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Young Innovators Poster Session

Inline production of multi-material pultrusion profiles

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Components made of more than one material are in the center of development at countless research and development institutions. These multi-material components are an important basis for efficient and economical lightweight design, especially in the automotive industry. The research project "Hybrid Pultrusion" – funded by the European Union and the Free State of Saxony – addresses the pultrusion process in order to be able to produce hybrid profiles from fiber-reinforced plastics (FRP) and metallic functional elements or other plastic elements in the future.

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1 Introduction

As part of the lightweight design trend, multi-material components based on FRP are increasing. Hybrid pultrusion profiles made of FRP and metal enable completely new application potentials with a high profitable production process.

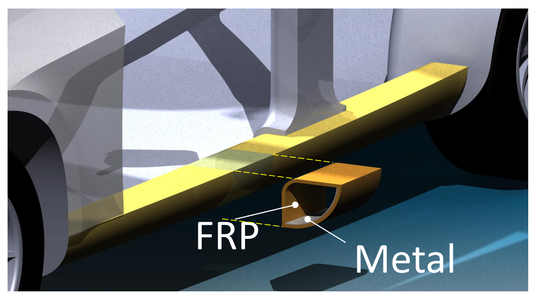

Fig. 1: Hybrid side sill

2 Method overview

The pultrusion process is used for the economical manufacturing of continuous FRP-profiles. For the development of a new process for hybrid profiles it is necessary to modify the classical pultrusion process. The additional integration of metallic semi-finished products into the process leads to a lot of challenges, for example the different thermal expansion of both materials. For that reason a completely new coating was developed to achieve a strong covalent bonding between FRP and metal.

The lacquer-like coating causes that both materials bond inseparably during the process and remain bonded even after cooling.

Fig. 2: Fiber raw materials and metallic semi-finished product

3 Results and discussion

The challenges of the hybrid pultrusion process include

- the defined supply and integration of the metal components into the pultrusion die,
- the controlled formation of the covalent bond in the course of the chemical curing reaction of the plastic matrix in the tool,
- new concepts for mold temperature control and sealing in the tool,
- targeted surface pretreatment of the metal to form high bond strength.

In order to prevent negative effects of thermally induced residual stresses on the bond strength, a powder paint coating is applied to the metals. To generate a large number of chemical bonds, the powder coating is adapted to the used pultrusion resin. Due to the flexibility of the coating residual stresses can be compensated.

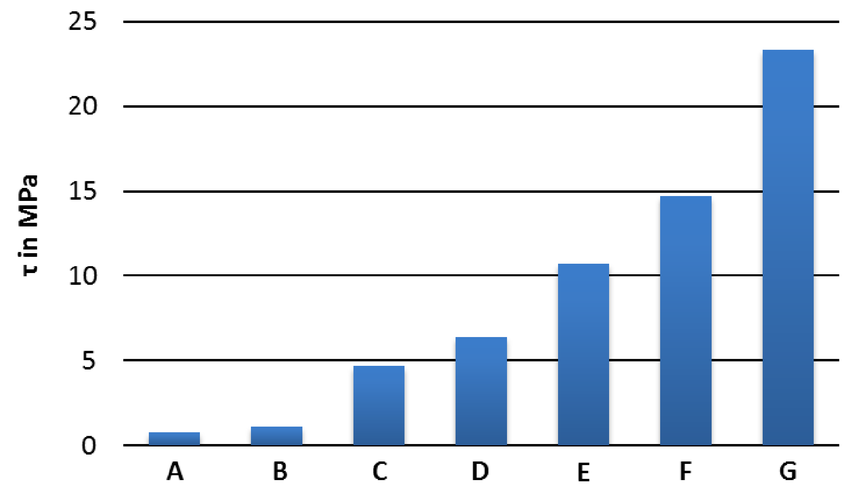

Fig. 3: Graphical representation of the bond strengths of various surface treatments

4 Materials

Hybrid profiles are made of glass fiber-reinforced epoxy resin and steel. Other fiber materials such as carbon and aramid as well as other matrix materials like polyurethane or polyester are also in the focus of research.

Fig. 3: Hybrid pultrusion profiles

5 Conclusion

Hybrid pultrusion profiles differ from currently used hybrid components. Advantages like

- new design and application potential for hybrid components,
- economical production,
- increased energy absorption capacity compared to classic FRP-profiles and
- alternative joining methods for FRP-profiles

of the modified process are relevant for future applications in lightweight design.

6 References

European Union
Europe funds Saxony.
EFRE
European Regional Development Fund

Freistaat Sachsen

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