

Injection Moulding Of Highly Filled Graphite Compound Bipolar Plates For Use In Fuel Cells

C.Kreuz¹, P.Beckhaus¹, T.Derieth¹, F.Mahlendorf², A. Heinzl^{1,2}



¹ Zentrum für BrennstoffzellenTechnik
Carl-Benz-Straße 201, 47057 Duisburg, Germany
c.kreuz@zbt-duisburg.de

² University of Duisburg-Essen
Institut für Energie- und Umweltverfahrenstechnik
Lotharstrasse 1, 47057 Duisburg, Germany



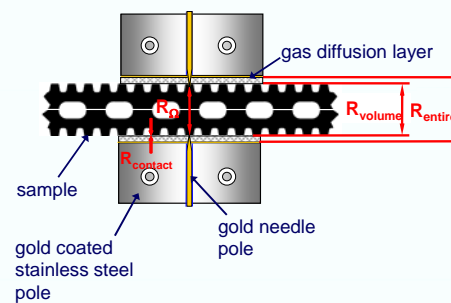
1. Compounding

- Highly filled graphite compounds consist of graphite, carbon blacks, (eventually additives) and a thermoplastic resin as binder, whereas the filler fraction is above 80 %.
- The production of compound material takes place in a twin screw extruder with a screw diameter of 25 mm.
- Two gravimetric metering units are used to obtain an accurate mixture of the filler and binder fraction.
- Mass flow of each fraction, zone and mass temperatures, torque and nozzle pressures are logged for quality assurance and process development.
- Actually up to 12 kg/h of highly filled graphite compound is producible.

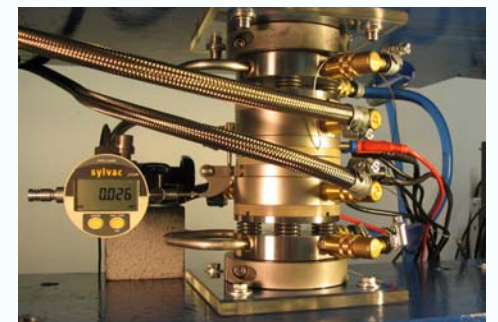


Twin screw extruder with gravimetric metering units, vacuum degassing and self designed nozzle

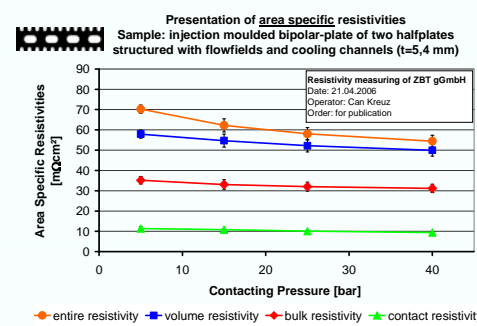
3. Characterisation



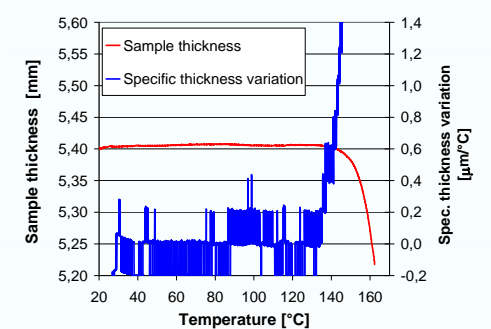
Functional principle of the four pole resistivity measuring facility



Heatable four pole resistivity measuring facility



Area specific resistivity of an injection moulded bipolar-plate



Heat deflection behaviour of an injection moulded bipolar-plate

2. Injection Moulding

- The injection moulding process of highly filled graphite compounds to thin, structured bipolar plates needs excessive injection pressures >3000 bar, therefore extensive clamp forces and a high power injection moulding machine.
- Crucial parameters for the process are the temperatures of mould and mass, injection velocities, pressure curves and material quality.
- To develop the injection moulding process, parameters like pressures and velocities are logged every 2 ms.
- The steady injection moulding standard process for a bipolar half-plate reaches a cycle time of only 18 sec.! So up to 100 bipolar plates per hour are producible!

Pro:

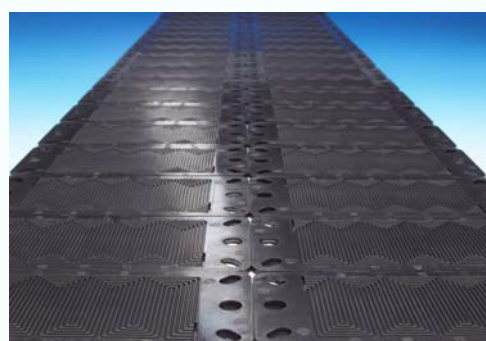
- Good conductivity and chemical stability
- Processable by mass production process
- High reproducibility
- Very short cycles time
- Cost effective

Con:

- Limitations in plate size
- Weight



High power injection moulding machine with a clamp force of 300 t and a maximum injection pressure of 3500 bar



Mass produced bipolar half-plates

4. ZBT's PEM fuel cell stacks

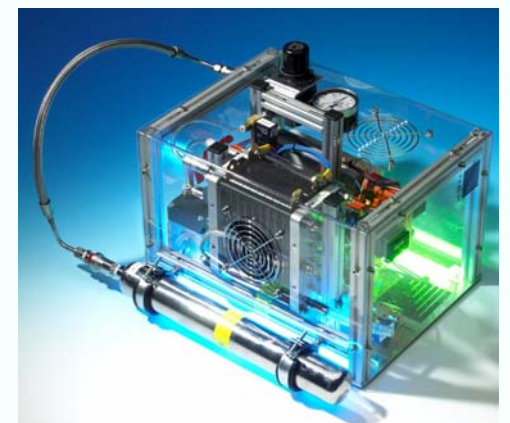
- ZBT designs and builds air cooled PEM short stacks with the in house produced injection moulded bipolar plates.
- State of the art is a 24 cell stack with a nominal power output of 400 Watt. Dimensions: 190 x 140 x 80 mm Weight: 3,2 kg
- Several fuel cell systems are build up for different applications.
- Small series production (still handmade) is established.



Small series production of fuel cell stacks



ZBT's standard fuel cell stack with 24 active cells



100 Watt fuel cell system with hydrogen storage cartridge



Acknowledgments: This work was supported by the European Funds of Regional Development and the Region of North Rhine-Westphalia, Germany

