Investigation of Adhesive Bonds in Electrode-Separator Compounds and their Influence on Battery Cell Properties

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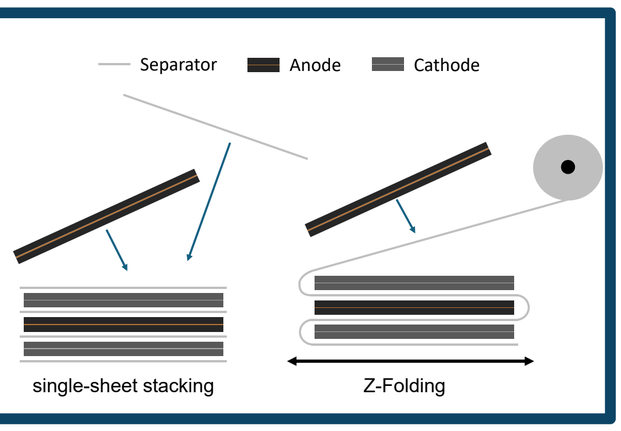
Motivation

- Stacking process is a crucial **throughput limitation** in battery production
- State of the art battery stacking relies on **discrete handling** of individual electrode sheets
- Lamination process involves **energy consumption** and **material limitations**



Objective

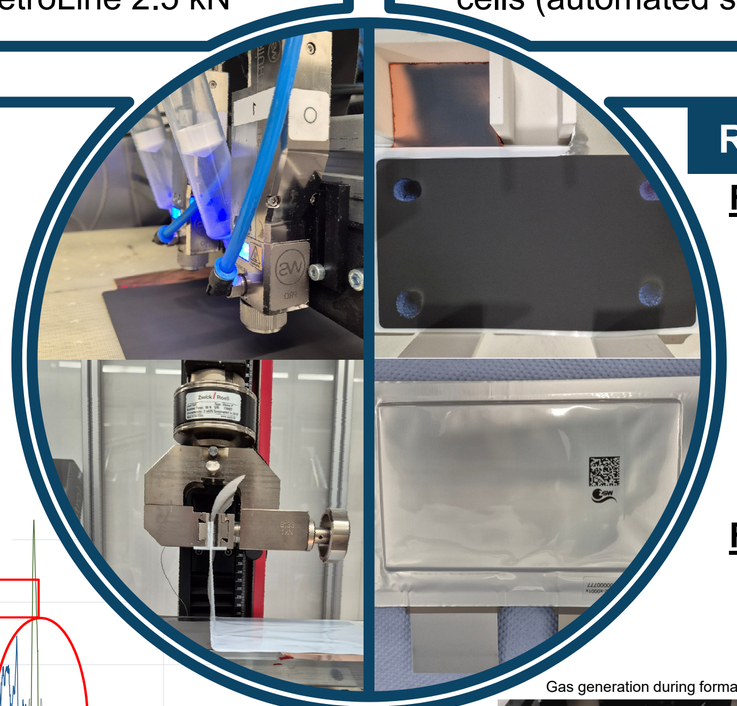
Application of **electrode binder**, which acts as an **adhesive**, as a **material-independent** and more **energy-efficient** process to join individual electrode sheets to a continuous separator web for use in an **industrial**, **continuous** stacking machine.

Approach – Process Investigation

- **Adjustable process parameters:** material, quantity, application form and pattern, temperature, various pressures
- **DoE** with evaluation of the resulting adhesive strength using a standardised **90° peel test** on the Zwick RetroLine 2.5 kN

Approach – Influence on Cell Properties

- Manual stacking of 5 **pouch cells (11 Ah)** using the developed adhesive joining method
- Formation and **benchmarking** with conventionally stacked cells (automated single-sheet stacking)



