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Effect of Repair Welding On the Properties of Welded Joints of Steel S700MC

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Abstract*—The article is describing the influence of linear energy of and repairable welding on the joints properties of S700MC steel, with 10 mm thickness treated using thermo mechanical method. In the case of steel treated using the thermo mechanical method, which has high level of plastic tolerance (deformation), during the welding process it is very important to control the level of heat introduced into the area of the joints (weld). The linear energy during the welding process should be limited to 10 kJ/cm. Furthermore, the additional heat introduced to the welded area after the welding process can rapidly deteriorate the properties of the created joints, particularly effected can be yield of the joints and HAZ. Too much heat delivered to the area of the welded joints will cause recrystallization and growth of the grain in the HAZ area resulting in the loss of properties gained during the thermo mechanical treatment, and in the joints there will be uncontrollable processes of MX type phase separation causing deterioration of properties of the welded joints.

***Index Terms*—Heating Effected Zone, Repair Welding, Thermo mechanical Steel.**

I. INTRODUCTION

During the last decades the producers of steel focused their efforts on the production of construction materials with higher and higher strength and yield, with characteristic improved weld ability and containing cheaper alloying additives. There has been a trend for the use of high performance steels in the construction, with the aim to lower the weight and production costs. In order to achieve such aims the appearance of thermo mechanical process of steel rolling (TMCP) was found particularly useful, which is based on a controllable rolling process with the accelerated cooling. The usefulness of materials for the production of welding constructions depends on different factors, which until now were not greatly considered in the assessment their welding abilities. An important problem in steels is the influence of alloy micro additives (niobium and vanadium) on the weld ability and properties of the welded joints. The role of the micro additives in these steels comes down to the creation of appropriate dispersion of carbides, nitrides and cabinetries of niobium and vanadium, during the controlled rolling process, which increase the strength properties through micro phase reinforcement and limited size of the grains [1-8].

II. RESEARCH

In this work, joints based on the S700 MC (Table 1, Fig. 1) steel with thickness of 10 mm were investigated, and welded using MAG method (Table 2). The drying and heating up temperature was 80 ^{o}C and the interlayer temperature was 60 ^{o}C. The chemical composition was carried out on the steel, on the G Mn4Ni1, 5CrMo weld and the joint material (Table 3-5).

Table 1. The chemical composition according to the regulation PN EN 10149-2 and mechanical properties of the S700 MC steel subjected to thermomechanical treatment used for cold moulding

Chemical composition [%]											
C max.	Si max.	Mn max.	P max.	S max.	$Al_{całk.}$ min.	Nb max*.	V max.	Ti max.	B max.	Mo max.	C_e** max.
0,12	0,60	2,10	0,008	0,015	0,015	0,09	0,20	0,22	0,005	0,50	0,61
Mechanical properties											
Tensile strength Rm, MPa			Yield limit Re, MPa			Elongation A_5, %			Impact strength, J/cm^2 (-20°C)		
822			768			19			135		

* - total amount of Nb, V and Ti should be max. 0,22%

** C_e – carbon equivalent (1)

$$C_e = C + \frac{Mn}{6} + \frac{Cr + No + V}{5} + \frac{Ni + Cu}{15}, [\%] \quad (1)$$