Abstract

The doctoral dissertation was meticulously crafted to address the critical issue of ferrite grain growth during welding, a problem that significantly impacts the mechanical properties of welds made of ferritic stainless steel. This research is of paramount importance, as it directly addresses the pressing needs of the industry in the field of applying new technologies for welding ferritic stainless steels. The goal is to broaden the use of these steels in machine parts and structural elements, where high strength properties, in addition to corrosion resistance, are a necessity.

For research purposes, ferritic stainless steel grade X2CrTiNb18 was selected. The test joints were made using the welding method 141 (TIG) in the PA position.

The work consists of five chapters. The first chapter is an introduction. The second chapter characterizes, based on a literature review, basic information related to the formation of mechanical properties of stainless ferritic steels resulting from the growth of ferrite grains as a result of heat input during their welding, characterizes possible ways of solving the limitation of grain growth by using welding additives such as titanium, or by using an additional heat treatment process aimed at relaxing the resulting welding stresses and obtaining a uniform fine-grained structure of the weld area and HAZ. The third chapter, concerning the experimental part, characterizes the theses and objectives of the dissertation, presents a research plan, describes the characteristics of the tested material, presents the research methodology and the obtained results, and their discussion.

The work culminates in a summary – chapter four, where the results of the conducted experiment are analyzed. These findings have significant practical implications, as they allow us to determine the effect of titanium addition during welding and the effect of heat treatment of joints after welding on the limitation of the phenomenon of ferrite grain growth in the weld area and on the mechanical properties of welded joints of ferritic stainless steels of the X2CrTiNb18 grade. The work concludes with chapter five, which presents the practical outcomes of the research. Based on the data obtained from the conducted experiments, the parameters of the welding technology of ferritic stainless steels of the X2CrTiNb18 grade were determined, along with the parameters of heat treatment after welding. A document confirming the recognition of welding technology according to the PN-EN15613-1 standard for optimal welding and heat treatment parameters, issued by the notified body TÜV Thuringen, was obtained, underscoring the real-world impact of this research.