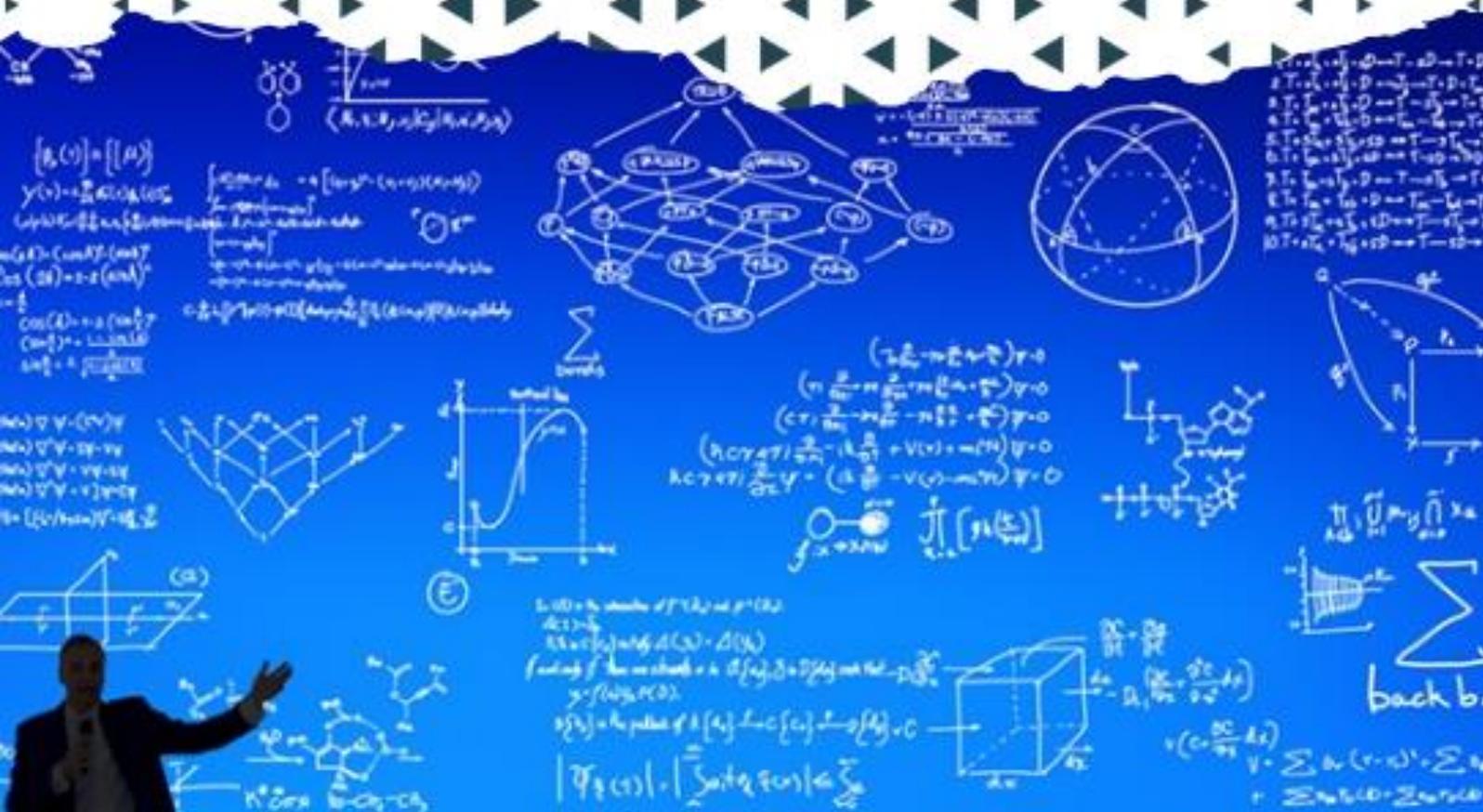




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## PRODUCTION OF AUTOMOTIVE POLYMER COMPONENTS UNDER PRESSURE AND ANALYSIS OF THEIR PHYSICAL PROPERTIES

