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MODIFIED PARTICLE FOAM COMPONENT WITH JOINING SURFACES AND METHODS FOR ITS PRODUCTION

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Technical task:
The production technology of components made of EPP particle foams has been established in practice for many years. Large quantities of superheated steam are used in the manufacturing process. In most cases, the steam supply for a production site is carried out centrally.
Aluminium tools are used in the manufacturing process. Their heat capacity is a multiple of the heat quantity actually required for production (welding of the particles). In each production cycle, over 99% of the thermal energy supplied by the superheated steam is used only to heat the tools and steam chambers. During cooling, a large part of this energy is lost or can only be reused at great technical expense. In the project it is planned to reduce the thermally effective mass of the tool. For this purpose, two solution approaches are to be used in parallel.

Initial situation:
Whether as sun visor, transport box or helmet - the range of applications for particle foams is already very diverse. However, due to the rather functional surfaces, the particle foams are mostly used hidden in the end product. By combining particle foam with suitable reinforcing materials and/or other processing methods, such as injection moulding or thermoforming, the range of applications for particle foams can be extended even further. PVSG - Particle Foam Composite Injection Moulding©* is the fundamental process innovation to enable the material-to-material bond between particle foam and thermoplastic. Minimised water vapour enables the integration of the foaming machine into the injection moulding process.

Solution:
A core idea of the process according to the invention is to melt and solidify an area intended for the joining of the component during or after the swelling of the pre-expanded particles in the mould of the automatic moulding machine so that a compact plastic joining surface is obtained.
According to the invention, during this solidification, an area of the mould is heated more strongly and optionally compressed more strongly with a punch. In this way, a compact thin thermoplastic layer is partially formed on the particle foam part, which functions as a joint.
Possible joining methods are thermal welding, but also gluing or joining with pressed-on snap-on joints.

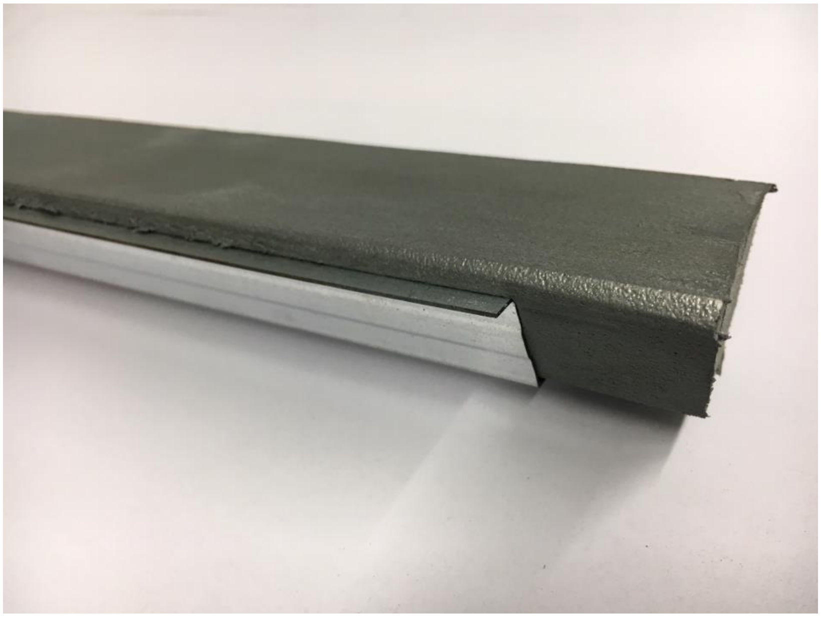

Figure 1

Figure 1 shows an extruded thermoplastic foam part that was pressed into a structured sheet metal part by means of pressure and temperature. This part bonds very well with the sheet metal part.

If the same test is carried out with a particle foam part, the low density and the air content in the particle foam means that good adhesion is not possible.

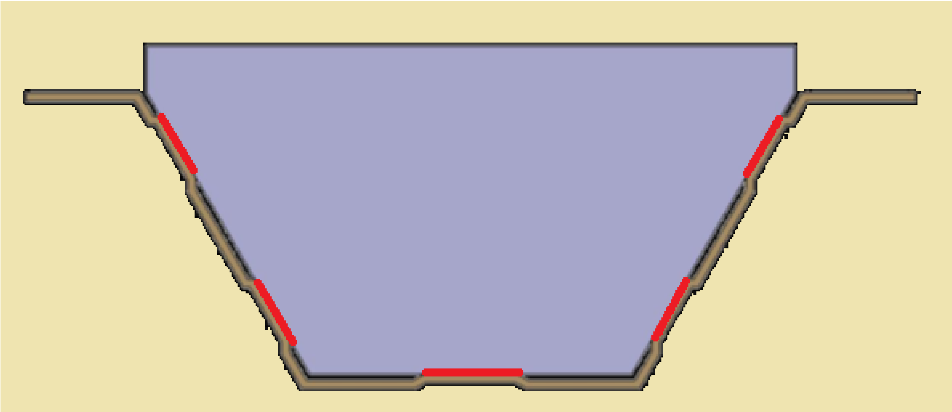

Figure 2

In figure 2 the areas to be strengthened are marked in red. Thus there is a compacted area in the particle foam component in the system/joining surface.

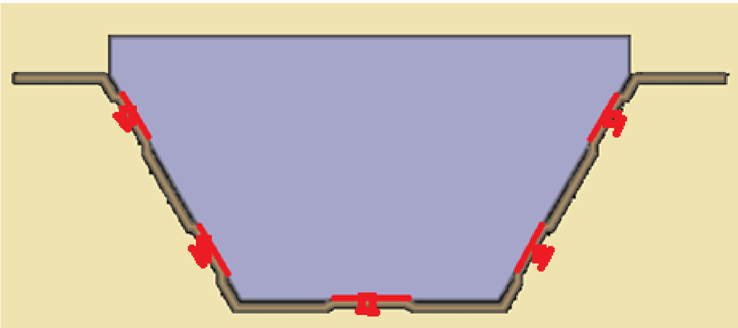

Figure 3

Figure 3 shows the formed element, which is inserted through the sheet metal part and riveted again.

Requirements:

1. strengthened area
2. solidified area with structure to achieve mechanical interlocking during joining
3. solidified area with snap-fit connection elements which can be formed in the melted area by the punch

Advantages:
Thermal insulation introduced into the tools reduces the effective heat capacity of the tool and limits it only to the technologically required zones. This allows steam consumption to be reduced by approx. 50 %. In addition, the drastically reduced media and energy consumption enables self-sufficient temperature control of the thermally active mould zones integrated into the system.
With these measures, cycle times can also be shortened. Due to the lower steam requirement, a central steam supply can be omitted. This results in additional savings, since heat and pressure losses associated with a central steam supply are eliminated.
In connection with the production, only the media compressed air, cooling water and electricity are required to supply the production machines.