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Influence of Hot Clad Rolling Process Parameters on life cycle of Reinforced bar of Stainless Steel Carbon Steel Bars

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Abstract

Experimental trial is made to produce and manufacture of a cladding resistance reinforced bars of stainless steel- low carbon steel bars. Grooved rolling with different ; passes design, clad rolling temperature, rolling speed, rolling direction and reduction ratio are employed to investigate clad bars properties experimentally. Tensile test and microstructure observation was done on the manufactured samples of clad bars to examine the rolling conditions on mechanical and microstructure properties; size and shape of bonded line region, and microstructure of stainless steel and low carbon steel for each cladding conditions. A comparison with the required specification for reinforced bars was done to choose the best production parameters. Results, shows that Rolling temperature, rolling direction and reduction ratio have more effect on clad bonding zone size and mechanical properties than rolling speed.

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Keywords: clad; hot rolling; stainless steel; low carbon steel; reinforced bars

1. Introduction

In recent years, bimetal cladding bars have been more and more used in a variety of industries to create combine functions. Among cladding methods, the cold and hot rolling is the most widely used in producing bimetal cladding material. The bimetal clad bar is comprised of two metals bonded across their interface. Because the two metals are

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metallurgically bonded it should behave mechanically like a single homogeneous bar, if a proper cladding process was done. According to the literature review there are numerous researches at the beginning have been worked out on corrosion resistance of cladding bars, which were reported or sponsored by National foundations or department of transportation or universities. Did not concentration on the way of manufacturing of this bars. These were only systematic corrosion testes may continue for many months or years [1-7]. Studying cladding bars during manufacture process specially with hot rolling were not too much. Most of them deal with production of ribs on the clad bar.

Cross, et al. [8], made a numerous testes to examine the mechanical properties for stainless steel clad reinforcing bar manufactured by rolling process using tensile test, impact test and scanning electron microscope (SEM). They found that the core failed prior to the cladding both the rebar core during tensile and the stainless steel have undergone brittle failure, and the stainless steel cladding has pulled away from the black steel core. Sawiki, et al.[9-13], made numerous studies experimentally and theoretically. They manufactured semi-finished bimetallic bars steel-steel resistant to corrosion by explosive cladding. Then an analysis of changes in the microstructure was performed both for the core, joint zone and for the clad layer, effect of clad thickness layer on the correct formation of ribs in finished bars. The quality of the joint between bimetallic layers, microanalysis of the different zones of the joint was made by the energy dispersive chemical analysis to find the composition rates of Cr, Si, Mn, Fe, Ni in each region. Microhardness test of layers in respective joint regions obtained after explosive welding comparing microhardness for stock materials and in bimetallic bars after explosive welding with different clad layer thicknesses. Comparing results before and after explosive founding that, high increase in microhardness in the joint zone. Which had a clad layer thickness of 1.0mm oval pass and the finishing passes were performed. Mróz,et al. [14], made a experimental analysis of the rolling process of Cu – Al bimetallic bars in elongation passes by groove-rolling. The variations in the shape of bars during groove-rolling were carried out in the study. The results proved that, the properly selected rolling parameters enabled a copper- aluminium bimetallic bar to be produced without any delaminating at the bond boundary and with a uniform distribution of the clad layer over the bimetallic bar perimeter and length.

From above review it can be concluded that most of these studies were carried out on corrosion resistance for clad bar and when they examine the properties of type of clad bar they do that for a manufacture company that is usually refused to uncover its secret. Also, The groove rolling process considered a complex process to produced clad bar and less applicable during first passes .So research concentrate on the choice of the shape and size to find the optimum clad thickness, but these not deal with reinforced clad bar (stainless steel and carbon alloy). In any case, the idea is an out clad over the black core and then hot rolled , but hot rolling using groove rolling was less use since it is difficult to produce cladding , skew rolling is more effectiveness. While groove rolling used in most cases for making ribs on the clad bar. These models do not offer exhaustive information about how a parameter varies throughout the clad bar length and cross section and in that intelligence can only yield limited universal information. Consequently in present paper, experimental trial is made to produce and manufacture of a cladding resistance reinforced bars of stainless steel - carbon steel bars. Grooved rolling with different ; passes design, clad rolling temperature, rolling speed, rolling direction and reduction ratio are employed to investigate clad bars properties experimentally.

2. Experimental work

2.1. Material selection

The stainless steel type 316, is an austenitic stainless, contain Molybdenum, Nickel and Chromium added to increased corrosion resistance. It was selected to be a clad layer for cladding of reinforced bars due to its good corrosion resistance to the aggressive effect of the environment, low price compared with full section stainless steel and its readily availability. Low carbon steel is selected as a base metal to meet the requirements for the mechanical properties of the reinforcing bars.