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PECULIARITIES OF RECEIVING AND OF PREMIXES AND PREPREGS PROPERTIES ON THE BASIS OF GLASS-FIBER WASTE

In the represented work it is offered to use the crushed glass fiber waste as a filler for polyester premixes and prepregs. The technological modes of production of products and important physical and mechanical properties of press materials on the basis of nonsaturated polyester pitches when using the crushed glass fiber waste instead of traditionally applied chopped glass fibers are defined. The obtained data allow to speak about possibility of use of secondary thermoreactive materials for production of small and mid-size products.

Introduction. The volume of the modern European market of polyester press materials is about 280 thousand tons a year. In production of vehicles – 43%, in production of products for electrotechnical and electronic industry – 40%, in other branches – 17% [1]. Premix is used generally at the production of small and mid-size products of difficult configuration

In the Republic of Belarus, there is no production of premixes, but there are enterprises, engaged in manufacture of products from fibreglasses for various industries. Such enterprises have sufficient technical and material resources for organization of premixes production.

At the production of polyester polymers and composite materials products technological waste is formed and also waste in the form of the products that served their term.

From the ways of processing thermosetting materials and the polymeric composite materials (PCM) on their basis crushing on various units is preferred. Products are crushed and subjected to the division into various fractional groups. The received particles are added into a composite as a filler [2].

There is a problem of using fine powder fraction of thermoreactive polymer with a size of particles up to 70 microns which after crushing possesses activity because of formation of reactive functional groups.

In the represented work, it is offered to use the crushed glass fiber waste as a filler for polyester premixes and prepreg without classification.

Main part. The basic composition of press materials (premixes and prepregs) is the following: the polyester binding – 45 wt %, glass-fiber waste (SVO) – 20 wt %, a mineral disperse filler – 30 wt %, additives – 5 wt %.

The crushed waste of fibreglasses represents polydispersed mixture of fibrous and fine fractioned components (Fig. 1).

The influence of parameters on the quality of the received pressing was determined by the density and the indicator of Shore D hardness. Experiments showed that the optimum pressing temperature from a condition of obtaining the maximum density and hardness is in range from 100 to 120°C. The indicator of hardness increases by 24% at temperature increase from 80 to 120°C.

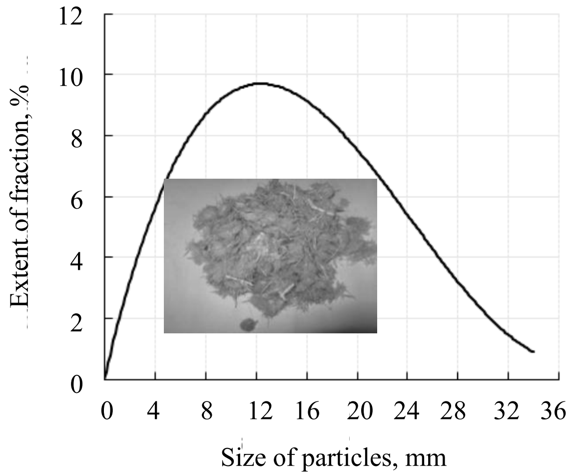

Fig. 1. Function of distribution of particles by the sizes and appearance of the crushed waste

Hold time depends on temperature of pressing, the sizes and the form of a product. The maximum hardness is observed when pressing a disk within 5 min. at the temperature of 120°C. The increase in hold time leads to the beginning of destruction of polymer that reduces density and hardness of the material.

When pressing products pressure is necessary for removal of air from press material and its consolidation. Overriding of the polyester binding is done without allocation of flying therefore the increasing of pressing can be reduced. The results of the experiment show that influence of increasing of pressing is insignificant (the increase in hardness approximately for 7%), however, at increase of specific pressure of pressing more than 10 MPa the considerable expression of binding in gaps occurs. The results of experiments give an opportunity to determine optimum parameters of process of pressing of flat articles of premixes on the basis of glass-fiber waste: temperature – 120°C, hold time at pressure – 1 min, the specific pressure of pressing – 7 MPa.

