PRODUCE AND TESTING COMPOSITES MATERIALS WITH DIFFERENT REINFORCED FIBERS AND MATRIXES

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Abstract

The mainly object of this work was made and tested of composite materials. These materials are used in many kind of technical field, like aviation, automotive, engineering, health and a lot of other kind of technical fields. For composites were used special textile fibers like carbon, glass, basalt and jute fibers. Fibers had 10 mm of length.For composites were used fabrics with matrixes. Number of layers was 4 in one sample. These fibers and fabrics were used with matrix, geopolymer matrix, epoxi matrix and polyethylene matrix. For geopolymer composites was used different volume ratio of components. These composites were made by same technique for all samples. Were tested mechanical properties of basic material and were tested mechanical properties of composites. Obtained dates were presented in graphs.

1 Introduction

In this time, it is still bigger call for composition of technical's materials. It was searched new materials in every fields, which will be satisfying high criteria for their properties. The most important things are in this case, their weight, price and mechanical and physical properties. These factors are deciding in choice of material. Composites with the lowest weight, the biggest strength and thermal resistance are most applied in aerospace industry. The applied in health industry are biocompatibility and strength properties. Every fields have own specific applied for material. The best of materials for these fields are composites. Their main object is improving properties of similar component in composite material. These materials expand their possible use in other fields [1, 2, 3,].

Composites were made from different fibers and matrixes. Typical fibers for composites are carbon, basalt fibers, glass, Kevlar. In this work were used carbon, basalt, glass and jute fibers. Fabrics were used like next reinforcement materials for composites. Were used same kinds of fabrics like fibers. Matrixes are resin, polypropylene, polyethylene, polyamide, geopolymer. In this work were used epoxy resin, geopolymer and polyethylene matrixes.

Geopolymers are inorganic man-made materials. They were made by basic reaction of aluminum-silicate minerals in alkaline environment. This reaction is by help normal pressure and temperature. Geopolymers look like stone but the properties of geopolymers are differentially better. This kind of matrix was used in a lot of modification and combination. This material can survive millennium [4, 5, 6,].

2 Mechanical properties of composites

2.1 Used components

In this project were used carbon fibers from Kureha, recycling carbon fibers from VZUL Praha, basalt fibers from Basaltex, glass fibers from Havel Composites and Jute fibers. The length of fibers was 10 mm and 100 mm. The volume ratio of fibers was 2, 4 and 6 % for composites with geopolymer and 5 % for all composites with other fibers. Next reinforcement component were used fabrics. Fabrics were applied carbon, glass, basalt and Jute. In sample were 4 layers. Matrixes were used geopolymer obtained from Ceske lupkove zavody, epoxy from Havel Composites and polyethylene matrixes. Geopolymer was made by burn of kaolin in 600 – 900 °C. This powder was mixed with activator. This activator was water glass from Setuza a.s. .

2.2 Method of testing samples

2.2.1 Testing by tension force

For these testing were prepared samples from short carbon fibers and geopolymer matrix. The samples had 150 mm of length, 50 mm of width and 10 mm of thickness. The length of fibers was 10 mm. The volume ratio of carbon fibers in composites was 2, 4 and 6 %. For testing was used dynamometer with mechanical jaws (fig.1). The composites were testing for tensile force.

All samples were tested after 1, 2, 3 and 4 weeks, because geopolymers need time for maturing and curing. Geopolymers were packaged in polythene during maturing and curing. It is necessary to used polythene, because geopolymers can craze.

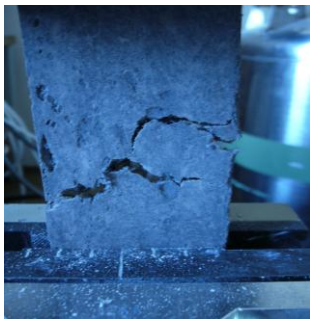

Figure 1. Picture of destroyed sample in jaws

2.2.2 Testing by 3 point bending

The samples had 100 mm of length, 20 mm of width and 2 – 10 mm of thickness. These samples were laid on two props like girder and by prickle is sag to destroy (fig. 2). Was measured Young´s modulus and maximal power to sag to destroy**.** Samples contained short fibers, long fibers and layers of fabrics. Samples with fabrics were made by two kinds of method producing. First method was impregnation and second was bathed.

Figure 2. Picture of bending of sample in 3 point bending teste

3 Results

All obtained dates from testing were presented on graphs.

3.1 Results of Testing by tension force

The samples have increasing tendency for strain force. This increase ending at 3rd week, after 3rd week increasing of strain force is smaller than 2 weeks before (fig. 3). The samples with 6 % of volume ratio have best result of strain force because in composites were more fibers. It wasn´t possible used more percent of volume ratio, because 6 % is maximum volume for good mixing.

