

RESEARCH REGARDING THE LOAD WIG WELDING OF ACTIVE AREAS FOR ASPHALT UNCOVERING MILLING CUTTER TEETH

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Abstract. Research refer to the creation of intelligent systems with self-protection for run-out and rotation self-blocking teeth for asphalt uncovering milling cutter, by load WIG welding of active bevels procedure, with thick and hard layers of carbides, which offer high resistance to severe conditions from the exploitation. We have used a tubular rod type adding material specially created for this case. A lot of loaded teeth in the active areas were created by means of this procedure and they were tested in exploitation on an uncovering milling cutter. The obtained results have proved a significant increase in the functioning time.

1. Introduction

As a result of worldwide road traffic increase and the conduct in safe and comfort conditions, the attention of specialists in the sector was concentrated towards ensuring the proper infrastructure. In this context many companies which perform construction, modernization or rehabilitation operations of road structures, using different variants of cutters and teeth. They differ not only according to the shape and dimensions of the active part and on the nature of the material milled by the milling technology used, the depth of milling, milling machines characteristics.

The milling teeth are subjected to complex stresses depending on the road structure type, the mounting method of the teeth, milling conditions etc., which act different and inevitably leads to their wear. In this respect various researchers have proposed various solutions [1, 2, 3] to increase sustainability of the milling teeth. Basically, the applied solutions are limited to depositing on the tapered active surface of the teeth with welding seams by different welding processes and fillers [4], some layers only provide local hardness increase, leading to asymmetrical wear, unilateral without removing the lock rotation around its axis.

In this context, within our research, we intend to develop an intelligent system for anti-wear protection of teeth active areas by achieving the weld load [5, 6] of circular rings using the WIG process, and rod tube filler specially developed for this purpose and offers intelligent self-protection systems for wear self-protection and locking the rotation.

We hope that in the future we shall create milling teeth with active surface loaded from the factory with layers deposited by WIG welding with tubular rods specially designed, that contain carbides which achieve the above-mentioned systems, significantly increasing their life.

2. Materials and experimental procedure

The research focused on a particular type of teeth of the instantiate equipment for road building operations structure.

Fig. 1 shows a milling teeth comprising two active areas, namely reinforced tip – milling body (1) and tapered body portion of the milling tooth (4), which aims to increase the wear resistance by

welding deposition of a layer (2), of appropriate width and thickness with high wear resistance and self-locking during the rotation around its own axis. The teeth are made of 41Cr4 (EN 10083-1).

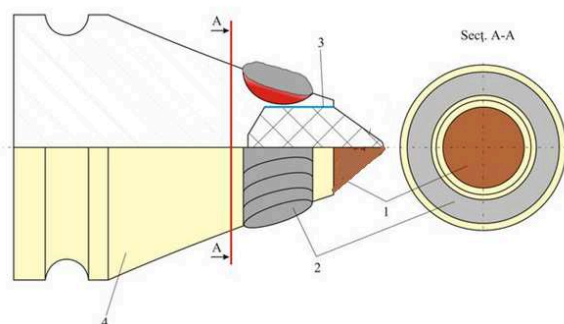


Fig. 1 Milling tooth

1 - tip cutter body, 2 - layer submitted by welding, 3 - brazing fastened area of the tip cutter body in the tooth body, 4 - milling tooth body

Weld cordons deposition on the active area (2) is carried out by customary welding processes with coated electrodes, the protective gases (MIG / MAG and WIG) or specific (laser and plasma jet), using fillers under the form of solid or tubular wire which can offer the loaded surfaces high hardness but not locking rotation protection.

The paper presents results obtained from charging active surfaces using WIG process and the tubular VTCr2,5TiD [7, 8], filler rod able to achieve deposits with very high wear with embedded tungsten carbide metal matrix (CW) that by environment friction (asphalt, gravel, rock, etc.) performs the rotation of the milling tooth. For this purpose we used an experimental setup which has allowed circular welds depositions with tubular rod fillers in semiautomatic mode. We established optimal WIG welding parameters (WPS) in order to obtain circular cords, laid with uniform thickness and according width.

