AP19680121 "Development of compositions of sand-polymer composite materials and technological support of their processing into machine-building products" – p.m. Yurchenko V.V.

Actuality

The project involves the production of products for machine-building and the construction industry, characterized by high profitability (high content of inexpensive filler and the use of thermoplastic polymer waste), increased operational characteristics (compressive strength at least 100 MPa).

Purpose of the project

The purpose of the project is to develop compositions of sand-polymer composite materials, modified with functional components, and technological support of their processing into machine-building products with an increased level of operational characteristics.

Expected and achieved results

Achieved results:

1) It has been established that SPC based on a mixture of polyolefins filled with quartz sand with a dispersion of filler particles in the range of 100...300 μm maintains an acceptable level of strength indicators at the uniaxial compression (at least 25 MPa), if the filler content does not exceed 75 wt.% when deformation of composite samples is not more than 5%.

2) Surface preparation of quartz particles slightly improves the interaction of the polymer binder with the filler, which is manifested in an increase in the compressive strength of the samples by 10-15%, as well as the impact viscosity by 10% within 70-75 wt.% of the content of the quartz filler. A positive effect was noted when introducing nanoparticles of silicon dioxide into the composition of PPK. When the nanomodifier content is no more than 0.1 wt.% (the so-called "doping additive"), an increase in compressive strength of SPC70 samples with treated filler particles is observed by 15% compared to the composition of the original composition.

2 articles published:

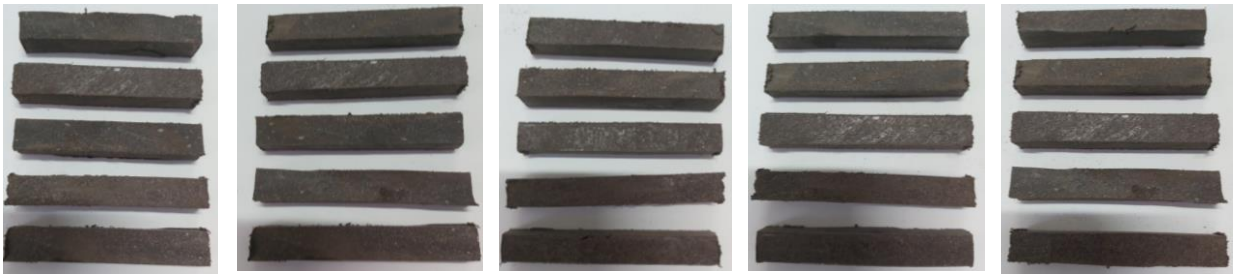
- Yurchenko, V.; Haiduk, V.; Skaskevich, A.; Zharkevich, O.; Zhetessova, G.; Reshetnikova, O.; Smagulov, A.; Mussayev, M. Study of Deformation and Strength Characteristics of Highly Filled Sand–Polymer Composites Based on Regenerated Thermoplastics. J. Compos. Sci. 2025, 9, 206. https:// doi.org/10.3390/jcs9050206 - indexed in the Science Citation Index Expanded database Web of Science (Q2) and having a percentile CiteScore in the Scopus database - 75%.

- Yurchenko V.V., Smagulov A.S., Reshetnikova O.S., Zharkevich O.M., Mussaev M.M. Investigation of Strength of Belt Conveyor Roller Bearing Shells //Material and mechanical engineering technology, No. 2, 2025. - KOKSONVO.

Expected results:

- the program of bench and industrial tests will be prepared and approved, the Act of implementation with the indication of recommendations for the application of the developed technology at the machine-building enterprises of Kazakhstan, Belarus and Russia will be prepared, the license agreements will be prepared. 2 articles will be published in peer-reviewed scientific publications indexed in the Science Citation Index Expanded and included in the 1st (first) and (or) 2nd (second) quartile of the impact factor in the Web of Science database and (or) having a percentile of CiteScore in the Scopus database of at least 65 (sixty-five). A patent will be obtained for the invention. A monograph will be published in English in a foreign publisher.

To determine the impact viscosity of sand-polymer composites, samples with different amounts of binder material were made.



a) b) c) d) f)

а) SPC 60; б) SPC 65; в) SPC 70; г) SPC 75; д) SPC 80

Figure 1 – Samples of composite materials for determination of impact viscosity indicators

As a result of testing SPC samples under uniaxial compression, the data were obtained within the limits of the fracture resistance of the studied composites (Figure 2).