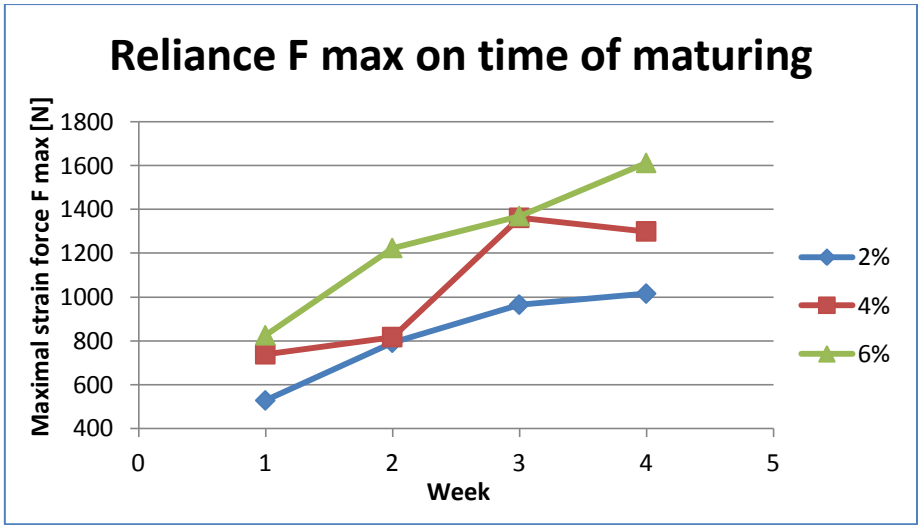

Figure 3. Graph of curves of strain force

Young´s modulus is the biggest for samples with 6 % of volume ratio. In 3rd week it was seen decrease for the sample with 6 % of volume ratio **(fig. 4)**. This sample has opposite direction of curve than samples with 4 and 2 % of volume ratio. It could be from method of testing and using mechanical jaws.

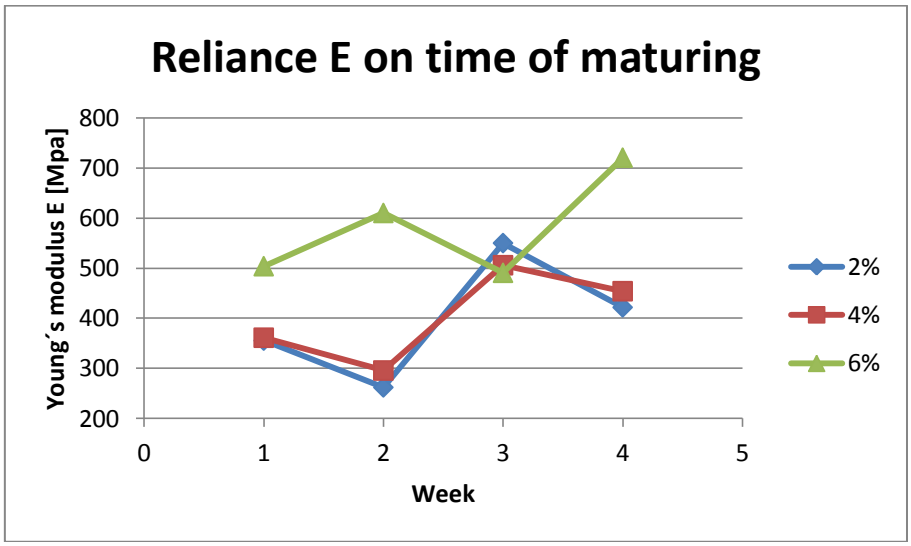

Figure 4. Graph of curves of Young´s modulus

3.2 Results of Testing by 3 point bending

Carbon composites were made with different kind of samples. One set of samples were made with three kind of long fibers. Length of the fibers was 100 mm. One of kind of fibers was virgin carbon fibers. Second samples were with recycling carbon fibers which were recycled by 550 °C. Last kind of long carbon fibers were used recycling carbon fibers which were recycled by 600 °C. Next kinds of samples were made with short virgin carbon fibers and with virgin carbon fabrics. Length of the short fibers was 10 mm.

Other kinds of fibers and fabrics were used glass, basalt and Jute. Length of the fibers was 10 mm and fabrics had same area density 200 g/m^2. The volume ratio for fibers was 5 % and was used 4 layers of fabrics in one sample.

3.2.1 Fibers composites

The best result of fibers composites had samples with carbon fibers. The virgin long carbon fibers had the most Young´s modulus. The second best result of these kinds of composites had recycling carbon fibers. The reason of this big Young´s modulus is volume ratio of fibers inside composites and longer length than composites with short length of fibers. The volume ratio was 40 % of fibers in composites (fig. 5).

Between composites with short length fibers had the best results carbon fibers. Recycling carbon fibers had better mechanical properties than virgin fibers, but difference isn´t too big. The dates from testing glass and basalt fibers in composites are same. The worst dates had composites with Jute. The reason is that Jute is natural fiber and during the temperature processes the fibers burn.

