

Some Specific Features of the Construction of Working Bodies Used in Machines Producing Parts from Composite Materials

Vagif Abbasov
doctor of technical sciences,
Azerbaijan Technical University,
prof. const.
Baku, Azerbaijan
vaqif.abbasov@aztu.edu.az
0000-0002-4633-6728

Shovgi Asadov
doctor of technical
sciences, Azerbaijan Technical
University, dost. Baku,
Azerbaijan
shovqi.esedov@aztu.edu.az
0009-0006-6228-4469

Chingiz Mammadov
doctor of technical sciences,
Azerbaijan Technical University,
dost. Baku, Azerbaijan
cingiz.memmedov@aztu.edu.az
0009-0003-3673-2609

Amrah Babayev
Ministry of defence industry of the
republic of azerbaijan Baku,
Azerbaijan cingizov@aztu.edu.az
0000-0002-4554-6985

Rauf Mammadli
Ministry of defence industry of the
republic of azerbaijan
Baku, Azerbaijan
memmedov@aztu.edu.az
0000-0002-1544-3897

Abstract: The article examines and analyzes some specific features of the working bodies in machine tools used for the production of high-quality products of machine parts made of composite materials with high precision geometric dimensions. In addition, the article analyzes the main structural elements of the worm screw head in the production of precision machine parts made of composite materials, taking into account the thermal and kinematic parameters of the worm screw design, the effect of the direct flow heads on the rotation speed. In addition, the article analyzes the main factors affecting the increase in productivity during the production process, the mathematical expression of the dependence of thermal and kinematic factors on each other, and compares the effect of maintaining a constant spray pressure, which is the main factor of the product quality indicator, on the friction coefficient and inclination angle of the screw and nozzle head.

Keywords: *endless screw, straight-flow nozzle, endless screw heads, composite material, screws, kinematic parameters, processing parameters, inclination angle*

I INTRODUCTION

Currently, one of the main reasons and the most important for obtaining quality products in the production of machine parts made of composite materials with high geometric dimensions is the correct selection of technological equipment in accordance with the production requirements in this

field and maintaining processing parameters at a high level. For this purpose and according to the technological characteristics of production, the equipment selected and constituting the production advantage is mainly thermoplastic automatic machines, extrusion machines and equipment, which are widely used in the mass and serial production of precision machine parts from composite materials. (Figure1)



Fig. 1. Thermoplastic automatic machine

In modern times, the main reason for the inability of precision machine parts made of composite materials to withstand the effects of many chemical, biological and physical factors - heat, light, radiation, oxygen, humidity, aggressive chemical and biochemical, reagents, mechanical stresses, etc. during processing, storage and operation is the sharp increase in the number of by-products released during their production, which directly depends on the design of the main working production organs of the machine

tools that produce the product. In this regard, the design of the main working production organs of the machine tools that produce the product is required to be selected in accordance with the principle of the technological operating mode of the screws, nozzles and their structures.

II DESCRIPTION OF THE PROCESSING SYSTEM

One of the necessary and main characteristics of the screws is the variety of the degree of compression of these structures, which directly affects the quality indicators of the released product. At the same time, the degree of compression is characterized by a change in the volume of the screw, especially near the hopper and at the end of the screw. In this case, the degree of compression for the extrusion of molten composite material varies from 1: (2.5-4). The scheme below shows screws of different designs depending on the degree of compression. (Fig. 2.a, b,c,d,e)