2.1. Description of the experimental montage used

The experimental montage, conceived and created in order to apply layers on the conical surface of the milling teeth, is presented in Fig. 2.

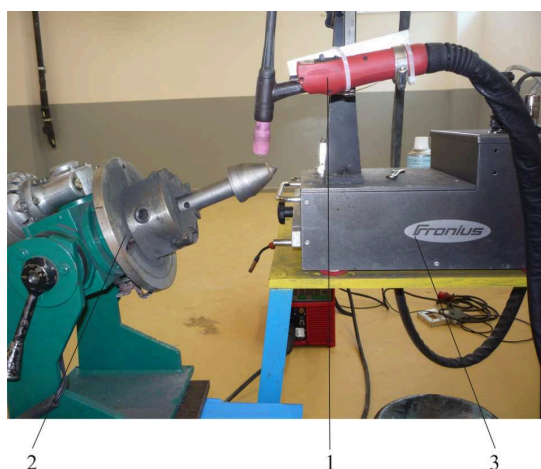


Fig. 2. The experimental montage conceived and created in order to apply layers by means of welding by WIG procedure of the conical part of the milling teeth using the tubular rod adding material

1-welding pistol WIG, 2-rotating mass and milling teeth position, 3- moving and positioning tractor of the WIG welding head

This experimental montage has allowed the applying of circular cordons welding layers, with adding material from the tubular rod used in semi- automatic regime.

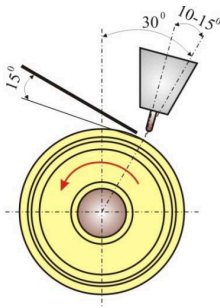
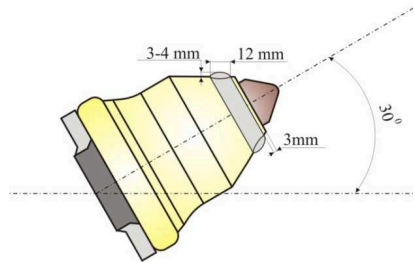
Thus, the milling teeth was positioned for the loading with the help of rotating and positioning mass, accomplishing the rotation with optimal welding speed by its self command. Also, the metal rod was introduced manually in the electric arch (Fig. 3), using an adequate montage.



Fig.3 Milling teeth positioning and the introduction of the tubular rod

2.2. Experimental research regarding the conical surfaces of the milling teeth tips by WIG welding loading with tubular rod adding material

The welding parameters and the details regarding the conical surfaces of the milling teeth regarding the loading of the conical surfaces of the milling teeth by WIG procedure with adding material tubular rod these are presented synthetic in the welding WPS procedure specification.

WPS		WELDING PROCEDURE SPECIFICATION					View Name: Milling tooth		
Welding processes: 141					COATING TYPE:				
Welding position: Horizontal					COAXIAL				
BASIC MATERIALS					ADDING MATERIALS				
MB1	Name:		41Cr4			Brand:	VTCr2,5TiD		
	Norm:		EN 10083-1			Norm:			
	Group:					Dimensions (mm): 300 x (6,5 x 2,2)			
Thickness (mm): ----		Diameter (mm): ----			Drying: Temperature/Time; (°C/h): N/A				
MB2	Name:		----			Unfusable electrode	Type: WOLFRAM 2% Th		
	Norm:		----				Diameter (mm): 2.4		
	Group:		----			Gas / Flow	Protection: Argon 99,99 (EN439)		
Thickness (mm): ----		Diameter (mm): ----			Root: ----				
Preheat temperature (°C): 220 ⁰ C					Gas flow	Protection (l/min): 10-12			
Temperature between layers (°C): 220 ⁰ C						Root (l/min): ----			
COATINGS DETAILS									
									
Weld	Welding processes	Size of filler material	Amperage (A)	Tension (V)	Current type Polarity	Wire feed speed (cm/min)	Welding speed (cm/min)	Linear energy (KJ/cm)	
1	141	6.5 x 2.2	125	25	DC+	-	8	-	

On the layers applied with tubular rod VTCr₂5TiD, on the experimented milling teeth tips, transversal sections were made in order to analyze metallographic the specific areas of the layering (Base material, HAZ and Weld). The microstructural aspects are presented in Fig. 4.