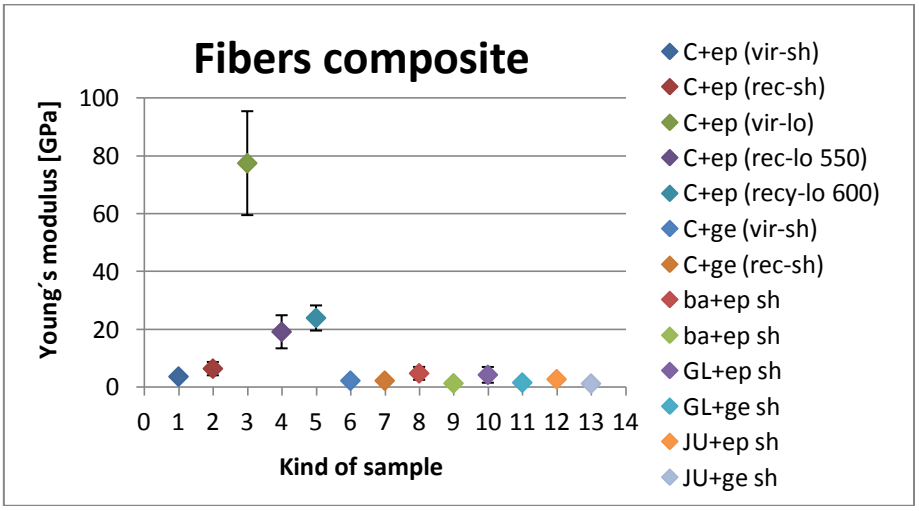

Figure. 5 Graph of results from testing fibers composites

3.2.2 Fabrics composites

Samples with carbon fabrics which were impregnated had the best Young´s modulus than samples which were bathed (fig. 6). Samples with glass and basatl fabrics which were impregnated had same reasult like carbon samples which were bathed. The worst dates from this testing had samples with polyethylene matrix. The best of all Young´s modulus had samples with epoxy matrix and samples which were impregnated.

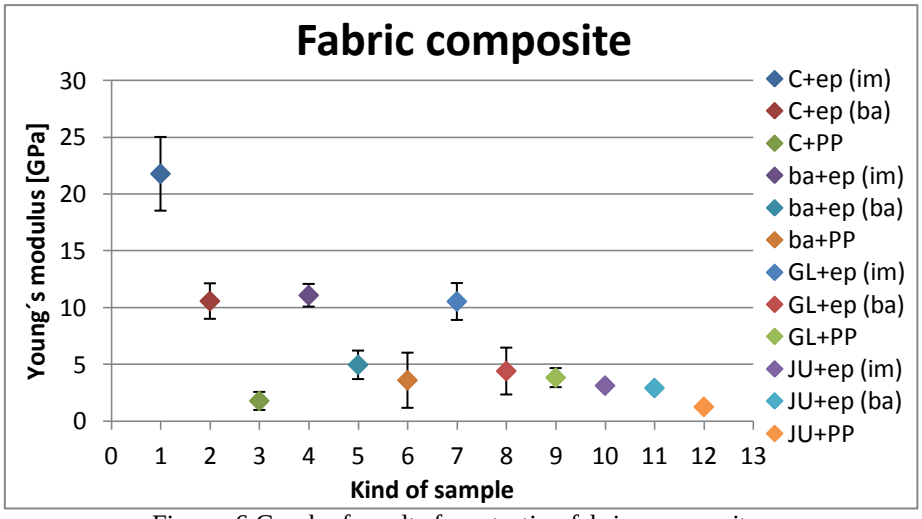

Figure. 6 Graph of results from testing fabrics composites

4 Conclusion

From the first kind of testing we obtained a lot of conclusion. The first from them is, that optimally ratio of volume was 6 % but not more, because if is it used more percent fibers, were made clumps inside of composite. The time of maturing and curing of all geopolymers is necessary 3 weeks. It is lower limit. From this testing were get opinion, that this kind of testing isn´t perfect. From this reason were made new samples and was tested 3 pointed bending.

From first graph of 3 point bending is seen big difference between short and long fibers. The biggest Young´s modulus had sample with long virgin carbon fibers, but the volume ratio for this sample was 40 % of fibers in composite. The biggest Young´s modulus for short fibers had samples with recycled carbon fibers with epoxy matrix. The mainly result from this testing is, that recycled carbon short fibers have same Young´s modulus like virgin carbon short fibers. Recycled carbon fibers are cheaper than virgin carbon fibers. For composites with short fibers are better and cheaper to use recycled carbon fibers.

The last graph we can write conclusion, that it is important to use correct method for produce of composites. The best Young´s modulus had samples with carbon fabric, which were impregnated. Young´s modulus of carbon fabrics which were bathed is lower, but the number is same like Young´s modulus for basalt and glass fabrics which were impregnated. Jute fabric isn´t good to use like reinforce element for composites with epoxy. Other samples had circa same numbers of Young´s modulus.

6 References

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