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United Kingdom
Street: 2 High Street City: Ashby Phone number 079 6425 7122
Zip code DN16 8UZ Country United Kingdom
USA
Soldiers Field Boston, MA 02163 +1.800.427.5577

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ANALYSIS OF PHYSICAL-MECHANICAL PROPERTIES OF NEW TYPE OF WOOD-POLYMER COMPOSITE MATERIALS

[1]S.S. Aliev, [2]E.A. Egamberdiev, [1]G.Yu. Akmalova, G.U. Ilkhamov
[1]Tashkent Institute of Chemical Technology
[2]Tashkent State Technical University named after Islam Karimov

Abstract. The composition and structure of fillers (poplar wood and MDF scraps) used in the production of wood-polymer composites based on polyvinyl chloride (PVC) were studied. A recipe for wood-polymer composite (WPC) was developed from poplar wood and MDF shavings and polyvinyl chloride composition, samples were taken on the created lines and their technological and operational properties were studied, appropriate changes were made to the recipe.

Keywords. Wood, wood flour, polyvinyl chloride, polymer, reinforcement, binders, modification, stabilizer

Introduction. The first enterprise producing WPC materials started working in Sweden in 1977. At that time, for the production of this type of product, the enterprise used PVC as filler and binder of chopped wood up to 30% of the total mass. The experience of this enterprise in the production of PC products was successful, and by the 1990s, this technology was used in European countries such as Finland, Sweden, Italy and the Netherlands. After the 1990s, it began to develop widely in Japan and China, which are the developed countries of the Asian region.

This production system is a major global problem in wood processing and production. As it is known from the literature, 40-50 mas in PVC-based WPC. the part is obtained on the basis of wood shavings. In the countries mentioned above, with products based on renewable natural resources of forests, this sector is provided with products that ensure long-term environmental, economic and social sustainability. Improving the availability and use of forest biomass, through wood processing and recovery from end products. The most important strategic objectives and research areas in Europe. It is known that recycled wood provides a large volume source for recycled products and new materials, which further increases the environmental impact of wood. Wood waste utilization is also recognized as a major problem in Australia. Market research has shown that the main reasons why small and medium-sized enterprises (SMEs) do not reduce their emissions is due to the perception of low profitability. This article aims to provide advice to SMEs in Australia's timber furniture sector on how to incorporate timber processing and recycling into their value-added product system.

Methodical part. Sawdust is dried to 8-10% moisture in an aero-dryer with the help of strong hot air flow. After that, PVC and mel ($CaCO_3$) and other chemicals are mixed together according to the recipe in a high-speed rotary mixer at a temperature of 120-130ºC (for better penetration of the polymer and filler). The mixed finished mass is allowed to rest for 8-10 hours and fed to the extruder in the required dose. Before that, the extruder is heated from 165ºC to 180ºC according to the zones. The mixture is mixed in the extruder zones, turns into a liquid, exits the forming head, and the resulting product is cooled in the temperature range of 10-15ºC. After cooling, the sample is cut into the desired format, during this process, the quality of the product,

the surface flatness, the flatness of the ribs and the mass of this product are measured. The operational properties of the samples are checked.

Experiment and its analysis. In preliminary studies, a recipe for PVC and wood composite was developed and its indications were determined. As a result of the study, it was found that with a decrease in the amount of wood flour and flour, the heat stability and water absorption index decreased from 127 to 95 oS and from 1.4 to 1.2%, respectively.

Table –1

Wood polymer composition recipe based on PVC

Components	1	2	3	4	Chinese example
Recipe, mass. part					
Polyvinyl chloride PVC SJ8	40	50	60	63	30-60
Wood flour	15	10	10	11	40-70
($CaCO_3$) $S_{уд}$≥250 m^2/kg	45	40	30	26	-
Polyethylene wax	0,55	0,5	0,45	0,35	0,1-0,3
Plasticizer	1,0	1,2	1,5	0,75	-
Thermostabilizer	4,5	4,0	4,5	6	4-8
Modifier	8	7	6	8	2-10
Methacrylic acid	2,5	2,2	2,3	3	-
Stearic acid	0,5	0,3	0,4	0,6	0,1-1,0
Operational properties					
Иссиқлик бардошлилиги, 180 ^oC, мин	125	103	110	97	61-99
Сув шимувчанлиги, 24 соатда, %	1,4	1,35	1,2	0,85	0,8-2,4
Зарбий қовушқоқлиги, кДж/$м^2$	17,5	16,6	17,2	17,8	13,7-15,8

Based on this, first a test sample was taken at the LLC "Khamkor R" enterprise and they have the following indicators.

