Electroslag Welding (ESW) -  
A New Option for Welding Aluminum Bus Bars in Smelters

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Abstract

In recent years, a new welding process for aluminum bus bars, Electroslag Welding (ESW), has been developed, tested and used industrially, permitting significant productivity gains both in time and manpower. ESW offers among other advantages the possibility to modify or repair bus bars of an operating smelter with minimum power shutdown time (about 20 minutes per full bus bar cross-section weld) and to build a new rectifier room reducing the construction time and the costs by more than 50 %. The present paper will describe this new welding process and its optimization, discuss the weld quality and present a few industrial applications, such as factory construction of the bus bar network of a new smelter by assembly of sub-modules and the alteration of the bus bar network of a smelter in operation in order to add a new rectifier to the network for additional production capacity.

Keywords: Electroslag welding (ESW); aluminum bus bar welding; busbar sub-assembly; aluminum smelter capacity creep.

1. Introduction

When it comes to join two very thick metal plates, Electroslag Welding (ESW) is the most productive, single pass welding process available. Developed simultaneously in the 1940’s in the United States by Kellog Co. and in the Ukraine by the Paton Institute, the ESW was used extensively with steel in the 1960’s for railroad tracks, bridge beams, ship hulls, traction motor frames, etc.

In the meantime, the traditional method used by the aluminum industry to weld heavy aluminum bus bars was « staggered plate » method (Figure 1). With this approach, plates about 12 mm thick are piled in a staggered pattern one by one. Gas Metal Arc Welding (GMAW) is then done on each edge. The process is then repeated until the joint between the two bus bars is entirely filled.

Figure 1. Staggered plate method for bus bar welding.

However, the resulting weldment has typically only about 80 % of full cross-section electrical conductance due to gaps that are left and weld quality issues; it is also very time-consuming