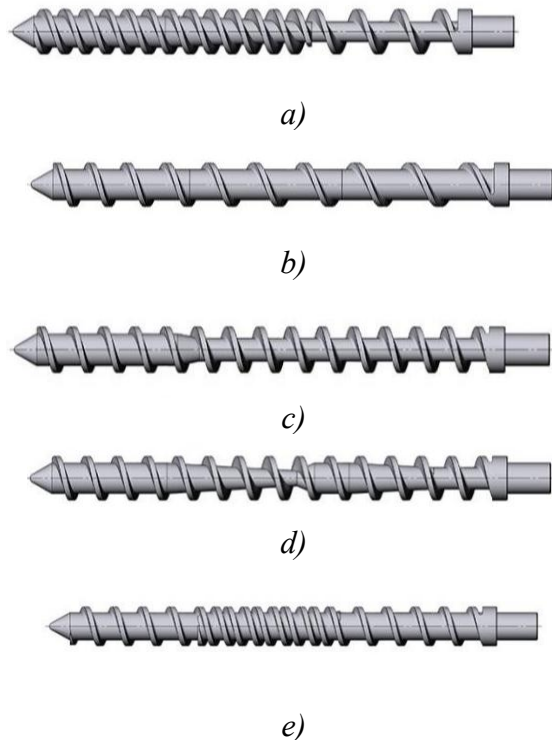


Fig. 2. Screw designs:

- a) Endless screw with a conical core, b) Endless screw with a short compression zone, c) Endless screw with reduced pitches, d) Endless screw with a dosing zone, e) Endless screw with vacuum suction

Of the screws shown in Figure 2, the most commonly used design in production and operation is the endless

screw screw with a short compression zone, some specific features of which have been determined by analyzing it in this article. These screws mainly consist of three zones: the loading zone, compression and dosing zones, the scheme of which is shown in Figure 3.

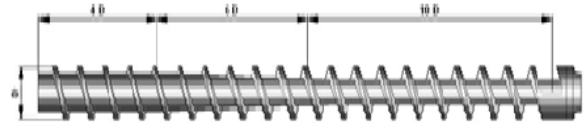


Figure 3. An endless screw with a short compression zone.

Here, in the loading zone, the raw composite material is transported from the hole at the bottom of the hopper to the hotter sections of the cylinder. In the compression zone, the volume between the screws of the endless screw decreases, which causes the molten composite raw material to be compressed, as a result of which the displacement becomes easier, the temperature T increases as a result of friction, and an even distribution of the temperature T in all directions in the molten composite is ensured. It should be noted that part of the temperature required for the melting of the composite material, T_1 is provided by friction during the displacement of the alloy, and the other part, T_2 , is provided by the heaters of the cylinder. Then the total temperature of the alloy composite material is calculated as $T_u = T_1 + T_2$.

III PERFORMANCE IMPROVEMENT

In the last dosing zone of the screw, the melting and pelletizing process of the composite material is completed, the finished mass dose passes through the forming head and moves towards the nozzle, where it is sprayed into the mold through a straight-flow nozzle. The nozzle, being considered the most important executive body of all pressure casting machines, fully ensures the shape and quality indicators of the product obtained (Figure 3)

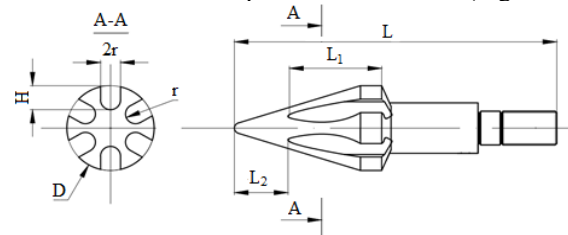


Fig. 4. Straight-flow nozzle used in augers

Nozzles are diverse and numerous in terms of type and design, the technological material of this element of the equipment, unlike the material of the screw, is made of copper, bronze or brass, which ensures that the temperature in the element is maintained constant.

According to the amount of pressure, nozzles are divided into low pressure heads up to 4 MPa, medium pressure heads up to 10 MPa, and high pressure heads above 10 MPa.

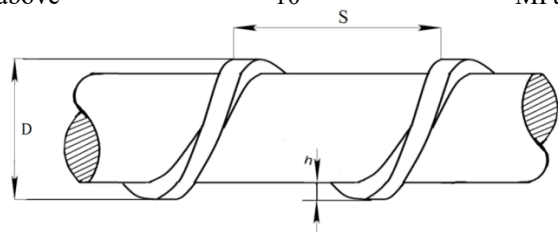


Figure 5. Profile of the screw channel of a worm screw
As a result of the friction of the molten composite liquid against the cylinder, the pressure of the alloy at the end of the screw increases and the standard number of revolutions of the screw varies between 20-100 revolutions/min.

