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RAW MATERIAL TRANSMISSION SYSTEM IN THERMOPLAST AUTOMATIC MACHINES

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ABSTRACT: The share of products and raw materials made from plastic masses is increasing globally in packaging, automotive, construction, medicine, agriculture, and many other sectors. This increases the demand for products made from plastic masses and requires faster and higher-quality production of raw materials. Increasing production efficiency, reducing labor costs, and stabilizing quality through the automation of the raw material transfer system in thermoplastic machines is relevant. This article examines the issues of achieving efficiency through the automation of the raw material feed system in thermoplastic machines.

KEYWORDS: Plastics, thermoplastic machine, transmission system, control and measuring instruments, specification, raw materials, reliability, automation.

INTRODUCTION: Today, the demand for plastic products is growing day by day. Plastic products account for 60-80% of household items. In addition, plastic products are widely used in mechanical engineering.

At the current stage of production development, the use of leading technologies is aimed at achieving the upper limit of the operational characteristics of designed and applied devices, while simultaneously reducing various production losses and improving the quality of manufactured products. The use of high-quality and highly reliable components of automated control systems allows for improved product quality[1].

All this creates a need for large-scale production of plastic products - optimization of the automatic operation of the machine for the production of plastic products leads to an increase in the efficiency of the machine for the production of plastic products, the ability to control and manage parameters in real time, accuracy, optimal dimensions, and a reduction in energy consumption.

Plastic is a material that can be easily molded and processed by heating and cooling. It can be made from artificial and natural polymers. Plastic can be hard or flexible, transparent or opaque, colored or colorless, and has different properties such as impact resistance, chemical resistance, strength, etc. Plastic products are widely used in various fields, such as packaging, medicine, automotive, electronics, household appliances, cosmetics, and others. Due to their lightness, strength, convenience, and low cost of production, plastic products have become very popular, replacing many traditional materials, such as metal, glass, and wood. However, plastic also has some drawbacks, such as the inability to biodegrade, which leads to environmental pollution. Therefore, now the world is actively searching for new ways to process plastic and replace it with more environmentally friendly materials.

METHODS: The raw material feed system for thermoplastic machine tools is a system that can control the parameters of raw materials for thermoplastic machine tools. From the parameters of raw material quantity, feed rate, power consumption, temperature, flow rate, level, raw material composition, and viscosity in the thermoplastic machine, I selected the temperature and raw material quantity. When selecting equipment, it is necessary to consider the parameters of the controlled and external environment, the dimensions and characteristics of the control object, the distance between the measurement point and the secondary instrument, the availability of power sources, and other factors. In addition, such requirements for automation tools as accuracy, sensitivity, inertia, as well as ensuring occupational safety conditions must be met. To facilitate system maintenance and reduce the number of backup tools, it is advisable to use fixed tools (manufactured by the same enterprise, single information system tools).

Control and measuring instruments must meet technological requirements corresponding to the limit value of the controlled parameter of the object:

• instruments with a standard recording area width of 250 mm, belonging to the accuracy class of 0.2, are used for control and adjustment of production processes requiring a high level of accuracy (error ±0.2%);

• for monitoring, measuring, and adjusting production processes requiring medium accuracy, instruments with a standard recording area width of 160 mm, belonging to the accuracy class of 0.5, are used (with an error of ±0.5%);

• mnemonic diagrams of automatic control systems, steering wheels, as well as instruments with a standard recording area width of 100 mm, belonging to accuracy class 1, are used in cases where high accuracy is not required in control and signaling systems (±1% error).

The scales of indicating and self-recording instruments should be chosen so that the necessary values of the measured quantities are located in the second or last third part of the scale; in some cases, it becomes necessary to use several instruments with different scales to control one quantity in different operating modes. When selecting control and measuring instruments, their inertia must be considered; in this case, the instrument's inertia should be less than the object's.

For the selection of automation tools, a specification for control and measuring instruments and automatic means (KIP I A) was first compiled. It shows selected primary converters, sensors, secondary instruments, microprocessor tools, cable products, lighting fittings, shields and control panels, control buttons, and regulating equipment. In this case, all control and measuring instruments and automation tools used in the project are listed sequentially by position.

RESULTS:

The devices presented here were studied for operation and installation, and selected for the process depending on the operating condition.

Figure 1. WIKA TR10-C raw material temperature measuring device
Sensor Material - Platinum (Pt)

Resistance at 0°C - 100 ohms
Measurement range - from -200°C to +600°C
Accuracy - ±0.1°C ~ ±0.3°C (according to EN 60751, class A or B)
Production Standard - DIN EN 60751 (standardized)
Response time - 0.5 ~ 3 seconds (depending on the model)
Signal type - Resistance (ohm) → analog signal (converted to 4-20 mA or 0-10V)
Connection type - 2, 3 or 4 wire [17].
WIKA TR10-C was chosen for measuring raw material temperature because this device's functions are very limited, operating time, and quality is good in every aspect, so I chose this device.

Figure 2. AIR 72 B6 Asinxron engine.
Power: 0.55 kW;
Rotation frequency (speed): 1000 rpm (6 poles);
Power supply voltage: 220/380 V is required;
Frequency: operates at a frequency of 50 Hz;
Operating mode: S1 operates in continuous mode;
Nominal current: 1.8 A (at 380 V) of current is required;
Level of protection: there is an IP54 dust and water spray protection system[4].