The parameters of technological process received experimentally were applied at production of samples for determination of physical and mechanical properties of premix and prepreg depending on the content of glass-fiber waste. The increase in the maintenance of SVO was made due to reduction of quantity of a mineral filler.

The received results of experiments in comparison are presented in Fig. 2.

Tests were carried out according to the established standards: on stretching for determination of durability at a gap in accordance with GOST 11262–80, for determination of durability at a bend according to the three-point scheme of loading in accordance with GOST 4648–71, for definition of the module of elasticity at stretching an bending in accordance with GOST 9550–81.

On dependences (Fig. 2) it is visible that with increase in extent of filling from 20 to 40% mas. mechanical characteristics increase in 1.5 and 2.5 times at stretching and bending respectively. Properties of premixes are on average 1.5 times higher, than at prepreg for any extent of filling. The exception is made by values for elasticity modules. At stretching the elasticity module at low values of extent of filling for premixes is 1.5 times higher, and at extent of filling 40% mas. – already by 2.2 times. For the elasticity module at a bend inverse relationship is observed: at low values of extent of filling modules differ by 2.5 times, and at extent of filling of 40% mas. – by 1.5 times.

Low values of mechanical characteristics for prepreg are explained by insufficient homogenization and impregnation of a fibrous component in material.

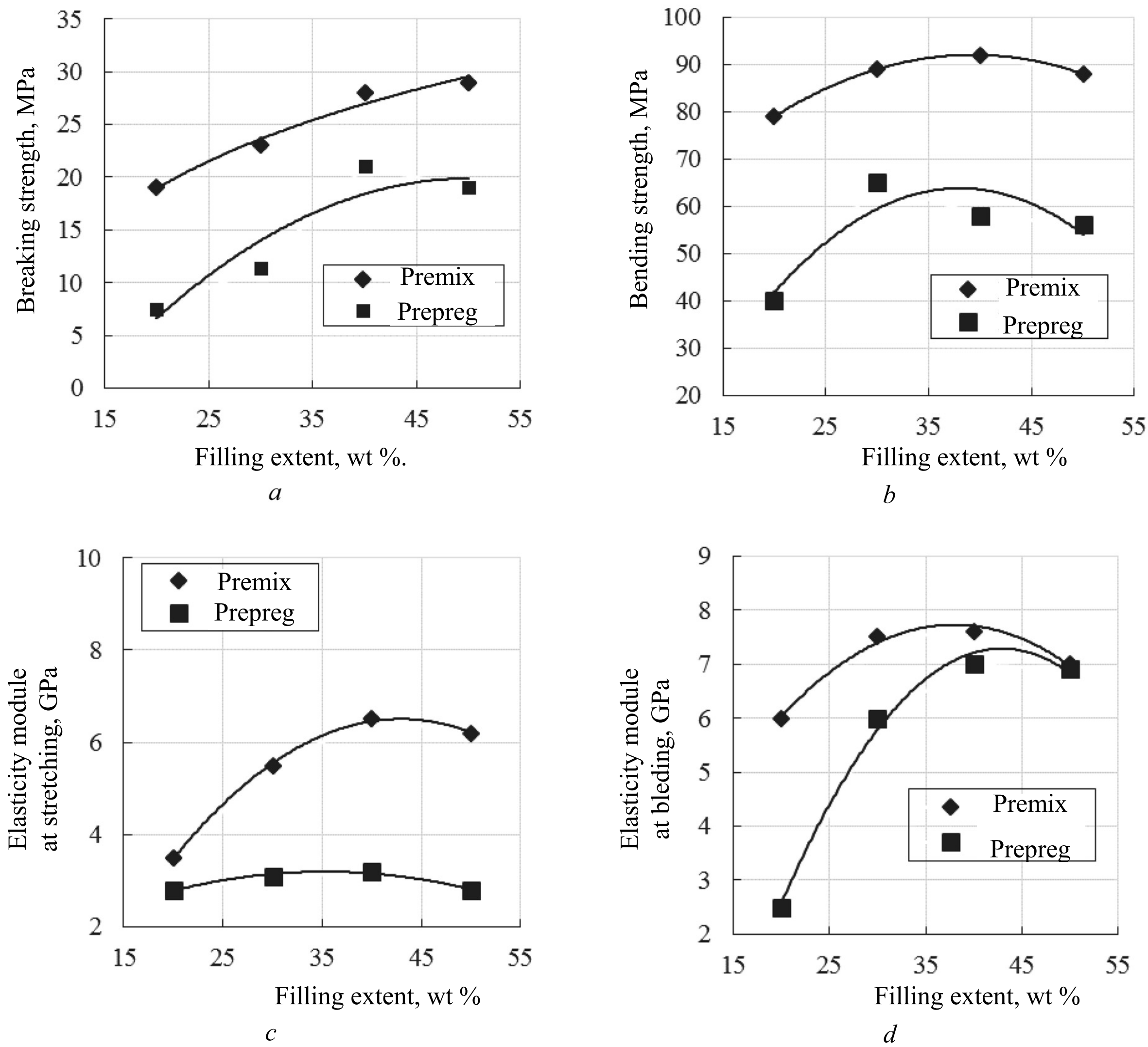

Fig. 2. Dependence of the main mechanical indicators from the extent of filling for press materials: durability at stretching (*a*) and bending (*b*), the elasticity module at stretching (*c*) and bending (*d*)

Physical and mechanical properties of secondary press materials

Parametres	Premix			Prepreg		
	Extent of SVO, wt %					
	20	30	40	20	30	40
Density, g/cm^3	1.3-1.5			1.4-1.6		
Durability at stretching, MPa	19	22	29	7.5	11.4	23.2
Durability at bending, MPa	79	89	92	40	65	58
