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CONSIDERATION OF THE USE OF DIFFERENT MATERIALS USED IN THE CONSTRUCTION OF MACHINERY ORGANS

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ABSTRACT

The proper choice of equipment and heat treatment of machinery components is made on the basis of technical and economic criteria, which are intended for technical reasons, to ensure that they are able to operate for a certain period and under certain overall conditions, imposed or chosen and in economic terms, that the economic conditions of implementation and economic efficiency are satisfied.

KEYWORDS: materials, technical-economic criteria, ferrous metal and non-metallic materials

1. INTRODUCTION

The following material categories are used in the construction of machinery components: ferrous metal (iron and steel); non-ferrous metal (non-ferrous and less frequent alloys, non-metallic metals); non-metallic (plastics, wood, rubber, textiles, and others).

Of these, the most commonly used are ferrous materials and non-ferrous alloys. More and more different plastics have been used recently.

The ability of machinery organs to function can be ensured by preventing and limiting and in some cases even emphasizing the effects of physical-mechanical and chemical phenomena occurring during their operation (various States of stress, deformations, the vibration of wear, corrosion, heating, etc.) which must be taken into account in the choice of materials.

The cost of materials, labor and exploitation, processing opportunities using the most productive methods, the possibility of replacing scarce materials, etc., must be taken into account economically.

Taking into account the many technical and economic factors involved in the construction of machinery parts, the correct choice of their materials is a major design issue.

To date, no technical-economic calculation relationships have yet been established to enable the best solution to select materials. This is why the choice of materials for machinery is solved unilaterally, more according to technical considerations of resistance, to various demands.

Examples of this are:

On a shaft, the conditions of resistance to these stresses must be satisfied, and elastic deformation must also be limited. For this purpose, a material with high modulus shall be chosen, i.e. carbon-carbon or alloy steel. Of these, in economic terms, the choice is for steel-carbon, since it is cheaper and non-deficient, but larger overall dimensions are obtained, which also increases the size of the other elements and thus increases the weight of the whole, thus exceeding the technical-economic weight index (kgf/CP).

2. CRITERIA FOR THE CHOICE OF MATERIALS USED IN THE CONSTRUCTION OF MACHINERY ORGANS

As can be seen, the design activity involves

two large categories of activities, namely:

- finding the best technical solution
- establishing the most appropriate materials for each component of the finished product.

As the first category of activities will be analyzed in other disciplines, some principles of material choice are outlined below.

At the basis of the choice of any type of material, the general validity criteria should always be:

- determination of the functional role of the part;
- determination of the character and value of mechanical stress;
- determination of temperature and environmental conditions;
- determine the principal properties of the part.

In the case of a spring, a large elastic deformation is required, under certain conditions of strength and gauge, which is ensured by the choice of leaf steel.

In order to reduce wear on moving parts relative to kinematic (high-bearing) couplings and energy consumption and in order to increase mechanical efficiency, under normal lubrication conditions, the bearing shell shall be made of anti-friction materials (cast iron, non-ferrous alloys, composition). The purpose of such material torques is to limit the wear to a single piece, i.e. the one whose replacement is more economical (the bearing shell). Friction materials, fonts, and other non-metallic materials, characterized by a high and relatively constant friction coefficient, resistance to wear, and high temperatures, shall be used in brake parts, wheels, and couplings by friction, etc.

For machine components working at high temperatures, alloyed steels are used, which are more resilient in such conditions as well.

Stainless steel, non-ferrous alloys or plastics shall be used for the corrosive action of different acid media.

For moving parts of fast machinery, in particular, those with rectilinear-alternating movement (engine pistons), non-ferrous alloys of low specific weight shall be used to reduce the inertia forces and to reduce the stresses caused by them.

Plastics are organic (macromolecular) products, obtained from synthetic resins and sometimes from natural resins, which contain in addition 40-70% of various filler additions (woven fabrics, paper, sawdust and wood chips, textile fibers, glass or asbestos) and certain quantities of plasticizers, colors, etc. The resins act as a binding agent and the fillings improve their mechanical properties.

According to the nature of the resins, plastic materials can be: thermos-reactive and thermoplastics. Thermo-active plastic materials, under the influence of temperature, become infusible and can no longer be used for a second formation, while thermoplastic materials soften at high temperatures and allow for a second formation.

Depending on the addition of the filling, plastics may be: stratified (with added stratified filling), composition (with added powder or fiber filling), and pressing (with no added filling).

The manufacture of various plastic products is done by pressing (most semi-finished products), by pressure casting (extrusion), by simple casting (low-residual products), and by cutting. The most used in the construction of machinery are plastic materials.

Classification of plastic materials:

(A) laminated plastics:

The textile fabric is a layered material with added cotton fabric filling (raw fabric, siphon, etc.).

It is manufactured in the form of sheets, plates, bars, pipes, and various pressed products.

It has high breaking and wear resistance (due to the fabric insert) and good electrical properties.

From the fabric, gears are constructed for fast and quiet gears, compressor disks and vanes, bearing housings, bearing shells, friction gears, etc.

Pertinax has added filling made of sheets of paper and is made in different forms. It has lower mechanical properties than the text, but it is cheaper. It is mainly used as an electro insulating material.

