Excavator bucket in a repetitive preventive maintenance system

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1. Introduction

The wear speed graphic of a product in relation to the lifespan, in efficient working conditions, shows an inflection point from which catastrophic wear begins thus the disposal of the product. [1, 2]

This finding allows the implementation of repetitive preventive maintenance in industrial practice, which provides equipping the product with wear additions, as well as replacing them, not the hole bucket, in the moment when catastrofal wear appears, with new ones that have simmilar proprieties [3]. Theese facts and the necessity of reducing excavator bucket wheight, namely exploitation costs, determined developing a new generation of excavator cups for processing basalt rock in hard exploitation conditions, by adappting on the self-protection to wear principle [4], combined with the preventive repetitive maintanance of lightweight excavator buckets, [5] that process agregate de balastiera, by equipping them with wear additions that resist processing conditions for basaltic rocks, processed in the Bata quorry, Arad county. [6] Studyes undertaken on the heaavywheight buckets, ussed to ptocess balastic rocks in Bata quorry, highlighted a good wear behaviour of the materials, microalloyed with boron, from the brand Hardox [7]. Changing the structural characteristics when cutting air-arc sheet Hardox 450 class, imposes taking meassures to reduce hardness in the HAZ, according to the sheet manufacturer, welding wear addition on the bucket suports are done with stainless austenitic materials [8].

These materials, under moderate shock conditions, shows a poor resistance to abrasion wear, fact that imposes wear protection of the welded joints, posible to accomplish by depositing the last layer with an addition material, with high hardness and good weldability between microalloy steel and welding joint.

Designing the new product was determined on the principle of self-protection to wear, according to fig. 1. Wear additions were cut according to the established design, 20 mm Hardox 450 steel sheets, by arc-air plasma cutting [9].

Cutting parameters were experimentally established on blank samples, by optimizing on the criteria of minimum thickness of HAZ. In the process of establishing cutting parameters, we observed the presence of slag, at the level of plasma jet output, remaining deformations of the wear addition, as well as influences on the HAZ size function to the size of the sheet that will be cut. Slag was removed by polishing and the heat influence at cutting on the wear addition layers, namely the HAZ, has diminished by optimizing cutting order as well as the temperature between two consecutive cuts. Air pressure varied between 6-7 atmospheres, cutting current was constant at 120 A, optimum cutting pressure was 6,5 atmospheres and the temperature between two successive cuts was 50°C±5°C. The cut was performed perpendicular on the lamination fiber of the sheet.

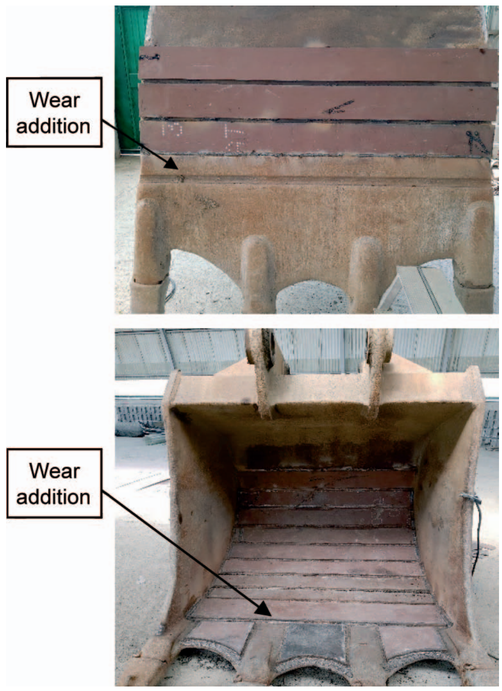

Figure 1. Design excavator bucket exterior/interior.

2. Experimental program

The experimental program for the development of technological welding, has sought to establish the following welded parameters:

- welding current
- temperature between two successive welded cuts
- welding order

In order to develop the wear addition joint on the bucket support and the self-protection to wear layers, we choose from SUDOTIM's products, electrodes SUDINOX 18.8.6 and SUDODUR E22Cr4WVTiLa, with welding parameters according to manufacturer specifications, used for welding are presented in table 1.