Elasticity module at bending, GPa	6.0	7.5	7.6	2.1	6.1	7.0
Elasticity module at stretching, GPa	3.5	5.5	7.5	2.8	3.1	3.2

Destruction of samples (Fig. 3) happened is fragile in places of a congestion of shorter fibers of waste of fibreglasses or a considerable congestion of a fine mineral filler that testifies to uneven distribution of a filler on volume and its agglomeration at mixture with the liquid binding.

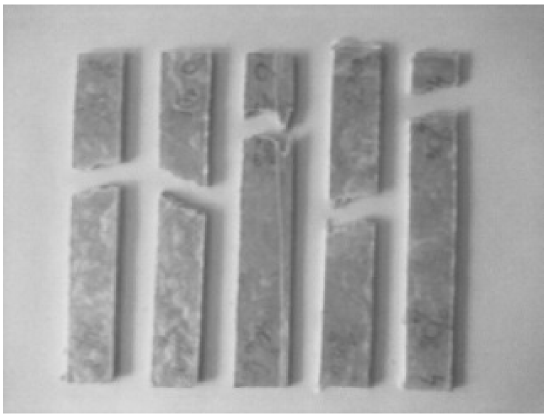

Fig. 3. Type of fragile destruction of samples from secondary press material

The filler which remained after a burning out of composite material was studied under a microscope, the length of all fibers was measured selectively and the histogram of distribution by the sizes was built. The analysis of results shows that in result of mixture and the subsequent pressing of press materials there is a crushing of a glass-fiber filler. The reference most often found value of fibers – 10–13 mm, final – 3.5 mm for premixes and 5.5 mm – for prepreg. Reduction of length is approximately 3 and 2 times respectively.

Reduction of length of the reinforcing fibers will led inevitably to decrease of phisical and mechanical characteristics of the received materials in comparison with the predicted parameters. The generalized results of experimental determination of mechanical properties of secondary press materials are presented in the table.

Analysis of results of experiment. From results of researches it is possible to assume that it is expedient to recycle given materials for the subsequent use in various the low-rate details and irresponsible designs for economy. Thus, the conducted researches show possibility of replacement of primary chopped fiber glass by glass-fiber waste by production of polyester premixes and products on their basis.

References

1. Панфилов Б. В. Композиционные материалы: производство, применение, тенденции рынка // Полимерные материалы. 2010. № 2–3. С. 40–43.

2. Шаповалов В. М., Тартаковский З. Л. Многокомпонентные полимерные системы на основе вторичных материалов / под общ. ред. Ю. М. Плескачевского. Гомель: ИММПС НАН Беларуси, 2003. 262 с.

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