RESEARCHES REGARDING RECONDITIONING OF BIMETAL MATERIALS HAVING AS BASIC MATERIAL VCRW85

G. NATH[1] L. SCOROBEȚIU[1] M. DAROLȚI[1]
M. STROE[1] C. EFTIMIE[1]

Abstract: *Loading of bimetallic moulds, having as basic material VCrW85, loaded by welding through various procedures, is realized with view of obtaining an adequate resistance to heat and at the same time maintaining a hardness over 55 HRC la 873-923 K. Therefore we have to choose the optimum variant (variants) of loading for achieving the desired mechanic characteristics and an as uniform as possible dispersion of the carbides of W within the steel microstructure frame.*

Key words: *carbides of W, trial temperature, resistance to heat, hardness.*

1. Introduction

It was established that in case of moulding big parts on hammers, it is very important the choice of mould type. So the solution is a mould composed with 3 levels loaded by welding, why?

During functioning, of course, the most affected areas are the cuts in mould, in the areas with maximum stress, or even on the entire active surface. As you can see in Figure 1.

The material loaded by welding being high alloy, ensures the mould a high durability, even if the mould is not made of a high alloyed material.

When the mould is worn, it may be reconditioned, using the same material of addition, as the initially loaded one.

In this way the moulds can be used even after 2 or 3 reconditions of the areas of maximum wear. This presents advantages towards reconditioning through re-engraving, because the height of mould block, namely its rigidity, does not modify. In case of choosing an adequate loading technology, as well as some adequate materials, the subsequent thermic technologies can be eliminated.

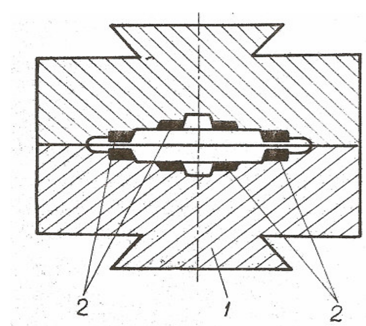

Fig. 1. *Bimetallic mould: 1 - basic material; 2 - high alloyed material*

There are also known loading by welding with alloys that require subsequent thermic

[1] Dept. of Materials Engineering and Welding, *Transilvania* University of Brașov.

treatments, but they are proffered to self-hardening alloys due to simplifying reconditioning technologies and obtaining a proper quality of the moulds [1].

During exploitation the most important parameters are:

- Repeated dynamic charges which can produce in the mould material tensions with values up to 200 N/mm^2.
- Alternative variations of temperature at the active surface, of 80-150 ^{0}C at small moulds and of 0.5-0.6 from the moulding temperature (450-1100 ^{0}C) at big moulds.
- An intense abrasive friction at hot between the moulds surfaces and the semi product, which increases during exploitation due to increasing the superficial rugosity of the mould.

The most pronounced wear is produces in the area of sliding, at the edge of the bur. This is first developed by losing, increase of connecting ray of surfaces, cold hammering and exfoliation of material, occurrence of scratches, advancement in depth of scratches and finally the destruction of mould, occurrence of cracks.

Controlling the complex wear phenomena, their counteracting by imposing some optimum technologic factors may lead to increasing moulds life and impose new themes of research in the field.

As a conclusion we should find such kind of material that may meet all the conditions of tenacity, increased resistance at tiredness and thermo shocks, as high values as possible for surface microstructure etc., which does not exist in reality, but researches go on.

2. Characteristics of Steel VCrW85 for Moulds

In Table 1 there are given the content of proper corresponding alloys according to SR EN 10027-1:2006, and there will result two values of equivalent carbide calculated for the inferior limit, namely for the upper limit of the content of elements:

Content of elements for VCrW85 Table 1

SR EN 10027-1:2006	Chemical composition %									Ce min	Ce min
	C	Mn	Si	Cr	Ni	W	V	S	P		
VCrW85	0.25 0.35	0.02 0.50	0.15 0.40	2.20 2.70	max 0.35	7.5 9.0	0.20 0.50	max 0.025	max 0.025	1.30	1.73

Due to high values of the equivalent carbide this steel is considered steel with reduced welding capacity.

2.1. Welding on with Covered Electrodes

In this respect in the specialty literature [4], it is recommended welding with basic cover electrodes.

When welding with covered electrodes due to the spring energy the metallic rod and cover are melted as well as an area of the basic material. From the electrode metallic drops come out and they are surrounded by a melted cover. The size of drops is mainly determined by the superficial tension of the melted metal, and its turn depends on oxygen. Oxygen influences the superficial tension by producing many small drops. The electric arch, drops carried along and bath of melted metal are protected by from atmosphere by gases and slag. Behavior at welding, properties and aspect of welded joints are highly influenced by the cover of electrode.

A modern cover contains approx. 12 up to 20 various raw materials which in their turn are blends of various substances. The raw materials for the electrode cover are grouped in Table 2.

