

Streszczenie rozprawy doktorskiej w języku angielskim

Abstract

The presented dissertation discusses problems related to the shaping of optimal functional properties of layered composites in the manufacturing process. The tests were carried out for three-layer AlMg5-Al-M1E composites produced by explosive welding. The obtained areas of connection of the components of the layered composite, despite the common method of their production, were quite different. Intermetallic phases were observed in the area of the Al-M1E layer junction. However, in the case of the junction of the Al and AlMg5 layers, no intermetallic phases were found. The research carried out in the work allowed for a comprehensive analysis of the behavior of various types of connections during the plastic shaping of sandwich composite sheets. The doctoral dissertation was presented in two parts: theoretical and experimental.

The theoretical part of the thesis discusses the issue of the theoretical and experimental basis of the process of manufacturing layered composites. It has been shown in this part of the work that the observed increase in the use of metal composites in so many industries implies the need for the development of modern methods of their shaping. On the other hand, traditional and commonly used methods require improvement, especially in terms of improving the quality and economic efficiency of manufacturing products. The literature part discusses the processes of joining and plastic shaping of layered metal composites. A description of the methods of joining metals and their alloys is included, with particular emphasis on the explosive welding method. The characteristics of the asymmetric rolling process of metal composites are presented, taking into account the aspect of shaping the functional properties and the durability of the layer connection areas.

The research part includes the scientific hypothesis, the purpose of the work, representative results of experimental research and their analysis. The paper proposes a controlled asymmetry of rolling of composite sandwich sheets as a parameter controlling the functional properties of finished products and contributing to the improvement of their production efficiency. The tests carried out as part of the work were divided into two groups of parameters, i.e. parameters related to the shape and geometry of the product and functional in the subsequent stages of the manufacturing process. The first stage of the conducted considerations was to carry out macroscopic and microscopic examinations of the components of the layered composites joined by explosive welding. The quality and durability of the connection areas was assessed. Then, the process of plastic shaping of flat composite products was carried out in order to reduce the

thickness of the layers constituting the composite. Experimental studies have shown the impact of uneven distribution of deformation on individual layers of the composite, and as a result, its uncontrolled bending after the rolling process. This phenomenon resulted in the need to introduce the straightening operation of rolled composite strands to the research part. Then, the impact of the parameters of the plastic forming process on the quality and durability of the joint areas of the composite sheets was assessed. For this purpose, tests of macro- and

microstructure, shear strength and microhardness at the height of the tested composite sheets were carried out. On the basis of the conducted experimental studies, the range of optimal conditions for the process of rolling composite products was determined. As a final result, conditions for the rolling process were determined to ensure that simple composite sheets with high-quality layer connections and optimal functional properties were obtained.

The considerations carried out in the doctoral thesis indicate that the process of manufacturing composite sandwich sheets has a high potential for implementation. The introduction of the developed consideration to industrial conditions is fully justified both in the technological and economic aspect.

The doctoral dissertation ended with a summary and conclusions from the considerations.