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DETERMINATION OF OPTIMUM TEMEPERING TEMPERATURE IN HARD FACING OF THE FORGING DIES FOR WORKING AT ELEVATED TEMPERATURES

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Abstract: *In this paper is presented only a part of the complex procedure that must be conducted in order to successfully regenerate damaged forging dies by hard facing. After identification of the type and cause of the dies damage, we have selected the procedure and parameters of hard facing, that were further corrected by test hard facing on models. In that way, we were able to relate the output results with the repairing technology. This made possible selection of optimum hard facing technology for the adopted procedure and the filler material, as well as for the chosen regime of thermal treatment.*

Key words: *forging tools, hard facing, tempering brittleness, toughness.*

1. INTRODUCTION

The forging dies are in exploitation subjected to numerous cyclic loads, thus, after certain operating time, the impression damages occur, and the tool has to be replaced or repaired [1, 2]. Statistical investigations of the damaged dies have shown that main causes of their removing from exploitation could be: change of dimensions and form of impressions due to friction and wear, cracks all over the die due to thermal fatigue, and micro cracks caused by action of the stress concentrators [3, 4, 5, 6].

Besides the thermal stresses, caused by temperature gradient, also appear the structural stresses, which depend on chemical composition of steel, kinetics of austenite transformation, and of the cooling speed. Due to influence of cyclic variation of thermal stresses, the initial cracks can also appear on the material surface.

In the present case, we analyzed the forging dies aimed for manufacturing parts in car and trucks making industry. During the excessive monitoring of dies in exploitation, it was noticed that failures could be due to following reasons: increase of the forged pieces dimensions due to worn die, deformation of the thin-walled portions of the die, appearance of cracks at certain parts of the die, and local fractures.

The aforementioned damages are remedied primarily by application of the manual metal arc welding (MMA) procedure, and machining is mainly done by grinding, depending on the application of the filler material. In order to select the optimum technology of forging dies hard facing, numerous test were conducted at the model whose sizes were determined according to the similarity theory principle, namely the non-dimensional analysis.

For the quality criterion of the performed hard facing was adopted the change of hardness and structure in the zones of the hard faced layer, namely in the heat affected zone and beneath it, as well as the resistance of the deposited layers to wear.

Hard facing of dies aimed for operation at elevated temperatures as an objective has generally their repairing by compensating losses caused by friction or crumbling.

2. MATERIALS FOR FORGING DIES MANUFACTURING AND THEIR CHARACTERISTICS

Refractory steels are used for temperatures above 300°C. Here we speak of small, medium and large dies, for hot forming, tools for pressing and extrusion of non-ferrous metals at elevated temperatures, tools for hot trimming, dies for pressurized casting of pure Al, Zn and Mg.

In the considered case, all experiments were conducted on forging dies made of steel Č5742 (DIN 17350 56NiCrMoV7) and Č4751 (DIN 17350 X38CrMoV51). Chemical composition, mechanical characteristics and microstructure of these steels are given in Tables 1 and 2 [1, 2].

Table 1. Chemical composition and comparative marks of steels Č5742 and Č4751

No.	Mark by YUS	Chemical composition, %									Relation to other standards	
		C	Si	Mn	P	S	Cr	Ni	Mo	V	DIN	UNI
1.	Č5742	0.55	0.3	0.7	0.035	0.035	1.1	1.7	0.5	0.12	56NiCrMoV7	U52NiCrMo6KU
2.	Č4751	0.40	1.0	0.4	0.025	0.025	5.0	-	1.3	0.4	X38CrMoV51	UX35CrMo05KU