	108,2	105,2
Polypropylene	176	162
Secondary PP	160,1	151,4
PP + plasticizer; 1 : 0,1	145,4	146,1
PP + plasticizer; 1 : 0,3	138,6	135,6
PP + plasticizer; 1 : 0,5	126,3	122,8
PVC resin	150	143,2
Secondary PVC	144,4	137
PVC + plasticizer; 1 : 0,1	136,3	130,2
PVC + plasticizer; 1 : 0,3	131,1	123,8
PVC + plasticizer; 1 : 0,5	126,5	120,6
Secondary PE, PP and PVC compounds	172	165
Secondary PE, PP and PVC compounds + plasticizer; 1 : 0,1	152,7	146,3
Secondary PE, PP and PVC compounds + plasticizer; 1 : 0,3	140,2	135,2
Secondary PE, PP and PVC compounds+ plasticizer; 1 : 0,5	132,4	128,6

According to the experimental results presented in Table 1, it can be concluded that the addition of soapstock and dioctyl phthalate as a plasticizer to their composition in order to recycle secondary PE, PP and PVC waste to obtain high-quality plasticized polymer products used for various purposes, just as the softening temperature of the above polymer is reduced. as it causes a decrease in the liquefaction temperature and recrystallization temperature. This is considered technologically appropriate.

The results in the table below were obtained when the strength characteristics of materials based on secondary polymer waste (σ_p -tensile strength limit, σ_v -bending strength limit) were studied in the conducted experimental work.

Table 2 shows the average values of important mechanical characteristics of single- and multi-layered sheet-shaped samples in elongation and bending.

Table 2.

Average values of stretch and bending mechanical characteristics of secondary PE, PP and PVC sheet materials

Type of material	In stretch, σ_p MPa		In bending, σ_v MPa	
	Range of measurement	The average value	Range of measurement	The average value
One layer	46.89—80.20	60.10	75.44—132.00	104.38
Two layers	53.96—74.40	63.15	78.38—163.34	112.66
Multi-layered	54.10—67.10	63.66	98.10—140.00	121.22

Loading was carried out at a speed of 5 mm/min of the machine mixer. Mechanical characteristics were obtained based on the difference of samples cut from sheet-shaped single-layer materials. Based on the research results, it can be said that the tensile strength of the samples decreased by 0.3% on average, and the bending strength increased by 1.2% on average. The

greatest deviations during extension did not exceed 12%, and during bending - 13%.

As the technology for obtaining secondary PE, PP and PVC materials has improved, their strength properties have improved, and therefore the average values for the same type of material have increased [2; page 143].

Modifications of the researched materials are presented in Table 3 below:

Table 3.

Relative values of tensile and bending mechanical strength limits of sheet-shaped samples obtained from secondary PE, PP and PVC

Type of material	Stretching strength limit, %	Bending strength limit, %
One layer	82,6	74,0
Two layers	87,9	73,0
Two layers	82,9	82,6
Two layers	88,2	106,5
Two layers	89,1	98,7
Two layers	98,8	126,9
Two layers	90,2	94,4
One layer	102,6	145,0
Multi-layered	100,5	115,5
Two layers	103,7	102,0

The influence of the material obtained on the basis of secondary PE, PP and PVC on the mechanical properties of the tensile deformation rate in the range from 0.08 to 100 mm/min was studied. The mechanical index quantities of the composition were obtained in absolute and relative values. This shows a linear relationship between typical strength and $\ln V$ (V -strain rate) for most polymer materials.

A 10-fold increase in the strain rate increases the strength by about 0.04 MPa.

The physical and mechanical properties of secondary PE, PP and PVC-based materials depend significantly on the nature of the plasticizers used. Compared with unplasticized rigid PVC material, the plasticization process softens the material enough to increase its absolute residual deformation. When comparing unplasticized and plasticized PVC material with phthalate plasticizers, their water absorption, strength, and relative elongation at elongation are significantly different from each other. Therefore, phthalate plasticizers, including dioctyl

phthalate (DOP), show very good physical and mechanical properties for PVC-based materials.

The research results showed that DOP is the most effective plasticizer in the processing of secondary PVC materials, and its amount [4; pages from 62 to 68] (mass percentage) when added to 10-13% shows the highest performance compared to other plasticizers. It should also be remembered that when using veneer materials obtained as a construction material based on secondary PVC, the amount of DOP is recommended to be up to 2.5%, because the moisture elasticity of the veneer may increase and its hardness may decrease.

Conclusion

The strength and deformation properties of secondary materials based on soapstock and dioctylphthalate based on PE, PP and PVC, strength indicators against compression, elongation, dynamic and static bending are comprehensively compared depending on the composition

of the composition and technological process parameters, PE, PP and PVC Based on this, it was found that modification with soap stock and dioctyl phthalate in 1:0.3 mass unit is the optimal recipe. It was also determined that the ultimate strength and deformation properties of materials made of secondary materials and molding properties depend on the amount of plasticizers added to the composition. For the first time, plasticized secondary materials were obtained from polymer waste based on local raw materials: polyethylene, polypropylene and PVC compositions. When obtaining products from PVC-based secondary materials for technical purposes, the primary PVC, as well as targeted additives such as soapstock and dioctylphthalate, stabilizers and fillers are added to the composition, based on the possibilities of obtaining materials with the necessary physical and mechanical properties under optimal processing conditions were justified.

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