LASER PRODUCTION OF VACUUM STAINLESS STEEL INSULATION PANELS

Task

Vacuum insulation panels (VIPs) represent an economic and effective solution for reducing energy consumption in large industrial, commercial and sports buildings of lightweight steel construction. In this connection Fraunhofer ILT has developed a laser technique for producing stainless steel VIPs.

Method and Result

For the development of an economically viable production process, the deep drawing method was compared with the folding technique. Owing to the thinness of the stainless steel foil it was not possible to produce a fault-free rectangular shape by deep drawing. While the pleated structures made it difficult to achieve a faultless seam, cracks also formed in the corners of the material. As an alternative, a folding method was developed which meets the technical requirements that exist for VIPs, such as vacuum-tightness. At the same time, this technique is less expensive to implement than the deep drawing method. The cutting and welding process was optimized and prototype VIPs were made using the multifunctional cutting and welding head from the company Laserfact. Thanks to the innovative combination of laser cutting and welding, the VIPs exhibited excellent technical characteristics as a cost-effective production technique. A 4-kW fiber laser from the company IPG was employed as the beam source.

The VIPs were produced using silicic acid as filler material. With evacuated insulation panels thermal conductivities can be attained which are one to five times lower than those of conventional insulation materials. To this end, a thick-walled panel material (1 mm) is produced as the carrier structure (outer panel). This carrier structure is completed with thin stainless steel foils (0.1 mm) to encapsulate the element for introduction of the filler material. The panels are evacuated at a pressure of $10^{-2}$ mbar. The welding speed was 4–10 m/min at a maximum laser output of 2.5 kW.

Applications

The production technique covers a wide range of applications. The VIPs can be used wherever insufficient space is available for conventional insulation materials, for example in refrigerators, buildings requiring renovation, large gates and doors on commercial buildings and halls for sports events.

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1 Laser-welded stainless steel vacuum insulation panel.
2 Microsection.