Table 1. Parameters used

Electrode type	18.8.6	E22Cr4WVTiLa
Welding current [A]	130±5	140±10
Diameter [mm]	4	4
Temperature between rows [°C]	Max. 100	Max. 100

Positioning the wear additions on the support was made so that the longitudinal arrow of them will be welding joint (figure 2).

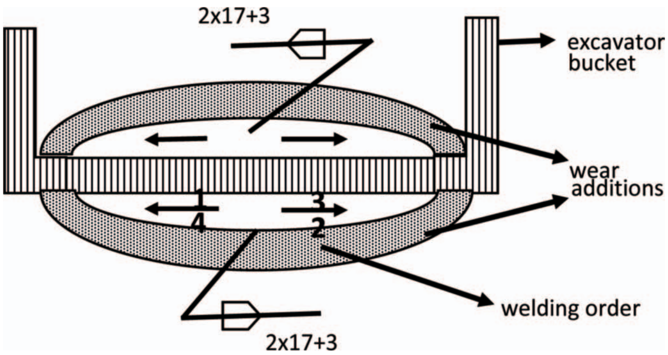

Figure 2. Positioning of wear protection addition on excavator bucket.

Welding as performed from the middle of the wear additions after temporary assembly and clamping [11].

3. Results and comments

Chemical-physical characteristics of the participant materials in the adapting process of excavator buckets were experimentally determined in order to compare them to prescribed data and assure quality constant for the new products. The chemical composition was determined on a spectrometer SPECTROMAXX, on samples extracted from laminates, from which the wear additions, buckets support and welding material are made, used in order to develop the new generation of excavator cups, presented in Table 2.

The determined chemical composition fits into manufacturer's specification, fact that assures, from a chemical point of view, quality constant of the new generation of excavator buckets. The chemical composition determined on the bucket supports makes possible framing them into the category of Hardox 400-450 class sheets, the concrete framing will be done after chemical composition tests.

Hardness values, determined on samples used to highlight the chemical composition, respectively in the HAZ are shown in the table below.

Table 3. Determined hardness

Material	Determination method	Determined values
HARDOX 450	HB	435; 440; 460; 452; 448
HARDOX 450 HAZ	HB	280; 310; 260; 283; 253
Bucket support	HB	380; 365; 410; 393; 375
18.8.6	HB	183; 195; 210; 188; 163

Data analyze highlights that the bucket support is most likely HARDOX 400, namely the fact that the HAZ softening, after cutting and welding was made with approx. 39% (477/277.2).

Experiments made in order to establish the effects of the cutting and welding cycles on the cracking tendency of the material from the wear addition layers, highlighted the 4th experiment, when cracks appeared in HAZ.

The thus developed buckets were weight and the discovered weight was compared with classic excavator buckets. We noticed a reduction in weight of approximately 20%.

4. Conclusions

Research performed highlighted the following:

1. The possibility of adapting lightweight excavator buckets by equipping them with wear additions capable to withstand sever exploitation conditions.

2. Reducing exploitation costs by diminishing the buckets weight.

3. The softening of the HAZ when arc-air plasma cutting and welding boron micro alloyed steel sheets.

4. The possibility of rational use of remaining deformations by choosing the above presented welding manner, as well as successive layer temperature, advance wear deposits and so on.

Table 2. Chemical composition

Material		Chemical composition prescribed and determined in mass [%]								
		C	Mn	Si	Cr	Ni	W	V	Ti	Others
Hardox 450	prescribed	0.18	1.30	0.25	0.10	0.10	-	-	-	B 0.013
	determined	0.22	1.38	0.30	0.11	0.09	-	-	-	B 0.08
Excavator bucket support	determined	0.18	1.22	0.18	0.15	0.11	-	-	-	0.09
18.8.6	prescribed	0.12÷0.18	5.5÷6.5	0.3÷0.7	17.5÷18.5	7.5÷8.5	Max. 2	-	Max. 0.3	Fe Residue
	determined	0.14	6.2	0.42	18.3	8.1	0.3	-	0.28	
E22Cr4WVTiLa	prescribed	1.8÷2.1	1.2÷1.5	0.3÷0.7	21÷24	Max. 0.3	3.5÷4.5	0.5÷0.7	Max. 0.7	Fe Residue
	determined	0.98	1.4	0.52	22.8	0.25	4.3	0.62	0.52	

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