Abbotextolite is a layered material with asbestos fabric as addition of filling. It is made in the form of sheets and discs for brakes and friction clutches. It has high temperature resistance.

Lignofoll is a layered plastic material with the addition of wood chips. It is manufactured in the form of sheets, plates, and bars. It has a high tear and wear resistance and is generally used for the same purposes as fabric.

Steclottextolite is obtained by impregnation of tempered glass-fiber fabrics with artificial resin followed by pressing. It has high breaking and temperature resistance, elasticity, and electro insulating properties.

For use in the construction of land, air and sea transport car housings, gears, etc.

(b) Composition plastics:

Extolytes and split additions are a pressing material, made with the stuffing of cut-into-pieces woven fabrics. Generally they have the same properties as textolytic, sometimes lower,

because the filling is not continuous. It is used in the construction of the applied bearing shells and guides.

Volochrivet is also a pressing material, with filling in the form of textile fibers (horsehair, cotton, etc.) being similar to textolite with fragmented but cheaper additions. Due to its small thermal conductivity and beautiful exterior appearance, it is used for the construction of hand wheels, levers, etc.

(c) Thermoplastic materials:

Organic glass or plexiglass is a transparent plastic material that is made in the form of sheets.

Vinyl is a polychlorovinylic resin with plasticizing and filler, which is made in the form of sheets, plates, pipes, bars, and press-plates.

It has high chemical resistance and electrical insulating properties, which are used for the construction of chemical machinery parts, electrical insulating equipment, pipes, etc.

Fluoroplastics are polymers of ethylene, of which the floraplasty or teflon is the most widely used in machine construction. It has a paraffin-like exterior appearance and has very high chemical resistance, high dielectric properties, and high resistance to high and low temperatures. As an anti-friction material has a low friction coefficient and can operate sometimes without lubrication. They have little hardness and the property of cold flow, which can only operate at low pressures.

It is used for the construction of lower grease bearing shells, chemical machine parts, pipes, electro insulating parts, etc.

Polyamide resins (polyamide) are manufactured in some countries as nylon and the most commonly used polyamide is relon. It has a high tear, wear, and temperature resistance, chemical stability, good metal adhesion, and weldability.

They are used for the construction of various complex parts (screws, nuts, screw fasteners, sealing rings, rivets, gears for fast grating, etc.) as well as synthetic fibers, coatings, and glue glues (adhesives).

3. THE CHOICE OF STEELS FOR THE MANUFACTURE OF MACHINERY PARTS

The choice of steels is based on mechanical properties, which are determined according to basic mechanical requirements, namely:

- static;
- dynamic;
- variable (fatigue);

In parts for which the dominant force is the static force of tension, the limit of proportionality shall be taken into account.

For parts where low residual deformations are permitted during the stresses, the leak-off limit shall be taken into account and for parts where breakage coincides with their decommissioning the breaking strength shall be taken into account.

In all the above situations, the correct choice also depends on the optimum determination of the value of the safety coefficient.

For cases where the part is subjected to shocks, high-tenacity steel is required, so after the determination of σp, σc, and σr, the higher-value steel for the determination of (z) or the resilience (KCU) is chosen.

If, after the direct tests on the test pieces, the results obtained are unsatisfactory, before the steel mark is changed, it is recommended to change the shape of the part and thus to change the concentration coefficient.

In the case of fatigue stress, a very important role in the determination of durability is the quunching depth.

Thus, low-quinding steels are preferred, provided that the required mechanical conditions are satisfied.

4. THE CHOICE OF FONTS FOR THE MANUFACTURE OF MACHINERY COMPONENTS

As is known, cast iron is an alloy of iron with carbon, the latter having a percentage of more than 2.06% but less than 6.69%.

The percentage of carbon that is higher than steel recommends that the fonts from the start to be suitable for the various friction couplings required by fatigue.

The behavior of fonts at varying stresses depends on the quantity of graphite, its size and shape, its distribution mode.

The characteristic of cast iron parts with stress concentrators is that cracks occur faster than on the same steel parts, but the time to destruction is much slower compared to the same parts.

Modified fonts are used for the manufacture of more sophisticated machinery components, especially those with nodular graphite. Lamellar graphite fonts are also recommended in some cases.

5. THE CHOICE OF NON-FERROUS MATERIALS FOR THE MANUFACTURE OF MACHINERY PARTS

Non-ferrous metals and alloys are of particular importance because, like fonts, they are often used to achieve friction couplings.

The parts in such materials are: bearing shells, worm gears. One of the reasons for imposing such materials, in the above cases, is limiting the use of ferrous alloys due to certain friction parameters (pressure, speed).

6. THE CHOICE OF NON-METALLIC MATERIALS FOR THE MANUFACTURE OF MACHINERY COMPONENTS

The use of plastics in particular and of non-ferrous in general, in the manufacture of machinery organs, is relatively recent and is due to their properties. These properties include:

- the ability to shape easily due to high plasticity.

Sealing components are a special place in the overall use of non-metallic materials.

Sealing is the operation to plug access to and from a container, chamber.

7. CONCLUSIONS

Given the many technical and economic factors involved in the construction of machinery components, the correct choice of equipment is an important design issue. To date, no technical-economic calculation relationships have yet been established to enable the best solution to select materials.

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