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Technologies for Manufacturing Parts from Polymer Materials Used in Motor Vehicles

Almataev Nozimbek

DSc candidate of Andijan state technical institute

E-mail: nozimalmataev@gmail.com

Annotatsion. This study investigates the technologies currently used in the manufacturing of plastic components for motor vehicles and examines the processes through which these technologies are implemented.

Keywords: polymer, polypropylene, advantage, mold, thermal, environmental

Introduction. Modern automotive manufacturing extensively utilizes polymer materials. The main reasons for their widespread application include their low weight, corrosion resistance, excellent technological properties, and the ability to reduce production costs. In modern vehicles, approximately 10–20% of the total vehicle mass consists of components made from various polymer materials. The use of polymers contributes to weight reduction, improved fuel efficiency, enhanced corrosion resistance, reduced vibration and noise levels, lower manufacturing costs, greater design flexibility, and improved environmental performance.

Currently, the following polymer materials are widely used in the production of plastic automotive components:

- Polypropylene (PP);
- Polyethylene (PE);
- Polyvinyl Chloride (PVC);
- Polyamide (PA);
- Polycarbonate (PC);
- Acrylonitrile Butadiene Styrene (ABS);
- Polyurethane (PU);
- Glass Fiber-Reinforced Composites;
- Carbon Fiber-Reinforced Composites.

Main Technologies for Manufacturing Polymer Components

1. Injection Molding

Injection molding is particularly suitable for producing large quantities of high-quality plastic parts with consistent dimensions and excellent surface finish, making it one of the most important manufacturing technologies in the automotive industry.

The process consists of the following stages:

1. Polymer granules are heated until they melt.
2. The molten material is injected into a mold under high pressure.
3. The material is cooled and solidified.
4. The finished part is ejected from the mold.



Advantages:

- High dimensional accuracy;
- Ability to produce complex-shaped components;
- High production efficiency;
- Suitable for mass production.

Applications:

- Bumpers;
- Instrument panel components;
- Housing covers and body panels;
- Electrical equipment housings.

2. Extrusion Technology

Extrusion technology is widely used in the automotive industry for manufacturing long, continuous plastic components that require consistent dimensions and high production efficiency. It is particularly suitable for producing profiles, seals, and protective coverings used in vehicle assemblies.

Advantages:

- Continuous production process;
- High productivity;
- Minimal material waste.

Applications:

- Pipes and tubes;
- Cable insulation and coverings;
- Profiles for doors and windows;
- Sealing and gasket elements.

3. Blow Molding

This method is used for manufacturing hollow products.

Technological process:

- The polymer is formed into a tube-like shape;
- Compressed air is introduced inside the mold;
- The material expands and conforms to the mold walls, forming the final shape.

Applications:

- Fuel tanks;
- Coolant reservoirs;
- Air ducts.

4. Thermoforming

Thermoplastic sheets are heated until they become soft and then shaped into the required form using a mold.

Advantages:

- Low mold cost;
- Ability to produce large-sized products.

Applications:



- Interior trim components;
- Trunk (luggage compartment) parts;
- Decorative panels.

5. Compression Molding

This method is mainly used for thermosetting polymers and composite materials.

Process:

- The material is placed into a mold;
- It is shaped under the influence of pressure and heat;
- The polymerization (curing) process is completed.

Applications:

- Composite body components;
- Electrical insulating parts.

6. Additive Technologies (3D Printing)

In recent years, the use of 3D printers in the automotive industry has been rapidly developing.

Main technologies:

- FDM (Fused Deposition Modeling);
- SLA (Stereolithography);
- SLS (Selective Laser Sintering).

Advantages:

- Rapid prototyping;
- Production of customized components;
- Reduced material consumption.

Applications:

- Experimental prototypes;
- Custom-made parts;
- Spare components.

Summary.

The use of polymer materials in motor vehicles makes it possible to reduce vehicle weight, improve fuel efficiency, and lower production costs. Injection molding, extrusion, blow molding, thermoforming, compression molding, and additive manufacturing are considered the main methods for producing polymer components. In the future, the development of composite materials and 3D printing technologies is expected to further increase the share of polymers in the automotive industry.

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