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Optimizing The Automatic Operation of A Plastic Grinding Machine

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Abstract
In this article, the problem of crushing secondary plastic raw materials is considered. Currently, the control of the plastic shredder is not automated, so the control is carried out by the operator. Based on the analysis of the control parameters in the work, the optimal option of automating the machine was proposed. The structural scheme of the technological process and the algorithm of the adjustment system were given.

Keywords: plastic products, automated management systems, plastic waste.

Introduction

Today, the demand for plastic products is increasing day by day. 60-80% of household items are plastic products. In addition, plastic products are widely used in machine building [1,2,3].
At the current stage of development of production, the use of leading technologies attempts to reach the upper limit of the operational characteristics of the designed and used devices, while reducing the losses in various productions, it is envisaged to increase the quality of the manufactured product. The use of high-quality and highly reliable techniques and technologies of automated control systems allows to increase product quality [4,5].
A piece of discarded polymer can pollute the earth for half a century. If it is buried, it will spoil the composition of the soil for a long time. When burned, it poisons hundreds of square meters of air. As the industry develops, our planet remains in the grip of waste. The fact that Mediterranean Sea, once home to some of the world's rarest marine animals and plants, is now called the "dirt of Europe" due to the ever-growing waste "islands" floating on the waves. The largest share of waste glue corresponds to the products. Tragically, this type of waste does not decompose even in 50-60 years [6,7,8,9].
Due to these problems, there is a need to recycle plastic products. Optimizing the automatic operation of the plastic grinding machine leads to an increase in the efficiency of the plastic processing machine, the ability to monitor and control parameters in real time, accuracy, optimal dimensions and a reduction in consumed electricity.

Materials and Methods

Nowadays, the development of science and technology requires paying great attention to solving optimization problems.
In the conditions of the current market economy, it is necessary to look at any problem, regardless of whether it is small or large, from the point of view of optimization.
The algorithm of our proposed control system is as follows. It can be clearly seen how our proposed system works [10-19].

When the plastic shredder is started, the current in both motors increases to the normal value. Let's define it as I1 =60 A for the first engine, and I3=23 A for the second engine. The current frequency in motors is V1=50 Hz, V2=50 Hz. T=30000 seconds is the time the machine can work in one shift. If a solid object falls on the bench, the bench should turn off, this is necessary for safety. If the first condition in the algorithm, I1<I2+5 is not met, there is a problem with shaft 1, and both motors are shut down. The current frequency in the motors is reduced to 0 value. Since the rotational speed of the motor shaft is directly proportional to the current frequency. When the current frequency is 0, the motor stops rotating. If condition I1<I2+5 is fulfilled, the second condition is passed to align the two shafts. In the second condition, I3 is the current in the 2nd motor, and I4 is the maximum possible load for the second motor. The condition I3<I4+5 is satisfied, indicating that there is no overload in shaft 2, which means that shaft 2 can crush more plastic than shaft 1. If the conditions I3<I4- 5 are fulfilled, it means not only that the second engine is not loaded, but also that the second engine is not running at speed. In this case, it is necessary to increase the speed of the first engine. For this, it is necessary to increase the frequency of the current in the first motor from 1 Hz. To overcome this, it is necessary to increase the speed of the M1 1 engine. For this, the current frequency in the motor is increased from 1 Hz. If the condition I3<I4+5 is not met, it indicates that shaft 2 is overloaded, that is, shaft 1 crushes more plastic than shaft 2. To eliminate this, it is necessary to reduce the speed of the M1 1 engine. For this, the current frequency in the first motor is reduced from 1 Hz. The condition t<T means that the dynamic behaviour of the process is automatically adjusted in 30,000 cycles. The algorithm of the system that automates the plastic grinding machine works in this way.

One of the ways to adjust the rotation speed of the shafts is to change the voltage drop in the electric motor.

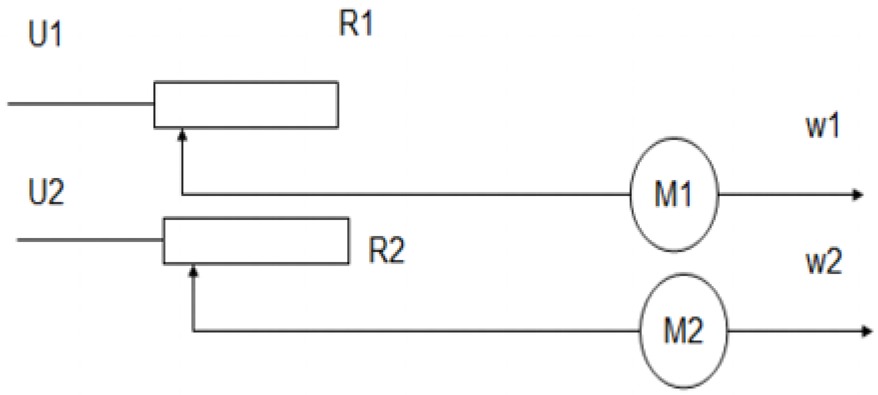

Figure 1. Adjustment of rotation speeds of electric motors M1 and M2 with the help of rheostats R1 and R2.

Modern times require great attention to the development of science and technology or solving optimization problems.

In the conditions of the current market economy, it is necessary to look at any problem, whether it is small or large, from the point of view of optimization [20-24].

Our two-stage plastic shredder consists of two electric motors. The speed of rotation of the first engine is not compatible with the second, that is, as a result of the first engine working too much, an overload occurs on the second engine. This indicates that it is necessary to control the value of the load current (I2) occurring in the second motor. For this, it is necessary to control the rotational speeds of the first and second engines [25-28].

Conclusion

Motor speeds can be controlled in two ways. The first one can be controlled by changing the value of the voltage applied to the motor, and the second by changing the frequency of the current coming to the motor.

If we change the voltage drop in the motor, the amount of heat released from it increases according to the Joule-Lance law. This changes the current in the motor. As a result, the control can be lost.

If we change the frequency of the current coming to the motor, the excess energy generated will be generated in the form of an electromagnetic field. As a result, the current in the motor does not change and the control does not go off track.

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