The application of rapid prototyping in the studing of samples of filtering materials based on woven nets

Aliaksandr Ilyushchanka[1, 2], Iryna Charniak[2], Aliaksei Kusin [2], Vecheslav Kaptsevich[3], Ruslan Kusin[3], Nataliai Rutkovskaya[3], Dmitry Shamal[4],
State research and production powder metallurgy association[1] – Minsk, Republic of Belarus
State Scientific Institution “O.V. Roman Powder Metallurgy Institute” [2] – Minsk, Republic of Belarus
Belarusian state agriculture technical university [3] – Minsk, Republic of Belarus
"3D systems" [4] – Minsk, Republic of Belarus
E-mail: alexil@mail.belpak.by, irinacharniak@tut.by, 2312444@mail.ru, 19081877@mail.ru, info@additive.by

Abstract: *In the paper consider materials for the rapid prototyping (RP) of experimental samples of filtering materials with an orthotropic structure based on woven nets (FMWN) assembled together with test-form and with using of 3D printing. RP made it possible to reduce the labor intensity of the process, primarily by eliminating the operation of sealing samples when using a traditional test form, as well as making the test form and the samples themselves. The data obtained allowed us to conclude that the use of 3D-printing is promising in further work for the manufacture of test form for studying the properties of filtering materials.*
KEYWORDS*: FILTER MATERIALS, WOVEN MESH, 3D PRINTING, SAMPLES, RESEARCH, PROPERTIES*

1. Introduction

At this time, additive technologies have found application in various fields of the national economy, including in mechanical engineering, medicine, construction and others [1, 2]. Due to its advantages: the ability to quickly change the shape of manufactured parts, which makes it possible not only to quickly obtain prototypes, but also to make changes to the basic design in accordance with the wishes of a particular customer, high dimensional accuracy of manufactured products, the possibility of switching from mass production to mass customization (the possibility of satisfying as many individual customers as possible), the possibility of creating products with a complex shape or even impossible configuration in conventional production, significantly reduce the duration of the production cycle, the timing and cost of launching the product into production (due to the lack of need for specialized tooling), increase the material utilization rate, reduce greenhouse gas emissions by optimizing product design and reducing material losses, production mobility (the time from the moment of product design to the receipt of the finished part can be reduced from several weeks to several days) and accelerate data exchange – 3D printing is considered to be a breakthrough technology that can change industrial production in the foreseeable future [3, 4]. The achievements of computer technologies arouse interest in new methodologies and technologies for improving and accelerating the development of subjects, objects, and materials. Rapid prototyping is a promising direction in this area [5, 6].

Rapid prototyping is used for the manufacture of filter materials with an orthotropic structure based on woven meshes (FMWN) intended for scientific research.

The structure and advantages of these materials are described in [7]. The application of the method was caused by the complexity of the design, manufacture, assembly and disassembly directly in the process of determining the filtering characteristics of the samples: the main difficulty was the need to ensure the sealing of the sample on all the surfaces bordering the tooling. It should be noted that similar problems were solved by the authors [8] (Figure 1).

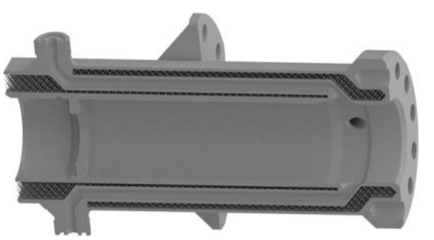

Fig. 1 *Example of the implementation of mesh structures in the design of a part*

The purpose of the work is to exchange experience in the use of rapid prototyping of filter materials with an orthotropic structure based on woven nets.

2. The results of the experiment and their discussion

3D – modeling and 3D – printing were used for the production of samples. The samples were produced on a 3D printer of the Uniz SLASH 2 model from a polymer material of the brand-the photopolymer Dentifix-3D Modeling HR. A model image of an experimental FMWN sample in the form of three projections is shown in Figure 2, a 3D model of one layer of an experimental sample made of woven mesh is shown in Figure 3. The technology of production of samples included the following stages. At the first stage, the FMWN was made with sealing along the contour at the border with the tooling (Figure 4), then the second part of the housing was made for supplying air or liquid, depending on the operation performed and connecting to the pressure gauge (Figure 5) and glued the tooling (Figure 6). The different stages of the process are shown in Figure 7, and the process of determining the size of pores is shown in Figure 8.

