POWDER METALLURGY INDUSTRY, ECONOMICS, AND ORGANIZATION OF PRODUCTION

A METHOD FOR DETERMINING THE ECONOMICS OF POWDERED METAL PART PRODUCTION

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In converting production to new methods the introduction of powder metallurgy methods is one of the most promising methods for increasing the effectiveness of the country's production. A particular obstacle to its wider use is the failure to solve a number of questions in the methods of determining the economics of powdered metal part production. The problem concerns parts which may be produced by more than one method, among them powder metallurgy. Here we will not consider the economics of using parts which, on the basis of particular properties, are made only by powder metallurgy methods.

The absence of a single criterion which gives a complete expression for the economics of this method of producing parts forces us to use for this purpose a system of common technical and economical factors. The economic factors consist of capital investment, net cost of production, time for paying off the capital expenditure, and profit from production.

The construction and use factors are primarily the efficiency of the units, the service life, the surface quality, lubrication conditions, etc. However, in the method presented by us only the most basic of these, service life, is considered.

Calculations of the economics of powdered metal part production are best carried out in stages: preliminary planning, planning the job, operating drafts, and first years of production.

The method given may be used in all stages of the calculations; however, in each of these, depending upon the availability of information, different factors may be taken into account. To a great degree the factors may be determined for the stage of the first years of production, and, to a known degree of approximation, for the stage of the operating drafts. Calculations for the stages of preliminary planning and planning of the job have a more general character and the factors used in them are, naturally, more restricted. This introduces the necessity for concrete and independent consideration of the working method for consolidated calculations.

In determining the economics of powdered metal production in comparison with other methods of production it is necessary to compare the capital investment required for each method with the economics in cost obtained with the introduction of each.

The capital investment in the development and introduction of powdered metal part production in place of another method of producing parts (machining, for example) consists of the following elements: the original cost of fixed expenses introduced; the remaining values of fixed expenses retired (old equipment subject to depreciation if it cannot be used in other operations); changes in the value of operating facilities; expenditures in planning and technical work. This total capital investment will decrease with an increase in the remaining value of equipment taken out of service when this equipment may be used in other operations, as will the total working capital used for the output of the other operations.

In general form the sum of the required additional capital investment, which must be used in calculating the economics of manufacturing parts by powder metallurgy, may be expressed by the formula:

\[ \Delta K = K_1 - K_2 = K_{fe} + K_{ed} + K_{pp} + \Delta O - K_{er} \]  

where \( \Delta K = K_1 - K_2 \) is the difference in capital investment for the change, that is, the total of additional investment; \( K_{fe} \) is the adjusted cost of newly introduced fixed expenses; \( K_{ed} \) is the remaining value of previously
used equipment subject to depreciation, after deducting the sale value (retirement value); \( \Delta O \) is the residual cost of equipment retired from used and either sold or used in other operations; \( K_{er} \) is the remaining value of retired equipment, sold or used in production; \( K_{pp} \) is the cost of planning and production work.

The capital investment in fixed expenses \( (K_{fe}) \) required in organizing powder metal part production may be determined by the formula:

\[
K_{fe} = K_{eq} + K_{mod} + K_{p} + K_{tech}
\]

where \( K_{eq} \) is the cost of new equipment, including the cost of its delivery, foundations, and putting in place; \( K_{mod} \) is the cost of modernization of equipment used in the production of powder metal parts; \( K_{p} \) is the cost of construction and reconstruction of buildings (or only reconstruction if the buildings are available); \( K_{tech} \) is the expenditures on technical equipment, auxiliary equipment and tools with useful lives of more than a year and a cost of more than 50 rubles each.

In powder metallurgy part production the expenses of production equipment consist of, primarily, the costs of mixing, pressing, and furnace equipment and equipment for oil impregnation. Frequently specialized equipment for some of the operations for powder metallurgy is not available or available only in limited quantities. Therefore in introducing new methods of production the need arises to modernize standard equipment or to create nonstandard equipment.

The capital investment in new equipment is determined for each type by the formula:

\[
K_{e} = K_{pl} + Q \cdot P \cdot K_{tr} \cdot K_{con} \cdot K_{ex}
\]

where \( K_{pl} \) is the expense of planning and designing the equipment; \( Q \) is the number of units of equipment necessary to introduce the method; \( P \) is the cost of producing a unit of equipment; \( K_{tr} \) is a coefficient based on the transport and purchasing costs; \( K_{con} \) is a coefficient based on the costs of construction work, foundation equipment and placing the equipment in place; \( K_{ex} \) is a coefficient based on the cost of obtaining experience on the equipment.

In the case of producing equipment in the same plant it is based on net cost. The capital expenses for technological equipment \( (K_{tech}) \) are determined in a similar way. Expenditures on modernization of equipment \( (K_{mod}) \) are made on the basis of an estimate.

Calculation of the expenditures in the passive portion of the fixed costs \( K_{p} \) is carried out according to the formula:

\[
K_{p} = \sum_{i=1}^{m} A_{p} \cdot K_{aa} \cdot E_{n} \cdot K_{u} \cdot H \cdot V
\]

where \( A_{p} \) is the production area occupied by a piece of equipment in a p-operation in m²; \( K_{aa} \) is a coefficient determining the additional production area (rest and auxiliary rooms, aisles, etc.); \( E_{n} \) is the number of units of equipment of a specific type and size used in an i-operation; \( K_{u} \) is the coefficient of use of the production equipment for the manufacture of parts; \( H \) is the height of the building in m; \( V \) is the cost of 1 m³ of building space in rubles.

If in setting up powder metal part production a portion of the active production investment cannot be used in the plant, then its remaining value (after deducting the sale value \( K_{eq} \)) is an increase in the total of additional capital investment.

The value of the average annual remaining standard working capital \( (W) \) for powder metal part production must be determined primarily in relation to the form of metal powders, the volume and conditions of production, and the cost of production. This calculation is carried out according to the formula:

\[
W = K_{ms} + K_{to} + K_{me} + K_{cl}
\]