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Figure 3. Vacuum pump.
Power consumption: 370 W (0.37 kW);
Voltage: 220 V, operating voltage 50 Hz;

Maximum pressure: 32 m (3.2 bar) can create pressure;

Security level: IP44 has a security level[17].

Figure 4. Nexon FGR200 Flow Sensor.
Accuracy: ±0.5% by measurement
Repetition accuracy: ±0.1% from measurement
Viscosity resistance: higher than 20 cSt
Output signal: Pulse, 4-20 mA analog or 0-10 V analog (by order)
Pressure resistance: up to 400 bar (depending on the material)
Measurement range: from 0.006 L/min to 450 L/min (depending on the model) [17].

Figure 5. Omran E2B-M18KS08-WP-B1
Working distance: 20 cm - has a measurement distance of 2 m;
Operating voltage: 24V DC voltage is required;
Output: equipped with an output signal NPN/PNP/4-20 mA/RS485;
Body: equipped with an IP67 protection system;
Advantages: Works without contact, dust-resistant[6].

Figure 6. Mitsubishi FX5U PLC
Nominal voltage: 24V DC voltage;
Supply tolerance: tolerance from -20% to +10%;
Internal flow consumption: 65 mA / 24V DC power consumption is equal to this;
Inrush current: 2.5 A/24V DC signal output;
Backup battery life: 5 years (for backup in case of power outage)
Maximum number of supported IO: can work with 112 pins;
Extension modules: have a maximum of 6 stacks via FRC cable;
Rear panel modules: low side support modules with a relay base and transistor;

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High-speed inputs: Single/Square type input (1x/2x/4x);
High-speed outputs: PTO (Pulse Train Output), PWM, with S-Profile output;
Analog input/output: transmits at a voltage of 0-10 V/4-20 mA;
Through the computer program: programming, online and offline simulation;
Interfaces: RS232/RS485 (via port RJ11) can work with interfaces;
Protocols: Modbus RTU supports;
Timer functionality: has the ability to change time based on 128 weekly, monthly, and annual schedules and manage programs within these time intervals.[8]

The input raw material parameter is automatically adjusted through R2 devices, the actuator R1 is adjusted to the required raw material consumption rate, and the output X is cooled in accordance with the input raw material consumption indicator and transferred to the consumer.

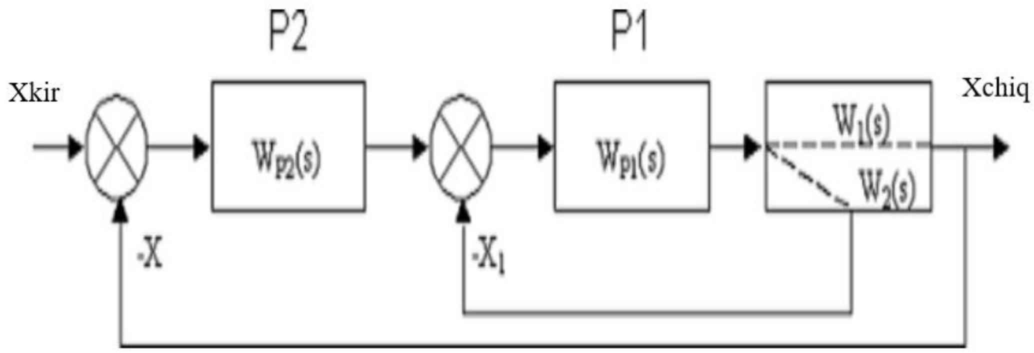

Figure 7. Structure of raw material consumption regulation

Brief description of the process of automatic control of raw material consumption Device for regulating electricity consumption p1

The p2 regulating device that adjusts the controlled parameter and, in turn, activates the actuator (we have a cooling device)

Raw material consumption indicator of the regulated object W1 (s) W2 (s)

WR1 (s) control, WR2 (s) actuator (electric power processing device) X,X1-signal of controlled values

According to the technical specifications, it is necessary to constantly adjust the consumption of the required raw materials. Raw material consumption is measured on a flow meter. The flow meter is calibrated with its connection, which is then entered using a potentiometer, resulting in an automatic control process. The potentiometer detects the signal difference and activates the magnetic key transfer device using electronic amplifiers.

Electron amplifier Uy = k2 U; Comparison element U=Uq-Ut;

Consumption meter T2 dUT/dt + UT=kT θ;

ko - transmission coefficient of the transmission device;

kt - transfer coefficient of the flow meter;

CONCLUSION: In this research work, based on the requirements of modern industrial production, the issue of creating and implementing a system for automatic transfer of polymer raw materials (plastics in the form of granules) to a thermoplastics machine (TPA) was considered. The project analyzed the widespread use of polymer materials in industry, in particular, in medicine, electrical engineering, mechanical engineering, and even in prostheses directly installed in the human body. Nevertheless, it was noted that currently there are no unified and universal standards for assessing the biological compatibility of plastics, which requires manufacturers to develop independent criteria and rely on existing standards. This requires companies working with polymers to pay special attention to quality control and standardization.

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