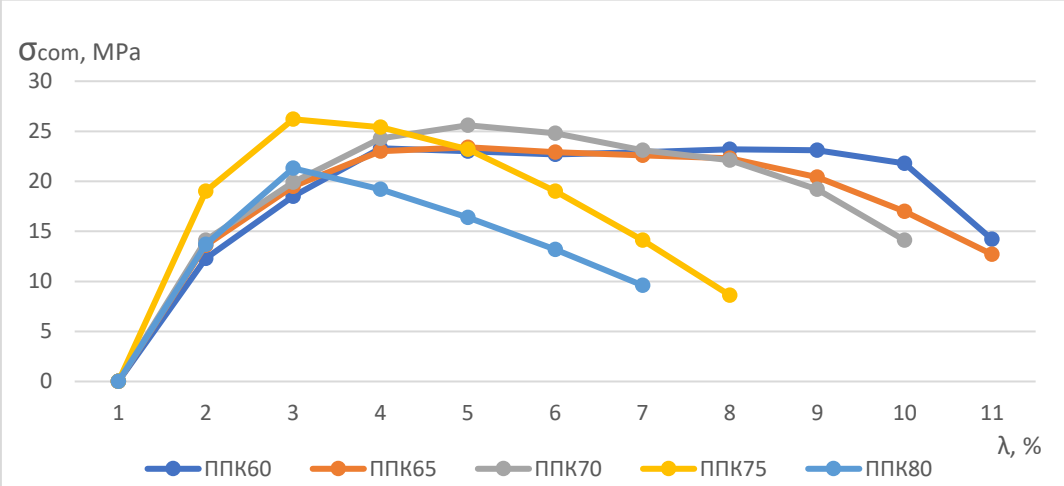


Figure 2 – Deformation-strength dependences during uniaxial compression of PPK samples filled with quartz filler in the range of 60...80 wt.%

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2. Tatyana Nikonova, Nataliya Val'ko, Aliaksandr Skaskevich, Andrey Kasperovich, Olga Zharkevich, Alexandra Berg, Gulnara Zhetessova, Essim Dandybaev. « Study of the Influence of X-ray Radiation on the Structure and Elastic-Strength Properties of Elastomers Based on Nitrile Bu-tadiene Rubber» в рецензируемом научном издании Polymers (MDPI) , индексируемом в Science Citation Index Expanded базы Web of Science (Q1) и имеющем процентиль CiteScore в базе Scopus – 81%.

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http://dx.doi.org/10.18796/0041-5790-2024-11-57-63 , having a percentile of CiteScore in the Scopus database - 33%.

4.Yurchenko, V.; Haiduk, V.; Skaskevich, A.; Zharkevich, O.; Zhetessova, G.; Reshetnikova, O.; Smagulov, A.; Mussayev, M. Study of Deformation and Strength Characteristics of Highly Filled Sand–Polymer Composites Based on Regenerated Thermoplastics. J. Compos. Sci. 2025, 9, 206. https:// doi.org/10.3390/jcs9050206 - indexable in the Science Citation Index Expanded database Web of Science (Q2) and having a percentile CiteScore in the Scopus database - 75%.

5. Yurchenko V.V., Smagulov A.S., Reshetnikova O.S., Zharkevich O.M., Mussaev M.M. Investigation of Strength of Belt Conveyor Roller Bearing Shells //Material and mechanical engineering technology, №2, 2025. – КОКСОНВО

Research group

Yurchenko V.V.	PhD, ass. professor, department TOMiS NPJSC "Abylkas Saginov Karaganda Technical University" h-index: 4; ORCHID 0000-0002-6543-1632 Scopus Author ID 57213756780
Zhetessova G.S.	d.t.s., professor department TOMiS NPJSC "Abylkas Saginov Karaganda Technical University" h-index: 5; Researcher ID: S-3369-2017; ORCID 0000-0001-6504-3405; Scopus Author ID 57219845188.
Reshetnikova O.S.	PhD, acting associate professor department TOMiS NPJSC "Abylkas Saginov Karaganda Technical University" h-index: 2; Researcher ID: S-3369-2017; Scopus Author ID 57201777271.
Zharkevich O.M.	c.t.s,professor department TOMiS NPJSC "Abylkas Saginov Karaganda Technical University" h-index: 8; Researcher ID N-9080-2017; ORCID 0000-0002-4249-4710; Scopus Author ID 55339344600.
Myssayev M.M.	PhD, associate professor department TOMiS NPJSC "Abylkas Saginov Karaganda Technical University" h-index: 4; Researcher ID: AAR-6997-2020; ORCID: 0000-0001-9875-8159; Scopus Author ID: 57220743851
Smagulov A.S.	Doctoral student of department TOMiS NPJSC "Abylkas Saginov Karaganda Technical University"
Kim A.S.	Engineer of machine tools with CNC CKiPR NPJSC "Abylkas Saginov Karaganda Technical University"
Altaybekova K.A.	Specialist DSandI departent TOMiS NPJSC "Abylkas Saginov Karaganda Technical University"

Information for potential users

The project involves the creation of polymer composite systems based on thermoplastic binders, as well as the use of quartz fillers to reinforce binders based on polymer and oligomeric components. The project is focused on the use of the available raw material potential, available to industrial enterprises of the Republic of Kazakhstan and the Republic of Belarus, without the use of imported components of composite polymer systems, including by involving in the production of regenerated polymeric thermoplastic materials based on household and industrial waste.

The target users of the obtained results of the project may be machine-building enterprises, mechanical parks of large and medium-sized enterprises in the mining industry, enterprises - producers of composite materials, enterprises specializing in the processing of secondary raw materials. The applicability of the obtained scientific results is also possible in scientific and project organizations, as well as in higher educational institutions, when teaching bachelors, masters and doctoral students.

Area of application

The field of application technology is quite extensive. Products made of composite materials have a high level of wear resistance and strength with their relative lightness and mobility. The technology implemented as a result can be applied to areas in mechanical engineering and construction, in the creation of military equipment, in cosmonautics and aviation, for the production of consumer goods.

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