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TECHNICAL AND ECONOMIC ASPECTS UNIFICATION OF IN MACHINE BUILDING

The analysis of regulations for the unification of products in machine building is conducted. Expediency determining the level of unification in machine building an based the economic criterion is proved.
Key words: unification of, coefficient applicability, repeatability coefficient, coefficient of mutual harmonization, economic criteria unification of.

Statement of the problem. Purpose of this work is to analyze the existing methodological framework of unification and searching the direction of it's improvement.

Statement of main results. As the cost of production effects on its competitiveness, so the objective function in the planning work on the unification of production is expressed in such form:

$$(N, n, B) \rightarrow min \qquad (1)$$

where N – the total number of constituent products in construction, n – the total number of constituent products items; B – the cost of production.

For evaluation the level of unification of products used such indexes (according to the regulatory method [3]): the coefficient of applicability K_3; the coefficient of frequency K_n; the coefficient of mutual unification K_{6y}.

The coefficient of applicability (%) is determined by the formula

$$K_3 = \frac{n_y 100}{n} = \frac{(n - n_o)100}{n}, \qquad (2)$$

where n_y – the total number of standardized constituent products items in construction, n_o – the total number of original constituent products items in construction.

The coefficient of frequency can be determined by the formula

$$K_n = \frac{N - n}{N - 1}100, \qquad (3)$$

These indixes used for evaluation the level of unification of particular construction (model). For evaluation the unification level of the group of constructions (models) used the coefficient of mutual unification:

$$K_{6y} = \frac{\sum\limits_{i=1}^{k} n_i - Q}{\sum\limits_{i=1}^{k} n_i - n_{max}}, \qquad (4)$$

where k – the total number of constructions (models); n_i – the total number of constituent products items in individual construction; n_{max} – the largest quantity of constituent products items in one of the constructions

(models); Q – the total number of constituent products items in the group of constructions (theiramount is equal to k).

Meaning of the indixes, which included in the formulas (2, 3, 4), are shown in [1] on specific examples.

Forexample, the Table 1 contains the quantity of constituent products and information about the level of unification according to the coefficient of applicability in own production the group of average second class buses LAZ-A141, LAZ- 1414 and LAZ-A1414*. This information was received after improving the engineering documentation. The difference between those buses is A141 staffed by engine Andoria ZT 6CT1072-/A1, and A1414 staffed by engine ЯМЗ-236А-10.

Table 1

Assembly units and components quantity in the group of buses

Number of products	Bus		
	A141	A1414	A1414*
The total number of general assembly units, n	997	965	780
The total number of original assembly units, n_o	474	562	480
Quantity of general details, n	2776	2969	2476
Quantity of original details, n_o	1022	1474	1327
Quantity of all products, n	3773	3934	3256
Quantity of all original products, n_o	1496	2036	1807
General level of unification K,%	60,35	48,25	44,5
Unification level K, % of assembly units	52,46	41,76	38,46
Unification level of details	63,18	50,35	46,4

As we see (according to the table 1), after the calculations according to the formula (2) were obtained paradoxical results - after improving the design of A1414* (reduced the absolute and original quantity components of products). The level of unification was reduced – it's contrary to the objective function expression (1). After the improvement the design documentation of course the cost of A1414* construction compared with A1414 will be lower.

So, quantitative indexes of unification is the result of mathematical correlation groups of the unified and original products. Also quantitative indexes of unification are not always represents the results of engineering and design measures of improvement the product. This confirms the expediency of other criteria and indexes application for evaluation the level of unification according to the coefficient of applicability of construction, particular economic.

The cost of the product can be determined [1] according to the total cost of it's constituent groups:

$$B = B_1 + B_2 + \dots + B_x = \sum_{i=1}^{x} B_i = \sum_{i=1}^{x} \sum_{i=1}^{y} b_{iz} n_{iz} = \sum_{i=1}^{n_y} b_{yi} + \sum_{i=1}^{n_o} b_{oi}, \qquad (5)$$

where B_i – the cost of a typical group; x – quantity of the typical [4] groups; y – quantity of the groups consists with the components with the same name in nomenclature of specific group; b_{iz} – cost of the component unit in nomenclature of typical group; n_{iz} =1, 2, 3…– quantity of the group with same name components name in nomenclature of specific group; b_{yi} – rated value of the certain standard size of the unification components group; b_{oi} – rated value of the certain standard size of the original components group.

Basedon the value of constituent groups the level of unification of construction can be determined (by cost):

$$K_{\acute{o}\hat{a}} = \frac{\sum\limits_{i=1}^{\ddot{i}_{\acute{o}}} b_{\acute{o}^{3}}}{\sum\limits_{i=1}^{\ddot{i}_{\acute{o}}} b_{\acute{o}^{3}} + \sum\limits_{i=1}^{n_{o}} b_{oi}} 100 . \qquad (6)$$

As we see from the formulas 5 and 6 the problem of reducing the cost of production is to reduce the number of it's constituents and the cost of constituents. Evaluation the level of unification (by cost) of product shows the constituent groups and subgroups with a relatively low level of unification. On the basis of it's information is possible to form the priority measures for enhance the level of unification. This will affects to reducting the cost of production in whole and improve the quality of this production.

But, evaluation the level of unification by the quantitative indexes remains an important aspect of unification towards the minimization of materials and standard C nomenclature which used in production. Nomenclature for the rolled metal and fixing products can be determined according to the formula:

$$n_{\mathcal{M}(\kappa)} = n_{s(p)} + \sum_{i=1}^{n_{S(p)}} \left(n_{\mathcal{M}(l)i} - 1 \right) , \qquad (7)$$

where $n_{m(k)}$ – nomenclature of sizes in relation to kinds of rolled metal (fixing products), $n_{s(p)}$ – quantity of rolled metal groups in size (quantity of thread nominals of fixing products), $n_{m(l)i}$ – quantity of metal brands (length of each fixing products nominal).

For example, the nomenclature of metal materials and fixing products that was necessary to minimize was defined on Lviv bas plant. To minimize the number, were chosen 14 groups of black and colored rolled metal and 38 fixing products items Table 2 shows the results of work on the example of rolled metal size quantity correction.

Table 2

Results of correction the number of rolled metalsizes

Kinds of rolled metal	Number			
	in relation to thickness and diameter		in relation to metal brands	
	Before correction	After correction	Before correction	After correction
Cold rolled	13	8	14	5
Hot rolled	12	11	7	4
Calibrated, round	75	26	13	7
Hot rolled, round	28	16	11	4
Calibrated, hex	34	14	7	3
Hot rolled steel seamless pipes	9	6	5	2
Cold distorted steel seamless pipes	39	20	5	2
Electric-welded steel pipes	16	11	2	1
Steel wire	39	22	1	1
Aluminium sheet	9	6	5	5
Brass sheet	5	3	3	2
Brass rod	10	9	1	1
Bronze rod	4	3	1	1
Whole sizes	293	155	75	38

As a result of correction of restrictive list were remained 133 out of 301 sizes of fixing products.

Conclusions : 1. Suggested the method of evaluation the level of unification according to the coefficient of applicability for improve the existing methodological base of unification in manufacturing and modernization products.

2. Evaluation the level of unification (according to the economic criteria) during the manufacture of products allows to excrete first of all it's typical groups (subgroups) with low level of unification and with high cost of manufacturing. It's allows for planning and realization the economically justified technological actions towards lowering the cost of products.

3. Evaluation the level of unification by the quantitative indexes remains an important aspect of unification towards the minimization of materials and standard C nomenclature which used in production.

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