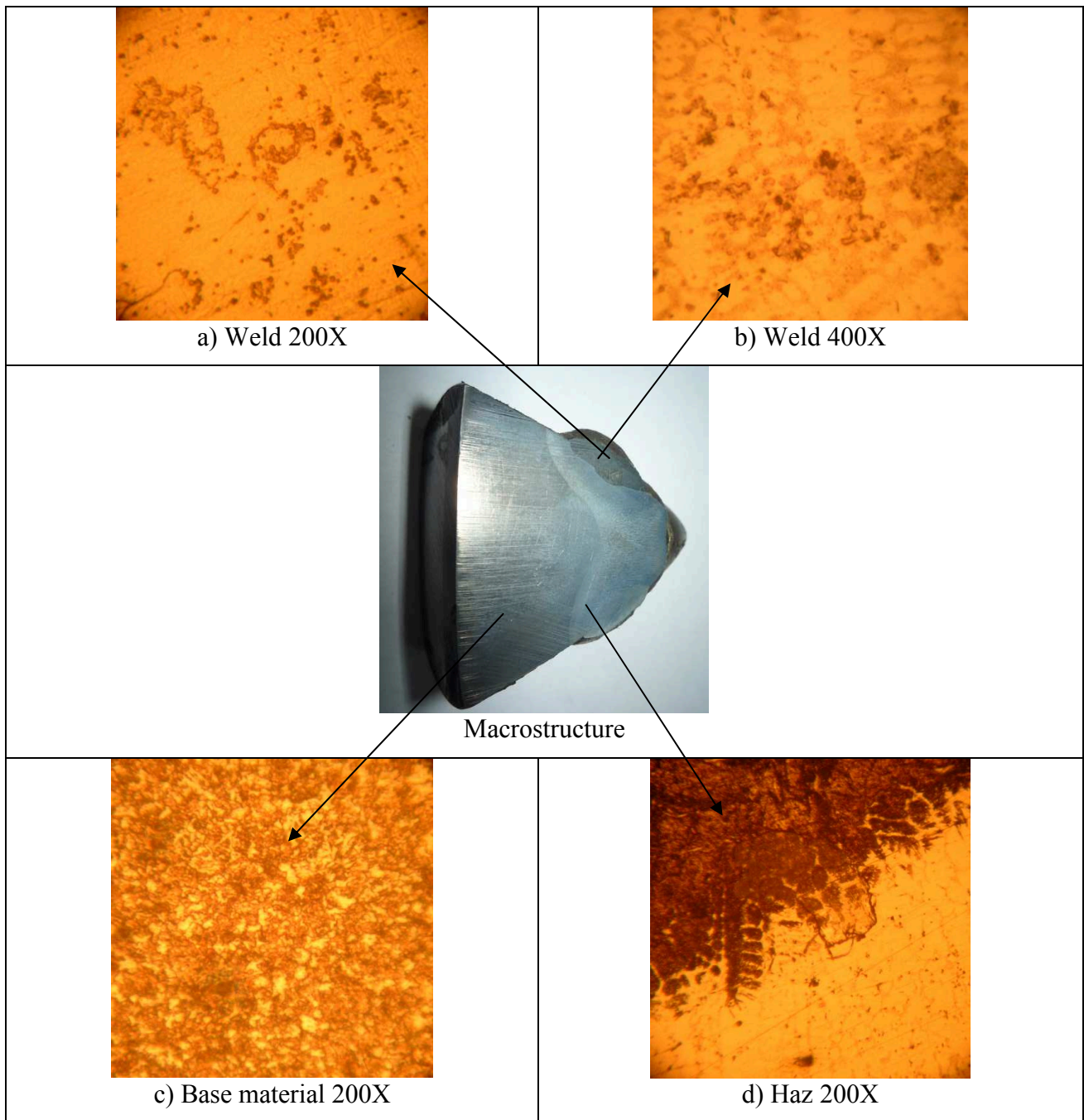


Fig. 4 Macro and microstructural images of the milling teeth loading area, by WIG procedure – tubular rod VTCr₂5TiD

