

Electromagnetic Joining: Process Design and efficient Equipment

The processes high velocity electromagnetic accelerated self-piercing riveting (EMR) and magnet pulse welding (MPW) are two process types of electromagnetic joining. Both processes are suitable for manufacturing of metal-composite hybrid parts.

In the EMR process a punch is electromagnetic accelerated to a velocity of 20 - 50 m/s. The kinetic energy of the accelerated punch gets transferred to high forming velocity of the rivet during the setting process. The setting behaviour at increased velocity can be beneficially used for self-piercing riveting of fibre reinforced composites to sheets from aluminium or other metals, Figure 1.



Figure 1: A carbon fibre reinforced composite (CFRP) sheet joint by means of EMR process with an aluminium sheet

The MPW process is a cold welding process. Accordingly, it is suitable to use with composites which have a low melting temperature, Figure 2. In MPW a flyer sheet is accelerated. If the impact velocity exceeds a minimum

Poynting GmbH

Alte Strasse 65
44143 Dortmund
Phone: +49-231-59 28 21
Fax: +49-231-59 28 32
info@poynting.de
www.poynting.de

Dr. Charlotte Beerwald
Phone: +49-231-59 28 21
info@poynting.de



value and further relevant process parameters are in the so-called weldability window then the welding process will be successful.



Figure 2: A conic composite tube is clamped between two welded aluminium sheet metal parts

A successful product and process design for the EMR and MPW processes requires finite-element analyses, Figure 3. They support a broad exploration of possible product designs in combination with the required tool coils, Figure 4. Both designs are optimized together and finally, an efficient process is specified. Accordingly, the requested discharge energy is minimized, which also minimizes the recommended resources on machine equipment. Furthermore, the tool coil durability is extended.

After the product and process design, the shape of the required current over time is specified.

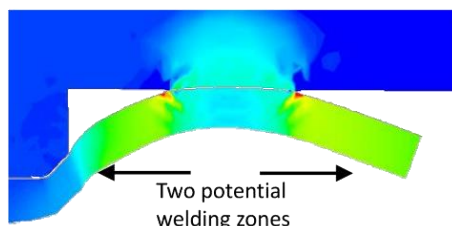
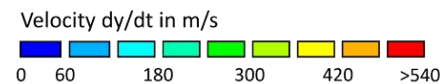


Figure 3: Determination of relevant welding process parameters by means of FEA

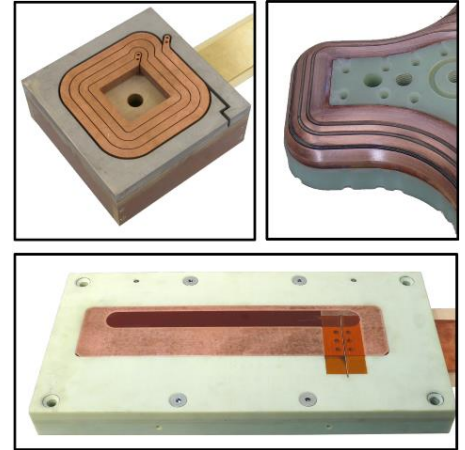


Figure 4: Tool coils

From a broad range of compact or modular machines a suitable one with the recommended discharge energy can be selected. It can be specialised on the specific process or it can be additionally used for further different processes. The last choice requires a configurable machine, which supports changing of the active capacitor banks, Figure 5. In this way, the shape of the current pulse can be adjusted and the optimum for a new process can be selected.



Figure 5: EMJ machine with 3 configurable capacitor banks