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ECONOMICAL ASPECTS AND MANAGEMENT OF THE INDUSTRIAL APPLICATION OF BIMETALLIC BUSHINGS

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Abstract. In the context of the integration of Romania in the EU the production increase and the utilization of the bimetallic products is expected in different fields due to the improvement of the electric, thermal, anti-friction properties, the improvement of the sticking, adherence possibilities, saving of the non-ferrous materials. The actual research in the field of bimetals hints at the gradual increase of the geometrical dimensions of the bimetallic bushings, the diversification of the assortments of the base materials and deposited layers in the direction of the increase of alloying degree, development of the automation and robot utilization for the deposition of the metallic layers. Savings of metals and critical alloys rich up to 90% in the case of the utilization of bimetallic half-products in the manufacture of apparatus with a high degree of incorporated intelligence.

1. Introduction

In the context of the integration of Romania in the EU the production increase and the utilization of the bimetallic products is expected in fields like:

- electro-technique, electronics, energetic and nuclear industry;
- chemical, petrochemical, metallurgic and machines construction industry;
- food, textile, wood, cellulose and paper industry;
- air, naval transport and telecommunications;
- consumer goods of longtime utilization;
- manufacture of pharmaceutical and cosmetic products;
- vacuum, cooling and ventilation technique;
- manufacture of synthetic resins and plastics.

2. Industrial applications of bimetallic bushings

The use of the bimetals carbon steel-bronze has as main purposes the followings [1]:

- the improvement of the electrical, thermal and anti-friction properties;
- the improvement of the sticking, adherence possibilities and surface appearance;
- bronze saving.

Bimetallic bushings carbon steel low alloyed – bronze obtained by special procedures of deposition are used especially for:

- connection bushings, connection couplings for feeding ducts;
- casings, contact points;
- motors sealing gaskets;
- connection bushings of the tanks for auto-vehicles radiators;
- tightening bushings for immersible boilers and heat changers;
- bushings and bearings for the containers under pressure and bearings for containers under pressure and condensers;
- the manufacture of the gearshifts, disks of the hydro-dynamic converters, disk brakes, synchronizing cones, clutches with multiple disks;

- bushings for crude oil refining installations;
- air-coolers at the converters with oxygen for the cooling of the blowing lances and converters hoods;
- half-bearings for tractor and truck motors;
- bearings at Diesel motors and tractors on caterpillars;
- bushings for the manufacture of big turning machines;
- bearings of the shake out machines compressors.

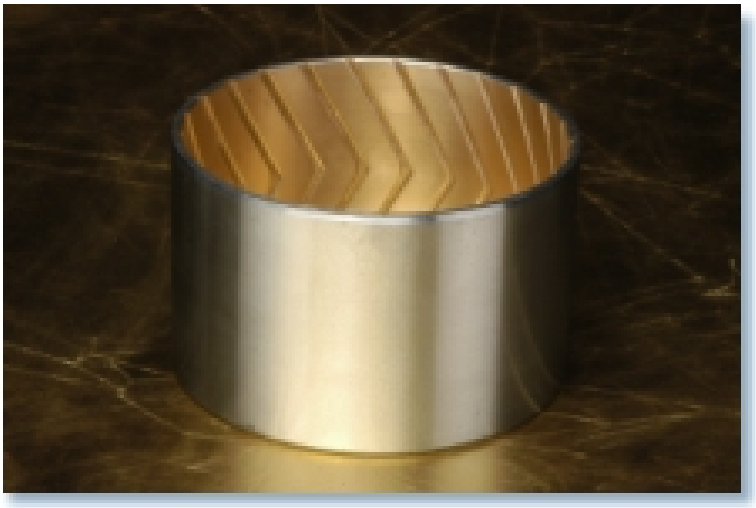

Fig.1. Bimetallic bushing of hypoeutectoid carbon steel low alloyed – bronze with tin

3. Economical aspects

By the utilization of the half-products and bushings with bimetallic layers the following aspects are had in view :

- saving of the expensive and critical materials and implicitly the imports reducing;
- obtaining a product that combine various properties, unreachable by using of a single metal:

a – the good thermal conductivity of the base steel with the corrosion-proof of the deposited steel;
b – high strength of the base steel with anti-friction good properties of the deposited alloy;
c – high mechanical properties and thermal dilatation coefficients different between component metals of the thermo-bimetal;
d – high technological properties of the base steel with distinct appearance of the deposited materials.
The thickness of the half-products and bimetallic bushings most utilized in the whole world is comprised between 0,5 – 5 mm, the proportion of the deposited layer SD being of 10 – 30%.

In fig.2. the variation of the ratio between the production cost of the monoblock massive half-product and the cost of the carbon steel – stainless high alloyed steel bimetallic half-product is presented, conforming to the economic studies effected in Germany and France.

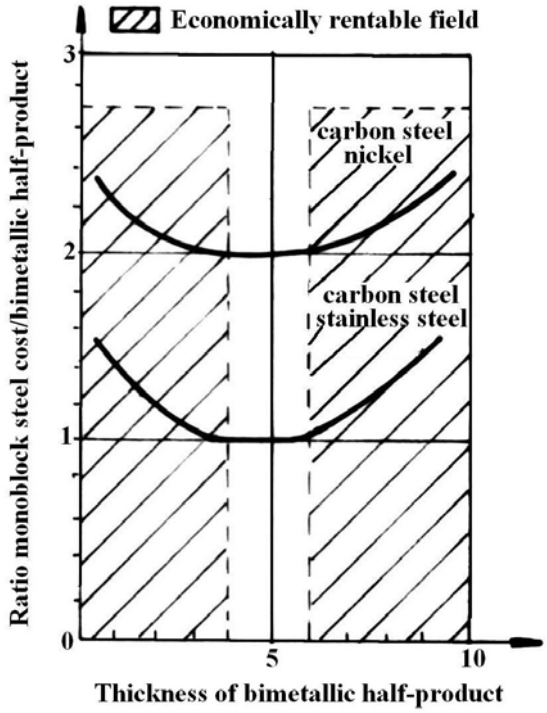

Fig.2. Variation of the ratio between the production cost of the half-products of monobloc metallic materials and the cost of the bimetallic half-products with deposited layer SD of these materials

Conforming to fig. 2 it is marked that for the thicknesses of the bimetal under 3-4 mm the economic advantage is increasing (the bimetals production is rentable), as well as for thicknesses over 5 mm.