In Weld (Fig 4 a and b), dendritic unomogenous structure solid solution alloyed with chrome and fine wolfram carburs, uniform, with iregular contour and also chrome carbours. In HAZ (Fig. 4 d), we highlight the mechanical mixing effect produced between Weld and Base material. In HAZ we register a mix microstructure of modified perlite+ferrite+martensite+residual austenite.

The hardness determinations were made in the areas indicated in Fig. 5, the values being registered in Table 1 and graphically represented in Fig 6.

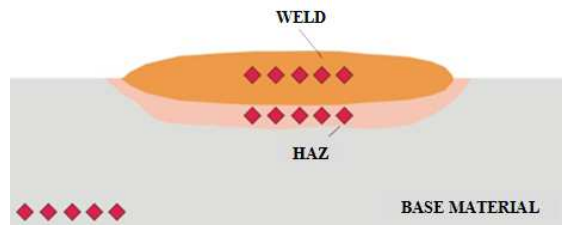


Fig. 5 Positioning the microhardness determinations

Table 1 Hardness

No. hardness impression	Microhardness HV ₀₁			Hardness HRC		
	Base material	HAZ	Weld	Base material	HAZ	Weld
Cordon						
1	320	558	778	32,1	53,1	62,9
2	335	562	781	34	53,3	63
3	326	560	775	32,9	53,2	62,8
4	327	568	776	33	53,7	62,9
5	328	550	782	33,1	52,6	63
Average	327,2	559,6	778,4	33,02	53,18	62,92

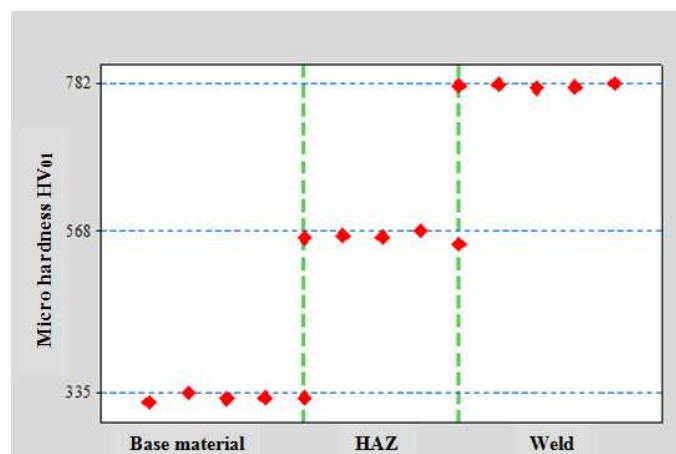


Fig. 6 Microhardness variation on areas characteristic to the layering

3. Results and discussions

The paper presents the results of mechanical-metallographic tests which characterize the surfaces load. Thus measurements in regards to the hardness of the loaded cross-sections which indicate that their values are at least twice in regards to the tooth body, which gives a high resistance to wear. Macro and microstructural analyzes showed that the tungsten carbide from the rod tube remains were partially melted and their shape is as a needle or globes, especially in the transition with the base metal showing a system in aging and self-locking rotation cutter teeth.

A lot of teeth loaded by this method have been tested on a machine, observing a uniform wear of the teeth and the active areas a significant increase in lifetime.

4. Conclusions

- An intelligent anti-wear protection body scraping tooth milling was designed and implemented for road structures by carrying the load by welding a circular layer of adequate thickness width and

high wear resistance and self-locking when rotating the its axis using WIG process with filler rod type tubular VTCr2, 5TiD the active surface area, especially developed for this purpose.

- The teeth made with the anti-wear protection system and self-locking during rotation were tested in terms of hardness, structural and functional behaviour.

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