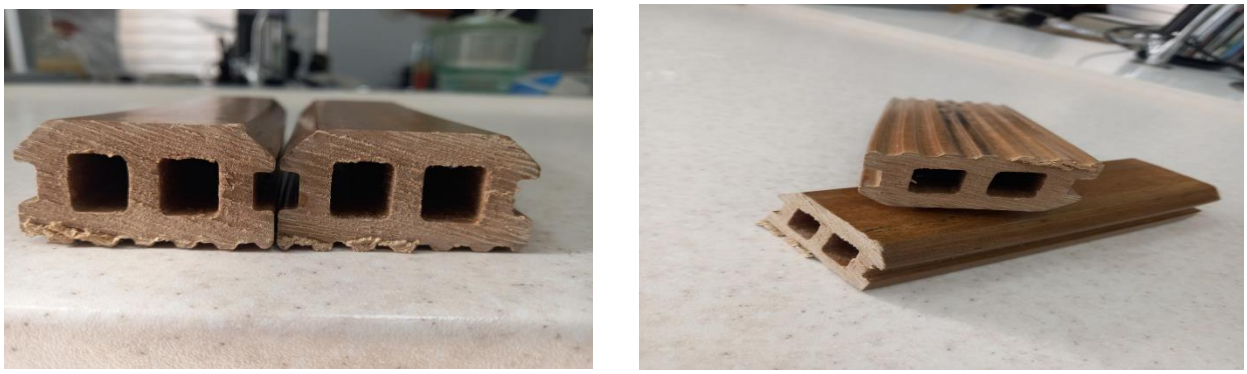


Figure 1. Experimental sample of wood polymer composite material based on PVC and wood waste

Preliminary studies have shown that the recipe we developed has some foaming, which is known to affect the quality of the product.

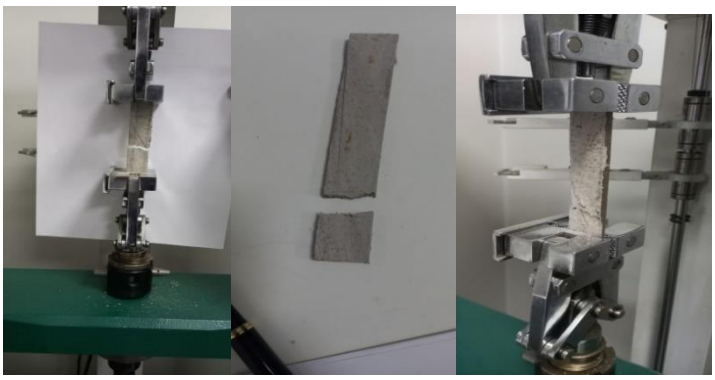
Table -2

Physico-mechanical properties of wood-polymer composites

Indicators	Sample №1	Sample №2	Sample №3	China WPC
Sample weight, g	165±5	165±5	135±10	140-165
Thickness, mm at least	4-6	14-16	14-16	16
Density, kg/m^3	965	1050	1100	950-1100
Bending strength, MPa	48,8	52,7	45,6	45-52
Density according to GOST 15139-69, kg/m^3	965	1050	1100	750

At the same time, the amount of fillers and thermostabilizers is of great importance in the production of a rigid product based on PVC. These were also taken into account when changing the recipe.

The tensile strength of wood-polymer composite materials was carried out according to the GOST 11262-2017 methodology. For this, samples were prepared according to GOST 26277. That is, the dimensions are 120x4x15 mm. In addition, according to this GOST, the rate of tension of the device was set to (0.5) %. When preparing the samples for testing, they were conditioned in atmospheric conditions for 16 hours according to GOST 12423-66. We calculated the tensile strength by applying the test results to the following formula and expressed them in the following table..



$$\sigma_{рм}=F_{рм}/A_0 ; \qquad (1)$$

where,$F_{рм}$- to the maximum elongation N; A_0–initial transverse surface of samples.

Table -3

№	Samples		Tensile strength, MPa	Maximum elongation, mm	Average tensile strength, MPa
1	Recipe 2 wood filler (5.46%)	a	4,8	2,08	4,908
		b	5,016	1,83	
2	Recipe 3 Wood Filler (7.96%)	a	6,63	2,326	6,11
		b	7,25	2,513	
		c	4,45	1,529	
3	Recipe 4 wood filler (10.46%)	a	8,15	2,995	6,925
		b	6,36	3,356	
		c	6,26	2,558	
4	Recipe 5 Wood Filler (12.96%)	a	12,06	4,185	12,097
		b	10,2	3,747	
		c	14,03	4,101	

From the results presented in the table above, we can see that increasing the mass fraction of wood filler in the recipe based on the composition led to an increase in tensile strength.

The conducted studies showed that the use of secondary PVC rather than primary PVC in obtaining YoPKM resulted in obtaining a product with relatively high physical and mechanical parameters. But in this technology, compared to the above production technology, it was mainly achieved by changing the temperature regimes in the extruder zones and in the mixing process. As a result of the research, it was possible to develop a standard recipe and obtain a high-quality PVC-based wood-polymer composite material. However, in our republic, there are currently a lot of poplar and MDF cores (more than 20+30 thousand tons, both of them). This motivates the development of a new recipe based on this source.

Conclusion. It was found that the parameters of the wood-polymer composite samples determined above serve to control and adjust the amount of fillers in the recipe in general. As a result of the research, a standard recipe was developed based on primary and secondary PVC and tested in semi-industrial conditions based on the created technological regulation.

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