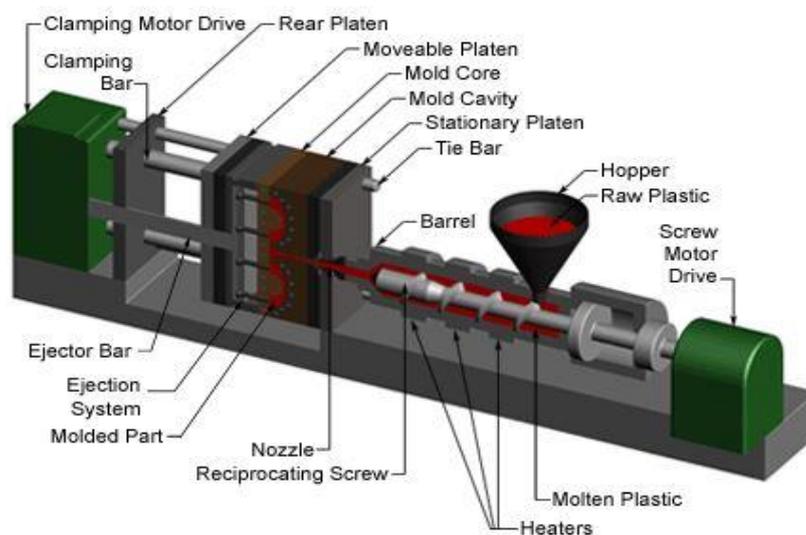
**Almataev Nozimbek**

Lecturer of Andijan State Technical Institute

E-mail: [nozimalmataev@gmail.com](mailto:nozimalmataev@gmail.com)

Purpose of the Work is to determine the physical state of automobile polymer parts produced under pressure using locally sourced polymer materials. As noted in [1-2], during the production of products from polymer materials, material waste does not exceed 5–10%, whereas in metal part production, it can reach 60–70%. Products made from polymer materials have lower friction and easier processing compared to metal ones. Moreover, the production cost of polymer parts is two to three times cheaper than that of metal parts.

A required amount of polymer composition is poured into the hopper of the injection molding machine. The polymer composition is fed into the material cylinder of the machine and heated for 30–40 minutes to a temperature of 220–240 °C. The polymer composition, heated up to 240 °C, is then injected into a mold preheated to 80–100 °C.



**Figure 1. Thermoplastic injection machine**

When the piston of the injection machine moves from right to left, the molten polymer composition is forced out of the cylinder and fills the mold. The temperature of the molten composition should be **20 °C above its melting point**, the **injection pressure** should be **30–35 MPa**, and the **holding time under pressure** should be **20–30 seconds**. After this, the pressure is released, and the mold is opened. The part is removed, flash is cleaned, any excess material is trimmed, and the part is allowed to cool in air to room temperature. Some parts undergo **thermal treatment**: they are heated in an oil bath to **120–130 °C** for **1,5–2 hours**, then cooled together

with the oil to **110 °C**, and finally cooled in open air to room temperature. After injection under pressure, the **dimensions of the polymer parts should be checked after 24 hours**.

The injection molding method provides **high work efficiency**, and it is possible to obtain the required dimensions without additional processing. However, the **need to prepare a separate mold for each part** and the **relatively weak adhesion of the polymer layer to the part surface** are considered drawbacks of this method.

In the production of automobile parts from polymer materials under pressure, the **holding time of the pressure** and the **temperature of the mold** play a crucial role.

Analysis of the experimental results shows that, as the holding time increases, the pressure force also increases. However, if the holding time exceeds **15–20 seconds**, the magnitude of the applied load begins to decrease.

The **maximum load** was observed in polyamide, while the **minimum load** was observed in polyethylene. This is related to the **physical and mechanical properties** of these materials and their **structural composition**. From this, it can be concluded that among polymer materials, **polyethylene fills the mold under pressure more easily than other polymers**, and it does not require a high force for molding.

An **increase in mold temperature** leads to an increase in the relative load. However, if the mold temperature exceeds **60–70 °C**, the magnitude of the relative load begins to decrease. This is due to the **different responses of the physical and mechanical properties of polymers to temperature**. That is, as the mold temperature increases, the polymer material flows into the mold more easily in a molten state, resulting in **better filling of the mold cavity** and **higher quality of the molded part**.

When the mold temperature decreases, the polymer material tends to solidify during the molding process, resulting in **incomplete filling of the mold cavity** and **poor quality of the molded part**. Among the polymers tested in the experiment, **polyethylene showed the best results** in this regard.

**Conclusion:** In the production of parts by injection molding under pressure, the **maximum load** was observed in polyamide, while the **minimum load** was observed in polyethylene. Among polymer materials, **polyethylene fills the mold under pressure more easily than other polymers**, and it does not require a high force.

That is, as the mold temperature increases, the polymer materials flow into the mold more easily in a molten state, resulting in **better cavity filling** and **higher quality molded parts**. Conversely, a decrease in mold temperature causes the polymer to solidify during molding, leading to



**incomplete mold filling and lower part quality.** Among the polymers tested, **polyethylene demonstrated the best performance** under these conditions.

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