The pitch of the screw of the screw S and the depth of the screw thread h significantly affect the productivity of the machine during the technological process. The value of the friction coefficient of the molten raw material to the screw varies between 0.3-0.6. Since the value of the friction coefficient of 0.5 corresponds to the angle of inclination of the screw screws of 19° , this value is considered favorable from a technological point of view. The screw torque M significantly affects the degree of compression during the technological process.

The speed of advancement of the screw in the channel of the cylinder during the spraying of the composite material is expressed by the following formula:

$$V = \pi D n / h$$

$\pi = 3.14$; D -screw diameter, mm; n -screw revolutions, rpm; h -screw channel depth, mm. (Figure 5)

Modern machines for manufacturing parts from composite materials are equipped with electronic sensor devices that determine the nominal values of temperature and pressure, which are placed at several critical points on the wall of the heating cylinder and the nozzle. In addition, computers equipped with special software are used to maintain the screw speed, the temperature of the molten composite raw material and the injection pressure stable and under control during the technological process.

IV CONCLUSION

The designs of the working bodies used in machines that produce parts from modern composite materials should be selected in such a way that it is possible to regulate the pressure of the molten composite mass in the technological process, which ensures that the finished product obtained with the resulting pressure is formed to the required standard.

REFERENCES

- [1] Əliyev İ.Z., Musayev S.A., Əliyev N.İ., Ağacanov R.Q. Plastik kütlələrin sintezi və analizi. Dərs vəsaiti. Bakı - 2016, 316 s.
- [2] Ə.G. Hüseynov, İ.Ə. Nəzərov, Ş.N. Əsədov, E. Bağiyev. "Detalların konstruksiyası və onların hazırlanmasına texniki tələblərin araşdırılması". "Mütərəqqi texnologiyalar və innovasiyalar" mövzusunda IX Respublika ETK, 1-2 may 2024, səh. 1034-1040.
- [3] Məmmədov Ç.M., Əsədov Ş.N. Kompozitdən olan dəqiq hissələr istehsalı ekstruder maşınlarının texnoloji xüsusiyyətləri. "İnşaatin müasir problemləri" mövzusunda Beynəlxalq elmi – praktik konfransın elmi əsərlərinin toplusu. Bakı, 24 noyabr 2023-cü il, səh 328-331.
- [4] Гусейнов А. Г., Аббасов В.А., Асадов Ш.Н., Мамедов Ч. М. Основная роль и значение выбора технологического оборудования при производстве прецизионные детали из композиционного материала. Conference: d Resource Saving Technologies: Experiences and Prospects». April 18, 2024 - Kyzylorda: Korkyt Ata KU, 2024- Pp.329-337..
- [5] Чингиз Мирзаммад оглы Мамедов. "Некоторые характеристики экструзионных машин для изготовления деталей из полимерных материалов". 2-я Международная научно-практическая конференция молодых ученых, аспирантов, магистров и бакалавров «Технологии, машины и оборудование для проектирования, строительства объектов АПК». Россия, г. Курск ст. 97- 102, 14 марта 2024.
- [6] Гусейнов А. Г., Аббасов В.А., Мамедов Ч. М., Асадов Ш.Н. Основная преимущества выбора шнеков при производстве прецизионные детали из композиционного материала термопластавтоматам. "Mütərəqqi texnologiyalar və innovasiyalar" mövzusunda IX Respublika ETK, 1-2 may 2024, səh. 974-979.
- [7] Гусейнов А. Г., Аббасов В.А., Мамедов Ч. М., Асадов Ш.Н. "Технологические особенности производства прецизионных деталей машин из композиционного материала методом экструзии". ВЕСТНИК Азербайджанской Инженерной Академии Международный научно-технический журнал. 2024, Том 16, No1, ст.31-36.