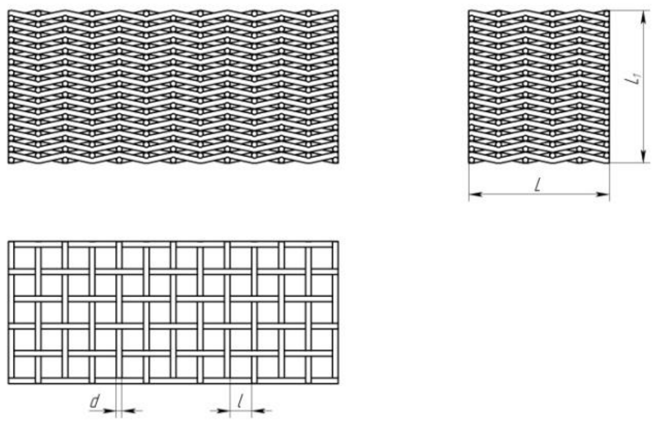

Fig. 2*. Model image of the experimental sample*

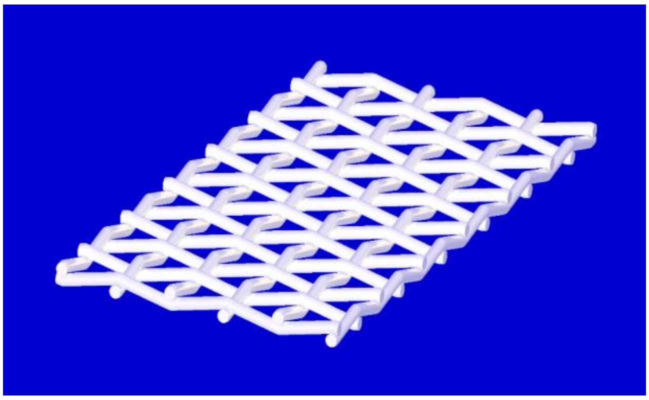

Fig. 3. *3D model of a woven mesh layer for the production of an experimental sample FMWN*

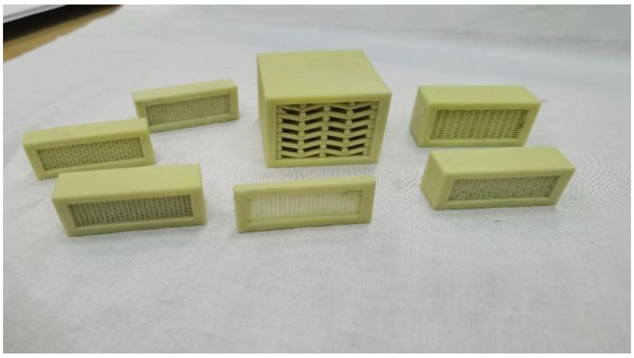

Fig. 4. *Physical appearance of samples from FMWN made with a part of the housing*

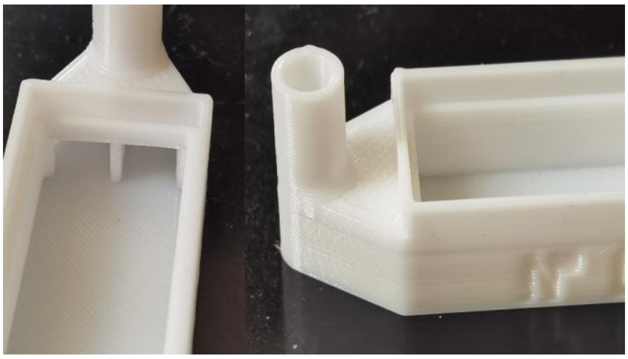

Fig. 5. *Photos of the lower part of the housing for the supply of technological media and connection to the pressure gauge*

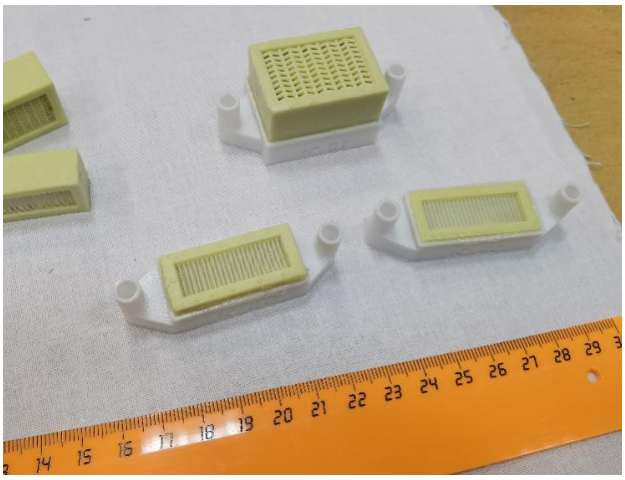

Fig. 6. *Physical appearance of the samples in the assembling*

Fig. 7. *Different stages of the sample production process*

Fig. 8. *The process of determining the size of pores*

The samples made it possible at the initial stage of research to establish the relationship of pore sizes, filtration fineness, permeability coefficient from the characteristics of woven meshes (wire diameter and cell size in light) and the thickness of the filter layer. The use of 3D modeling and 3D printing in the production of experimental samples has reduced the complexity of the process, especially in terms of sealing samples before measurements, as well as production equipment and samples themselves. In addition, the experience gained allowed us to conclude that it is promising to use the 3D printing method in the future for the production of equipment for studying the properties of filter materials

Conclusion

The materials on rapid prototyping of experimental samples of filter materials with an orthotropic structure based on woven meshes (FMWN) assembled with equipment using 3D printing are presented, which made it possible to reduce the complexity of the process, first of all, sealing the samples before measurements, as well as production the equipment and the samples themselves. The experience gained also allowed us to draw a conclusion about the prospects of using 3D printing in the future for the production of equipment for studying the properties of filter materials. The disadvantages that should be taken into account in the future (for example, by introducing correction coefficients) you can include the fact that it is impossible to take into account the influence of deformation of mesh layers on the properties of FTWN during the study

3. References

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