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DVS – DEUTSCHER VERBAND FÜR SCHWEISSEN UND VERWANDTE VERFAHREN E. V.	Thermally sprayed coatings on components made from non-reinforced and fibre-reinforced plastics	DVS Technical Bulletin 2315

Replaces October [illegible] issue

Inhalt:

1. General

This technical bulletin provides information on the production and post-processing of thermally sprayed coatings on plastic components. Due to the extremely poor heat resistance of most plastics and the relatively low bonding strength of sprayed coatings compared with coatings on conventional metallic substrates, additions and further explanations are needed to supplement the remarks in DIN EN 13507, DIN EN ISO 14924, DIN EN 15520 and Technical Bulletins DVS 2301 and DVS 2311 regarding the coating of plastics.

This includes information on both the production and structure of fibre-reinforced compounds, as well as data relating to the permissible temperature load of common matrix systems. Furthermore, notes on possible methods of improving the bonding strength of thermally sprayed coatings and on post-processing using machining processes are also provided.

Due to the sheer scale of commercially available plastics and the broad range of material properties, only the most common polymer types can be considered in this technical bulletin. However, many of the notes in this technical bulletin can also be applied to other types of plastics. The user should also undertake a detailed study on a case-by-case basis in the relevant scenarios.

2. Application engineering designs

Due to the specific material properties of plastics, the amount of heat transferred into the component must be kept considerably lower than the heat input prevalent with metal substrates. Plastics for the most part also have widely differing thermal coefficients of expansion compared with metallic and ceramic coating materials, which can lead to unfavourable residual stress states and bonding problems. Particular consideration must be given to this aspect in relation to material selection, coating structure and temperature management. Negative effects can be minimised by producing multi-layered coating systems or graduated coating structures, using high gun wire feed speeds and undertaking intensive component cooling. When coating fibre-reinforced plastics, care must also be taken to ensure that the machining process - including pre- and post-treatment - does not damage the composite structure (fibre matrix). Machinability depends largely on the matrix composition and level of reinforcement. For this reason, precise information on the substrate should be to hand and - if possible - the production process for the composite material itself should have already been adapted with regard to the coating-relevant requirements.

2.1. Manufacturing techniques and structure of fibre-reinforced composites (FRC)

Typical manufacturing processes, frequently used fibre and matrix systems and material abbreviations are listed in the following Tables 1 to 4. Figures 1 to 3 show examples of different types of fibre-reinforcement.

Table 1. Selection of manufacturing process for FRC.

Process	Semi-finished products
Resin Transfer Moulding infusion process (RTM)	Fibre fabric Tissue Fibre structures
Autoclave technique	Prepreg (impregnated fibre fabric or tissue)
Compression technique	Prepreg
Winding technique	Fibre rovings
Lamination	Tissue, tile

DVS, Technical Comittee, Working Group „Thermal coating processes“

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Table 2. Typical reinforcing fibres for FRC.

Reinforcing fibres	Semi-finished products
Glass	Roving Tissue Mats Short-fibres
Carbon	Roving Tissue Mats Short-fibres
Aramid	Roving Tissue

Table 3. Typical matrix systems for FRC.

Matrix systems (resins)	Abbreviation/material
Duromers	EP (epoxy resin) UP (unsaturated polyester resin) PF (phenol formaldehyde) BMI (bismaleinimide) PI (polyimide) VE (vinylester resin)
Thermoplastics	PA (polyamide) PC (polycarbonate) PEEK (polyether ether ketone) PEI (polyetherimide) PESU (polyethersulfone) PPS (polyphenylene sulphide)
Elastomers Foams	Polyurethane Silicone rubber

Table 4. Abbreviations for reinforced plastics.

Abbreviation	Material
Aramid	Reinforced with aramid fibre (polyacrylamide, PTPA)
BRP	Boron-fibre reinforced plastic
CRP	Carbon-fibre reinforced plastic
GRP	Glass-fibre reinforced plastic
HS-CF	Reinforced with high-strength carbon fibre
HM-CF	Reinforced with high-modulus carbon fibre

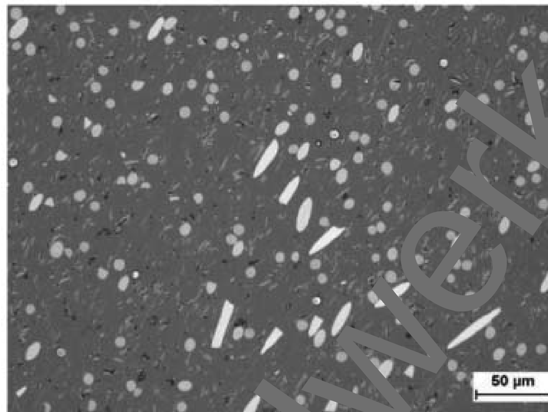

Figure 2. Cross-section of PEEK polymer with 10% short carbon fibre-reinforcement, 10% graphite and 10% PTFE additives.

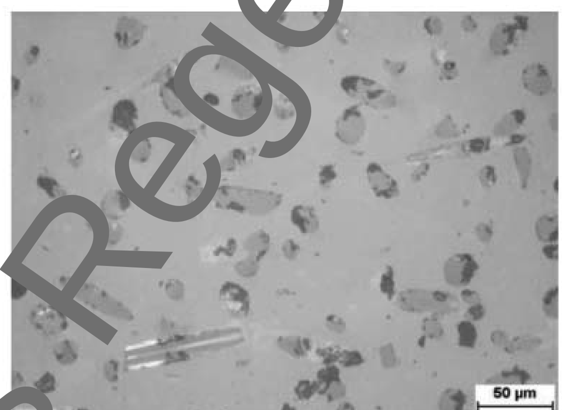

Figure 3. Cross-section of PEEK polymer with 30% short glass-fibre reinforcement.

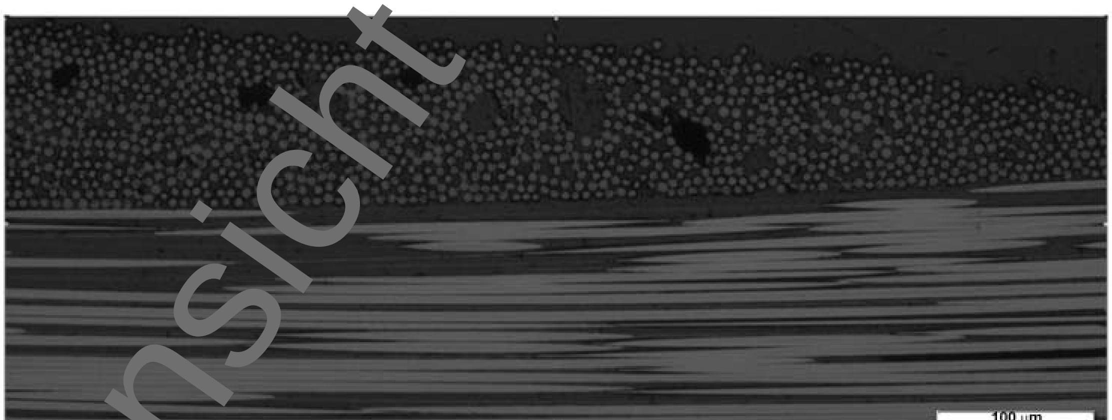

Figure 1. Cross-section of a CRP laminate produced from carbon-fibre rovings.