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Comparative Aspects of the Temporal Characteristics of the Production of Various Plastic Products

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Plastic has a special place in the manufacture of various products. Production of plastic products consists of several stages. Each stage has its own time characteristics. Thus, the duration of the production of plastic parts depends on the individual stages. A comparative analysis of the time aspects of the formation of various plastic products showed that the duration of the molding process is affected by the holding time under pressure, the time of pauses.

***Keywords**: simulations, plastic products, production stages, casting cycle, injection molding*

1. Introduction.

Plastic is an organic material that has a number of useful properties. Therefore, plastic products are widely used in various fields of human activity. Plastic products used in construction, engineering, medicine, for the manufacture of various objects of human life [1–3].

For the manufacture of various plastic products it is necessary to use a special technology. One example of such technology is injection molding [1, 4]. More than a third of the total plastic products volume is produced by injection molding.

Production lines for the production of plastic products are inexpensive. Within the shortest time, you can change the entire range of products. The duration of the molding process of plastic products is one of the most important parameters of the technological process of injection molding. Therefore, a key parameter in the production of plastic products is time. Also important is the generalization of temporal characteristics for different plastic products.

Thus, the main purpose of this study is to compare the temporal characteristics of the production of various plastic products.

2. Material and methods.

The duration of the molding process will be understood as the casting cycle of a plastic product. The plastic casting cycle includes the time to complete [5]:

– Mold closure,

– Approach and squeeze the injection unit to the sprue bushing,

– Injection of the plasticized weight in a mold,

– Hold under pressure,

– Mold cures or cooling process,

– Withdrawal of an injection unit,

– Mold opening and an finished product expulsion in the tray attached to the bed.

The sequence of such operations depends on the selected mode of operation of the equipment. In general, this determines the duration of the molding process for a plastic product.

Many options for the duration of the process of molding plastic products may consist of different subsets [6]:

$$\tau_{lm} =< \tau_{m_i^j}, \tau_{hup_i^j}, \tau_{cool_i^j}, \tau_{e_i^j} >, \quad (1)$$

$$\tau_{m_i^j} =< \tau_{clo_i^j}, \tau_{spr_i^j}, \tau_{ope_i^j}, \tau_{p_i^j}, \tau_{sn_i^j}, \tau_{plu_i^j}, \tau_{smc_i^j} >, \quad (2)$$

where

$\tau_{m_i^j}$ – machine time;

$\tau_{hup_i^j}$ – hold time under pressure;

$\tau_{cool_i^j}$ – time of a mold cooling;

$\tau_{e_i^j}$ – extraction time of a product from a matrix;

$\tau_{clo_i^j}$ – time closing the mold;

$\tau_{spr_i^j}$ – injection time of a plastic material melt in an mold;

$\tau_{ope_i^j}$ – time opening the mold;

$\tau_{p_i^j}$ – pause time (mold service);

$\tau_{sn_i^j}$ – "course" time of a nozzle (supply);

$\tau_{plu_i^j}$ – "course" time of a plunger / screw;

$\tau_{smc_i}^{j}$ – estimated time of melt stay in the cylinder;

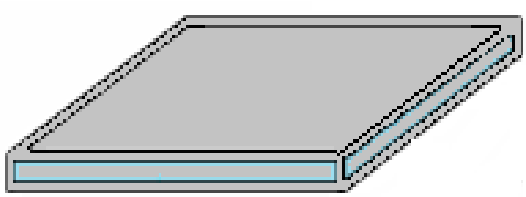
i – number of formation process, $i = 1,..., I$;

j – type of the formed plastic product $j = 1,..., J$.

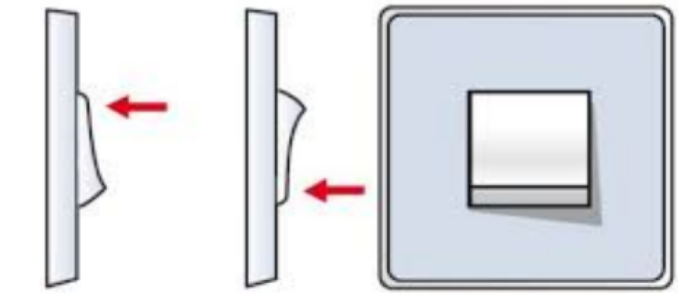
Model in accordance with formulas 1 and 2 helps to make a comparison of the temporal characteristics of the production of various plastic products.

3. Results and discussions.

We will consider various plastic products (Figure 1).



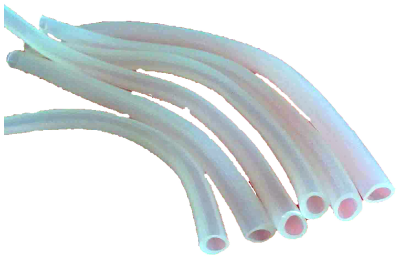
a) first product



b) second product

Figure 1. Various plastic products

c) third product



d) fourth product

Figure 1. Various plastic products

The first product (Figure 1a) is a flat rectangular plate. For formation of this product one-gating mold is offered. The material of the product is polystyrene & rubber. This material has a high impact resistance.

The second product (Figure 1b) is the base and the slider for the light switch. For formation of this product one-gating mold is offered. The material of the product is atsetiltsellyulozny etrol. This material has strength, transparency, light resistance, difficult flammability and low flammability.