Content of a highly alloyed cover of electrode Table 2

1. Minerals and rocks	*Dross formers:* CaO, TiO_2, SiO_2, MgO, FeO, Fe_2O_3, MnO, MnO_2, Mn_2O_4
	Ionizing substances: Compounds of K/Na, $CaCo_3$
	Protection gazes former: Me_2CO_3
	Fusing agents: TiO_2, MeF_2
2. Deoxidants	Mn, FeMn, Si, FeSi, SiMn, Ti, Zr, Al, Mg
3. Alloying elements	Cr, Ni, Mn, V, Mo etc.
4. Binders	Silicate of Na/K liquid

2.2. Rendering by Welding Procedures in Gases Protective Environment with Alloyed Wires

Application of WIG welding procedure to rendering moulds is more seldom used due to difficulties in obtaining highly alloyed rods with constant diameter, without overlapping material, oxides and other impurities on surface.

Materials for welding consist in:

- **electrode of W** alloyed with 2% Th, Zr, Ce, for improving emission conditions, an easier arc ignition, a better stability of this one, higher loading with current;
- **protection gas** may be argon or helium;
- **addition materials** are mostly made of metallic rods from metallic alloys depending on the followed characteristics of rendering surfaces [2].

3. The Influence of Welding Procedure upon the Properties of Basic Material

Here arises the question that, in case linear energies is maintained at a constant value $q/v = 1 \cdot 10^6$ J/m, at what extent is produced an alteration of the material properties, welded through various procedures.

Having in view that mould made of steel VCrW85 have an operating system at heat, there were performed tests of bending by shock at heat, at temperatures between 293 and 973 K.

Taking into account this aspect, we started drawing test tubes from the same material with VCrW85, having thickness of 15 mm and area of $200 \cdot 100$ mm^2.

Welding parameters in Table 3.

Welding parameters used in charging steel VCrW85 Table 3

Charging procedure		Welding with covered electrodes	WIG welding	MIG welding	Welding with atomic hydrogen
Welding	Intensity of welding current I_s [A]	150-160	110-120	290-310	230-250
	Tension of electric arc U_v [V]	24-26	18-20	26-28	78-80
	Welding speed v_s [m/min]	0.18	0.12	0.45	0.55
	Linear energy [J/m]	$1.05 \cdot 10^6$	$0.96 \cdot 10^6$	$0.97 \cdot 10^6$	$1.03 \cdot 10^6$
	Material for addition	Electrod Castolin 6806	Steel rod VCrW85	Wire PP-3H2V8	Steel rod VCrW85
	Diameter of material for addition [mm]	5	4	3	4

Following the trials for hardness HV30 done upon test samples of steel VCrW85, charged through various welding procedures, there were obtained the values from Table 4.

The results obtained following bending trials by shock are presented in diagram from Figure 2.

Hardness HV30 of steel VCrW85 Table 4

Place of determinations	Charging procedure			
	Welding with covered electrodes	WIG welding	MIG welding	Welding with atomic hydrogen
In basic metal	402	415	417	402
Under belt	546	572	591	568

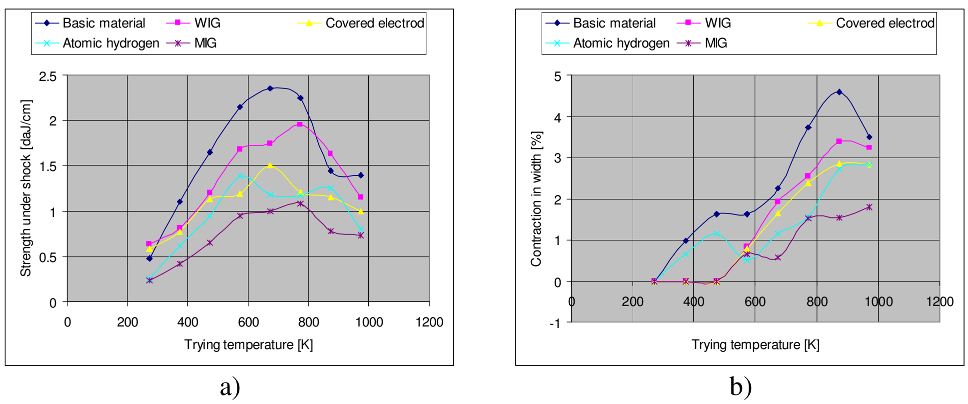

Fig. 2. *Variation of mechanic properties obtained by bending trial through shock: a) variation strength under shock; b) variation contraction in width*

4. Conclusions

Analysing the results obtained through various welding procedures, framing at the same linear energies, there were obtained mechanic properties with variable values depending on procedure.

Therefore the most pronounced hardening of ZIT was obtained in case of charging by MIG welding, and at trying of bending by shock was found out an increase of fragility for temperature of 293 K which decreases together with increasing testing temperature.

Considering that the temperature of functioning conditions of moulds is situated between 573 and 773 K, out of the test results it is observed that WIG welding and welding with covered electrodes influences the least the properties of basic material [3].

References

1. Chiriță, V., et al.: *Heat Moulding of Metals*. Bucureşti. Editura Tehnică, 1968.
2. Iovanaş, D., Iovanaş, R.: *Reconditioning and Mending of Welded Products*. Braşov. Editura Universității *Transilvania* din Braşov, 2005.
3. Scorobețiu, L.: *Steel Welding with W, Cr, Mo Used In Mould Building for Heat Plastic Deformations*. In: Ph.D. Thesis, Institutul Politehnic *Traian Vuia*, Timişoara, Romania, 1975.
4. Strassburg, F.W., Wehner, H.: *Stainless Steel Welding*. Timişoara. Editura Sudura, 2007.