The influence of the use of composite materials on the rationing of material resources in mechanical engineering

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Abstract. The majority of machine-building enterprises, when planning material and technical supply (MTS), use various statistical data collected and systematized for previous periods that underlie the calculation of standards for resource consumption. Depending on the level of technical development of production, used technologies and changes in the design of products, factors are identified that determine the need for adjustments to consumption rates in a minimum time. The article analyzes structural and technological factors, substantiates their influence on the determination of various types of consumption rates during the formation of MTS.

1. Introduction
The active use and introduction of new technologies and materials in mechanical engineering in the last decade, on the one hand, confirms the effectiveness of their use in industry, but, on the other hand, leads to serious changes in the design of products and existing specifications for standardizing material resources in accordance with technological maps processes [1-6].

Due to significant design and technological changes, it is very difficult at factories to adjust the directories and normative documents on the consumption of material resources every year. As a result, situations arise that have a negative impact on the efficiency of an enterprise’s production activity — excess stock or a deficit of required types of resources, which is unacceptable in machine-building production, since simple equipment often arises.

2. Research Method
Based on the analysis of statistical information, the enterprise management makes the following decisions regarding various aspects of production activities:

production aspect:
- formation of requirements for the quality of products based on the analysis of similar types of products from competitors;
- determination of the nomenclature of production;

technological aspect:
- introduction of new technologies and industrial equipment;
- implementation of effective production and MTS system management, adjustment of material resource expenditure standards and development of new approaches to assessing consumption norms and standards, optimizing the supply plan by taking into account the overlapping needs of services and departments, differentiating the supply...
Due to the tightening of environmental requirements, requirements for material consumption, energy and resource consumption for technical systems, enterprises are forced to resort to changes in design, constantly refining certain blocks and assemblies [8].

Moreover, when planning the MTS, it is necessary to take into account the return logistics flows associated with the return of the defect and with the processing of parts accepted for recycling [7]. Changing the design of the product in order to reduce material consumption lead to a change in the rate of consumption of material on the part.

Often, engineers are faced with the task of upgrading the product in order to endow it with new physical properties. The most effective way to solve this problem is to replace the workpiece material from which the product is manufactured. These operations lead to a change in individual consumption rates for two positions.

Technical products are also characterized by the development of modifications for various purposes based on the base product.

The refinement of the design in order to increase reliability by narrowing the functionality of the product is characteristic of special-purpose products. In this situation, the need for materials and components is reduced. An extension of functionality, on the contrary, leads to an increase in resource requirements. To avoid both of these situations, as well as to minimize cases of excess stock of resources, it is necessary to carry out the adjustment of material consumption in regulatory documents.

3. Results

Technological changes include [9]:

- replacement of the production site;
- change in production technology.

In connection with the advent of new resource-saving technologies, this technological change becomes the most relevant. As a result of the introduction of new technologies, individual consumption rates and consolidated material sizes are significantly reduced [10; 11].

For the correct use of regulatory costs, it is necessary to consider the elements of the standardization process in the areas of calculation: work in progress and finished products, physical parameters of standardization, and additional work.

![Figure 1. Rationing process](image-url)
Moreover, material resources, the consumption of which is normalized, have their own classification, which is based on the types of resources used in figure 2.

**Figure 2.** Classification of consumption rates by type of material resources

Rational rationing is a big problem in mechanical engineering, since there are four levels of detailing the norms of resource consumption, presented in Figure 3. Individual consumption rates are at the base of rationing and planning of material and technical supply. At this planning level at each enterprise, depending on production technologies and available equipment, the unit of regulation is such units as the part, unit, product in units of mass, volume, etc. The generated and systematized data at this level form the basis for the planning of material and technical supply.

The specified consumption rate includes planning not only material resources for each type of output (in terms of unit), but also basic and auxiliary materials, fuel and energy for technological processes for each type of product (parts, products, etc.)

**Figure 3.** Levels of detail for flow rates
4. Conclusion
Given the above, it is worth noting that today it is impossible to organize an effective MTO system without taking into account design and technological factors. To optimize the supply of resources and ensure the smooth operation of production capacities, it is necessary to timely update the regulatory documents governing consumption rates.

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