Highlight

Aachen,
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Intelligent power control methods for the quasi-simultaneous laser welding of thermoplastics

Quasi-simultaneous laser welding (QSLW) of thermoplastics has been used for many years and it has proven its applicability to industrial use in many cases. Nowadays, due to the relative recent avalalbility of high blilliance laser sourcess and development of process control methods based on temperature detectors new perspective arise for the further improvement of the process. Latest results of the work within the European POLYBRIGHT project indicate that using an intellingent power control method the process robustness can be significantly increasead.

Pyrometers are already proved and used in various applications for the process control of the laser polymer welding. However, pyrometers can be also used in order to generate customized power control curves and subsequently an application adapted temperature profile. Using this approach an intelligent power control method can be developed for the QSLW and the welding parameter window can be enlarged. This method uses a pyrometer to extract optimal laser power curves to keep the material longer above the melting point during the welding process. Conventionally for the QSLW a fixed laser power is set and the melting of the materials occurs towards the end of the welding cycle. The intelligent power control developed combined with the use of high brilliance laser sources enables the fast heating of the materials above the melting temperature and keeps the materials in the molten state longer compared the standard OSLW process. This approach leads to an optimal diffusion of the polymeric chains over the interface in the welding area and therefore to a high weld strength and process robustness.

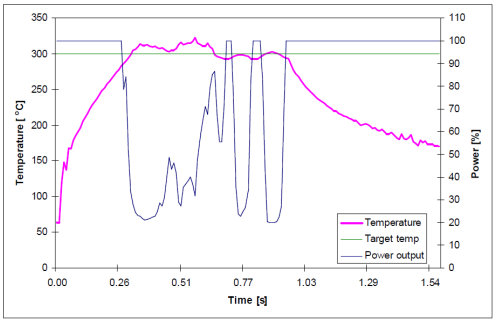

Figure 1: Intelligent power control for the robust QSLW of thermoplastics

The principle of the power control method is illustrated in Figure 1. In the beginning of welding the pyrometer adjusts the power to 100% and after the target temperature was achieved pyrometer adjusts the power according to set temperature. Simultaneously the resulting laser power curve is recorded and will be used as a master for the actual welding later in the production.

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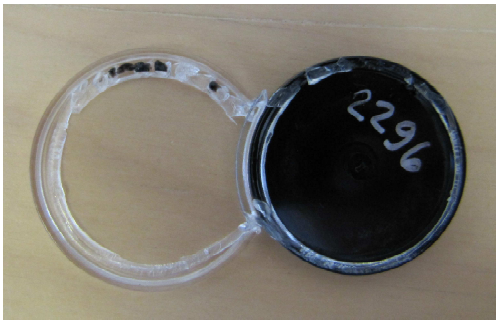

Figure 2: Polycarbonate samples after the tensile test, welded using a customized power control curve

Using this approach several welding experiments are carried-on with cylindrical samples made of Polycarbonate (PC). The first results show that the process tuning is easier and that the weld strength in on the same level as for the traditional QSLW. Figure 2 shows the test samples after the tensile test. The analysis of the fracture indicates that the weld strength should be close to the strength of the base material.

Considering that the use of pyrometers for the process control represents a significant cost factor and that the use of these devices with scan heads requires a demanding adjustment effort (e.g. correction of the chromatic aberrations) the intelligent power control proposed could represent, at least for several applications, a cost effective solution for increasing the reliability and reproducibility of the welding process.

For any further questions our experts will be pleased to provide you assistance:

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