

mgr inż. Michał Krzysztoforski

Faculty of Transport
Silesian Technical University

Summary of dissertation

Usage properties of welded busducts using micro-jet welding technology

During the PhD thesis, the influence of the new technology of micro-jet cooling on the welding process of aluminum alloys was investigated. Welding of alloys is a key factor in the production of large-size responsible welded constructions on the example of busducts. It was found that the use of micro-jet cooling in the welding process of aluminum alloys gives the possibility to modify the structure and properties of welds. These changes affect the functional properties of busducts during their operation, with special focus on their electrical and mechanical parameters.

As part of the work, a review of the literature was made and tests were carried out that can be divided into two stages – preliminary research and fundamental research. As part of the preliminary tests, a design and manufacture of a prototype micro-jet injector for welding aluminum alloys was carried out. Then samples were made in accordance with the internal instructions of one of the busduct manufacturers, it was checked whether the electric conductivity is influenced by the welding method, the thickness of the material or the type of filler. The next stage was the production of samples cooled with a micro-jet injector and carrying out thermovision tests. Then, in order to check whether the electrical properties of the weld are affected by different cooling gases and welding speed, appropriate samples were prepared from the alloy 1050 used for the construction of busducts. The control samples were welded without additional cooling. The electrical resistance of welds was measured on such samples and X-ray examinations were performed. The purpose of the preliminary tests was to check whether it is possible to improve the electrical properties and whether the use of additional cooling in the welding process does not negatively affect the welding incompatibility.

After the review of the literature and preliminary research, the thesis was proposed:

"Making welds with the use of micro-jet technology in the construction of busducts will ensure better mechanical properties of welded joints and reduce the power losses of busducts."

In order to confirm the right of the thesis, fundamental research was then carried out in which the influence of the number of microstreams, the pressure of the cooling medium outflow and the distance of the microjet coler from the welding torch in relations to the electrical conductivity and mechanical properties of the welds were analyzed. The basic work schedule was established in accordance with the principles of experimental planning. The next step was to perform microstructure tests and to carry out diffractograms to confirm changes in the microstructure caused by the use of additional cooling. The material for testing was the 1050 alloy used to build busducts. An AlSi5 electrode wire (4043) was used.

The results of measurements of conductivity and tensile strength as well as metallographic tests

unambiguously confirm the desirability of using additional microjet cooling in the aluminum welding process. In the conducted tests, samples made without additional cooling were characterized by the lowest electrical conductivity and the highest tensile strength. It was found that the use of additional cooling has a positive effect on the electrical and plastic properties of the welds and thus the thesis has been confirmed.