NEWS RELEASE

Robot-based filament winding unit for the research and optimisation of wet winding processes for pressure tanks

Researchers integrate different optical measuring systems for the inline documentation of production faults

Aachen, August 2020 – The Institute for Plastics Processing (IKV) in Industry and Craft at RWTH Aachen University has put into operation a new robot-based filament winding unit from the firm Hille Engineering. Especially for the Delfin consortium project, this will open up new possibilities for research into potential savings in the production by wet winding of Type 4 pressure tanks for fuel cell vehicles.

In the research project funded by the PMVI, a total of nine project partners (see picture) are carrying out research on the optimisation potential in the production of pressure tanks. They are looking at the entire value chain with the aim of increasing cost and material efficiency. In the project, a research team from IKV has assumed the task of studying the mechanical and thermal behaviour of the liner-boss-valve interface. In addition, the team is developing methods for the inline documentation of production errors in the wet winding process. Production faults in this context are taken to mean any deviations between the design of the tank by simulation and the actually manufactured tank. Because of the variety of possible production deviations, the research team will initially focus on documenting the fibre band geometry (fibre band width, fibre band orientation, fibre band thickness) and the positioning of the fibre band on the pressure tank. For this, they are evaluating the different optical techniques currently used for measuring.

Integration of optical measuring systems into the plant engineering

To obtain a reliable evaluation, integration of the measuring systems into the new plant engineering is of major importance. The robot-based filament winding unit works according to the principle of the moving mandrel, in which the winding mandrel moves back and forth on a linear axis in front of the thread eye. The thread eye, as part of the deposition head, is attached to a 6-axis KUKA KR 300 industrial robot. The deposition head contains an integrated winding mandrel for four fibre spools, a separate filament tension control for each filament, an impregnating unit and an additional band tension control. This enables precise fibre band deposition on the mandrel. The clamping length of the new machine is 300-3,000 mm, allowing the production of parts with a maximum weight of up to 300 kg (including mandrel). The diameter of the mandrel is limited here to 800 mm. Attainable winding velocities are up to 2 mm/s, depending on which mandrel is used. In addition to the wet winding process, the machine is also suitable for towpreg winding because of its high modularity in the deposition head.

The measuring technology for the fibre band geometry is integrated in the deposition head. Apart from the circumferential winding pattern, steep and flat helical winding patterns can also be examined. In order to be able to carry out initial tests quickly, suitable mountings for the optical measuring systems are currently being prepared.

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Virtual reconstruction of the pressure tank

To determine the lay-up position, inline documentation of the fibre band alone is not adequate. To establish the position of the fibre band on the mandrel, the machine coordinates – and thus the lay-up position – are linked up to the measuring data, so that a spatially resolved allocation of the measuring data and thus a virtual reconstruction of the pressure tank is made possible. For this, the new winding unit features a rail-mounted PC with an SQL database, via which the position data and other relevant process parameters such as take-off speed, filament tension, knife gap and resin bath temperature are made available for the data evaluation.

The research project is being financed as part of the National Innovation Programme Hydrogen and Fuel Cell Technology (NIP) with funds from the Federal Ministry for Transport and Digital Infrastructure (BMVI) under funding code 03B10104D. The grant for the research project amounts to around EUR 7.5m. The programme coordinator of the NIP is NOW GmbH.

About IKV

IKV - the Institute for Plastics Processing at RWTH Aachen University, is Europe-wide the leading research and education institute engaged in the field of plastics processing enjoying outstanding reputation. More than 300 staff are employed in finding solutions to problems connected with processing, materials technology and part design in the plastics and rubber industries. IKV's close contacts with industry and science, together with its outstanding facilities, enable cutting-edge research in plastics technology and ensure that students benefit from a comprehensive, practically oriented course of study. Plastics engineering graduates from IKV are thus sought-after experts in industry. In organisational terms, IKV is divided up into the four specialist departments of Injection Moulding, Extrusion and Rubber Technology, Part Design and Materials Technology, and Composites and Polyurethane Technology. The institute also takes in the Centre for Analysis and Testing of Plastics, and the Training and Further Education department. IKV is run by an Association of Sponsors, which currently has a membership of about 300 plastics companies from all over the world. Univ.-Prof. Dr.-Ing. Christian Hopmann is Head of the Institute and Managing Director of the Association of Sponsors. He also holds the Chair of Plastics Processing at the Faculty of Mechanical Engineering at RWTH Aachen University.

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Total view of the new, robot-based winding system in the composites technical centre of the IKV

The project consortium consists of nine project partners in total. The project is funded by BMVI and the programme coordination of this innovation project is carried out by NOW GmbH.