The Effect of Pulse Current and Post Weld Aging Treatment on Precipitate Phase and Mechanical Properties of Weld Bead

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ABSTRACT

Because of expeditiousness in recent products and under the trend of expedite product-elimination rate, it shall lay more emphasis on appearance, quality, light weight, convenience and recyclability of goods more than their functionality. The development of light metal industry just meets the environmental protection propaganda which calls for energy saving, a decrease of carbon dioxide emissions and resource recycling practiced globally, thus making light metal industry exist high potential for development. Among these light metals, magnesium, aluminum and titanium are most well-known. Titanium is a material featuring light weight, high specific strength, and extraordinary corrosion-resisting trait as well as a perfect material applied to stateless structure. As the difficulty of metallurgy and the processing for titanium materials in early days resulted in high cost of material and reprocessing, the major application was available for military and aeronautics industry. Gradually, the mature development of vacuum metallurgy and processing technology, titanium is widely used in general industries. Recently, the applied scopes for titanium have gradually grown wider that it requires carrying out the welding processes. Researches concerning to titanium alloy welding, however, is still quite deficient in Taiwan currently. In this experiment, therefore, we selected the most widely applied welding method -Gas Tungsten Arc Welding to carry out the welding experiment with changing the frequency of pulsing current on 15V-3Al-3Sn-3Cr titanium alloy. Due to the fact that such titanium alloy can achieve a goal of enhancing mechanical strength without a great loss of elongation through appropriate heat treatment. This research will be focused on comparing the base metal and pulse weld before and after the heat treatment as well as discussing the influence of pulse frequency and precipitation phase relative mechanical properties. From experimental results indicated that the base metal undergoing solution aging treatment achieves the best combination of tensile strength and elongation. After the weld has undergone different frequency of pulsing current, the grains of weld can reach refined effect while strength is increased but still lower than the primary base metal. After carrying out the post-weld aging treatment, both hardness and strength increased significantly, and meanwhile, there appeared one situation that the ultimate tensile strength decreased slowly with increasing the frequency. It is believed that there exists a close relation between the precipitate phase ratio and distribution. Generally speaking, the overall mechanical properties of 9 Hz pulse frequency weld undergoing the post-weld aging treatment have the best presentation. We expect findings of this research will be helpful to the techniques of the titanium alloys industry and make it more widely used in other fields.

Keywords : 15V-3Al-3Sn-3Cr Titanium Alloy, Gas Tungsten Arc Welding, Pulsing Current, Post-Weld Aging Treatment

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