Using the half-products and the bimetallic bushings low alloyed carbon steel – bronze, the percentage savings presented in table 1 are obtained.

Table 1. Average savings achieved by the obtaining and utilization of the bimetals low alloyed carbon steel -bronze

Cr.Nr	Savings resulted by the utilization of the bimetals low alloyed carbon steel - bronze	Proportion of deposited layer SD, %	
		10 %	20%
1	Value savings	39	24
2	Quantitative savings regarding the alloy of deposited layer SD	81	65
3	Minimum ratio between the price of the deposited alloy SD and the price of the base material MB in order to achieve value savings	4	5

Indicative calculations in order to establish the costs of some half-products and bimetallic bushings carbon steel–copper and carbon steel-bronze with the proportion SD 15%, by comparing with the technological proceedings are presented in the table 2.

Table 2. Comparative costs of the of the half-products and bimetallic bushings depending on the technological proceedings

Cr. Nr	Manufacture proceeding	Estimative cost		
		France, Germany, Sweden	Russia, Ukraine	Romania
1	Method of compound ingot	118%	120%	120%

2	Method of compound package	123%	127%	125%
3	Method of welding in slag bath	!05%	105%	105%
4	Centrifugal methods	100%	100%	100%

From the table 2 it is remarked that the most advantageous proceedings from the economic point of view are those based on centrifugal methods → much more the real possibilities of the immersion and centrifugation proceedings which eliminate operations and equipment necessary to pre-heating, manipulating, casting into spin casting machines, extraction.

Having in view a possible series production in Romania, the products would be competitive on the European market taking into account that for a period of time the expenses with the man power will be low [2].

In fig.3 the percentage savings (%) are indicatively synthesized in the presented curves, that are achievable by using a ton of bimetallic half-products of low alloyed carbon-steel – stainless steel and of a ton of half-products and of a ton of bimetallic half-products and bushings of low alloyed carbon steel - bronze → instead of a ton of half-products of stainless steel, respectively bronze.

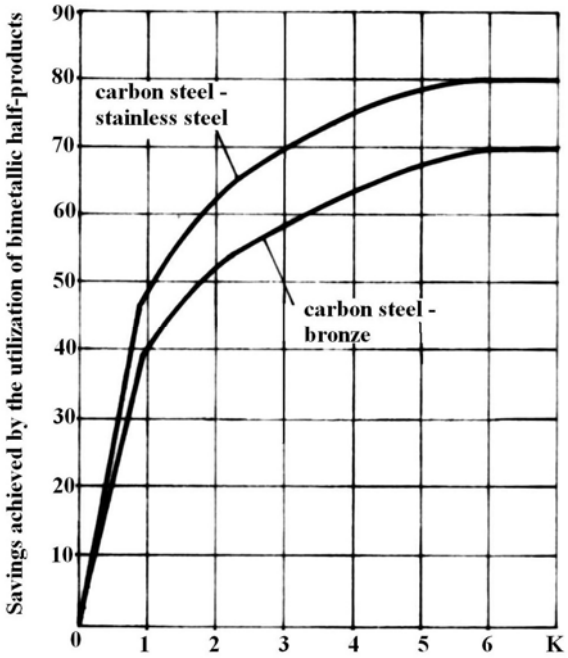

Fig.3. Savings achieved by the utilization of bimetallic half-products

The savings represented in the ordinate have been established depending on the ratio K from the in the abscissa (K= ratio between the surface of the cross section of the carbon steel half-products and the surface of the deposited layer section). As much bigger is K as the obtained savings are higher. In the building machines, energetic and automobile industry the bimetallic half products and bushings of low alloyed steel – anti-friction material are used on a large scale and they have superior characteristics: high and stable friction coefficient at different temperatures, low wearing and long service time, resistance at high temperatures and good thermal conductibility, high resistance at corrosion, ensurance of a slow braking [3].

The utilization of the bimetallic half-products and bushings of steel bronze achieve a 60-70% average of savings of Cu alloys; in the case of apparatus and machines

manufacture (products with a high incorporated intelligence degree) the savings can reach even up to 90% scanty metals and alloys (in which case they are used as thin layers deposited and tight joined by MB of carbon or low alloyed steel).

The economic efficiency is as much bigger as the geometrical dimensions of the products are bigger and the proportion of the deposited layer SD is reduced at minimum values.

4. Conclusions

The actual tendencies in the world in what concerns the bimetallic bushings of carbon steel- bronze and carbon steel-high alloyed steel are:

- the gradual increasing of the geometrical dimensions bushings leads to the increasing of the economical advantages in the case of the utilization for welded constructions of big dimensions;
- the manufacture of the bimetallic half-products and bushings of great dimensions for special utilizations in the petrochemical, energetic and nuclear industry;
- the continuation of the research for the extension of the ranges of MB and SD in the direction of the increasing of the alloying degree for the large utilization in the automobiles industry.

The technological proceedings of immersion and centrifugation impose also from the economical point of view existing a sale market for the bimetallic bushings, the technological proceedings having big possibilities of automation and robots utilization.

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