The third product (Figure 1c) is the filter housing. The material of the product is polystyrene block grades D and T. This material is used for high-frequency insulation products. This material is water resistant, has high mechanical strength. For formation of this product one-gating mold is offered.

The fourth product (Figure 1d) is an insulating tube. Product material – polymonochlorstyrene filled. For formation of this product one-gating mold is offered.

Table 1, Table 2 and Table 3 shows: stages of the formation of each plastic product using injection molding, time characteristics of each stage of the formation of the product (the parameters that display the time are seconds).

Table 1. The values of the main parameters, which form the molding process duration (first product)

№	Parameter	Designation	Value
1	Product weight (gr.)	m	19
2	time of the melt in the cylinder	τ_{smc}	2
3	time closing the mold	τ_{clo}	2

4	time plunger forward	τ_{pluf}	27
	time of hold under pressure	τ_{hup}	
5	time of turn, a plunger back	τ_{plub}	2
6	time of a pause	τ_{p}	3
	time of a mold opening	τ_{ope}	
7	cooling temperature	τ_{cool}	–
8	time of extraction of a product from a matrix	τ_{e}	1
9	formation process duration	τ_{fpd}	37

Table 2. The values of the main parameters, which form the molding process duration (second product and fourth product)

№	Parameter	Designation	Value	
			second product	fourth product
1	Product weight (gr.)	m	15	4.8
2	time of the melt in the cylinder	τ_{smc}	1	1
3	time closing the mold	τ_{clo}	2	2
4	time plunger forward	τ_{pluf}	25	6
	time of hold under pressure	τ_{hup}		
5	time of turn, a plunger back	τ_{plub}	2	2
6	time of a pause	τ_{p}	35	3
	time of a mold opening	τ_{ope}		
7	cooling temperature	τ_{cool}	–	–
8	time feeding nozzle;	τ_{sn}	3	1
9	time of extraction of a product from a matrix	τ_{e}	1	1
10	formation process duration	τ_{fpd}	69	15

Table 3. Values of the main parameters, which form the molding process duration (third product)

№	Parameter	Designation	Value
1	Product weight (gr.)	m	20
2	time of the melt in the cylinder	τ_{smc}	1

3	time closing the mold	τ_{clo}	2
4	time plunger forward	τ_{pluf}	25
	time of hold under pressure	τ_{hup}	
5	time of turn, a plunger back	$\tau_{p\,lub}$	2
6	time of a pause	τ_{p}	20
7	time of a mold opening	τ_{ope}	2
8	cooling temperature	τ_{cool}	3
9	time feeding nozzle	τ_{sn}	2
10	time of extraction of a product from a matrix	τ_{e}	1
11	formation process duration	τ_{fpd}	58

In Figure 2 shows a diagram of the process of forming each plastic product, which we consider. The charts also show the temporal characteristics,[7]. This allows you to compare the temporal characteristics of the production of various plastic products.

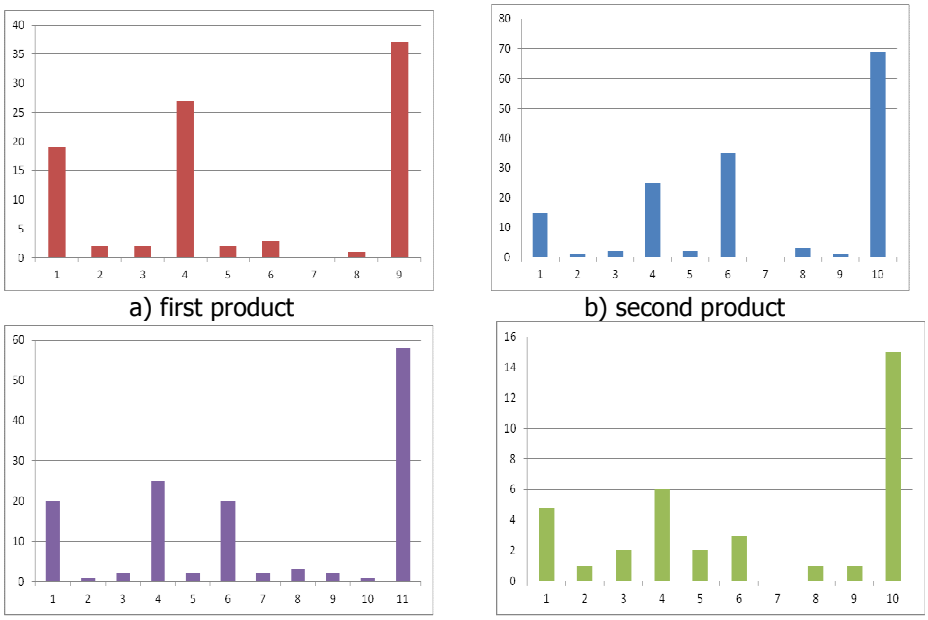


Figure 2. Diagrams of the formation of various plastic products

We can say that the duration of the molding process is affected by the holding time under pressure, the time of pauses.

4. Conclusions

In this study, we examined the problems of the formation of plastic products. We have shown that the time factor is important in the manufacture of plastic products. The duration of the production of plastic parts depend on individual stages. We have identified the main stages of the formation of plastic products. We conducted a comparative analysis of the time aspects of the formation of various plastic products. It has been shown that the duration of the molding process is affected by the holding time under pressure, the time of pauses.

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