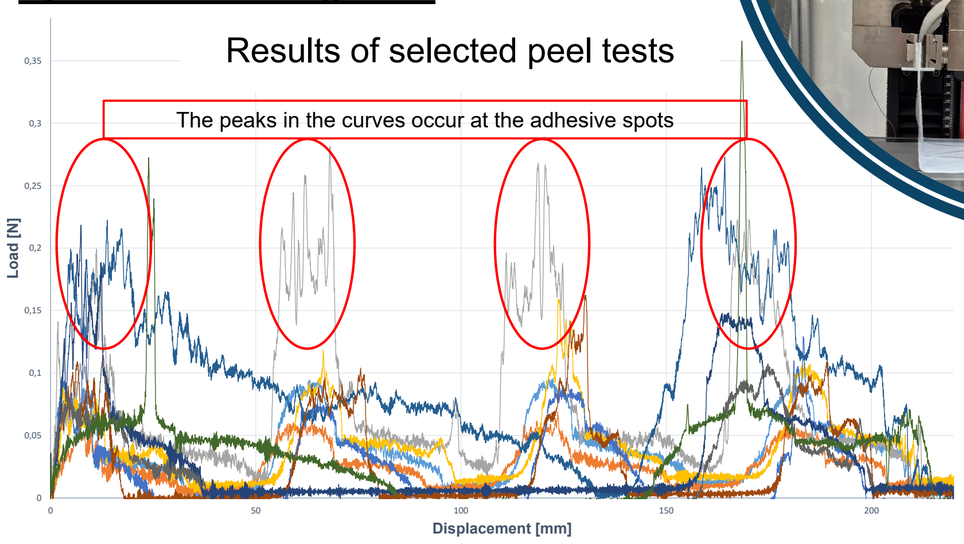
Results – Process Investigation

Preliminary investigations:

- **SBR** (40.1 wt% dissolved in water) with 0.5 wt% **CMC** has proven to be the most suitable binder system with regard to processability and mechanical properties of the resulting compound

Systematic investigation:

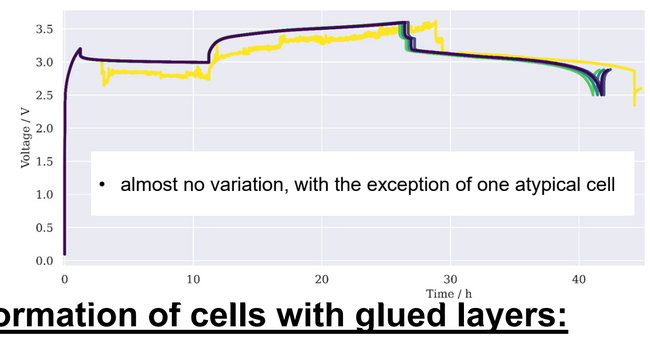
Results of selected peel tests



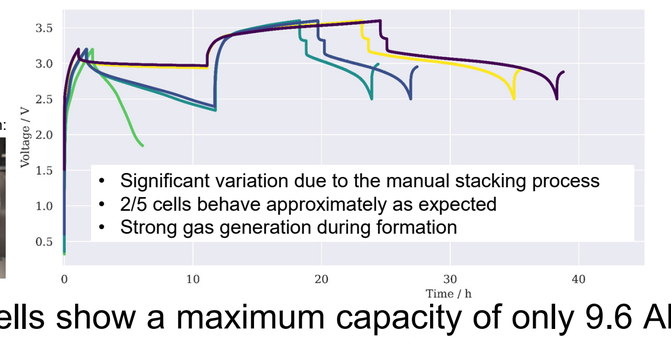
- Binder quantity and temperature with significant, linear influence on adhesive work (area under curve)
- Application pattern with significant influence on the compromise between tear force (peak height) and adhesive work

Results – Influence on Cell Properties

Formation of cells without glued layers:



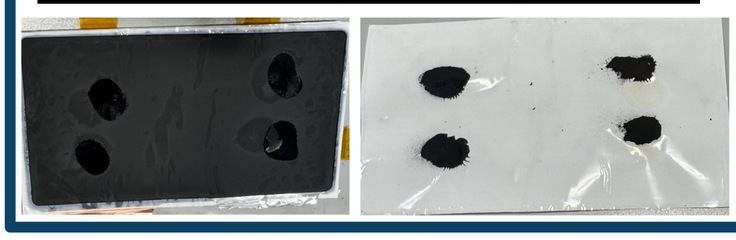
Formation of cells with glued layers:



Gas generation during formation:

- The glued battery cells show a maximum capacity of only 9.6 Ah (Nominal capacity and benchmark cells: 11 Ah)

Post-mortem analysis of the glued cells:



Delamination of the active material as a possible cause of reduced capacity

Outlook

- Further **investigations** with alternative binder mixtures to prevent delamination of the active materials
- Identifying a material system that has **no negative effects on cell performance**
- **Integration** of the optimized process into the existing machine prototype and **scale up** towards higher process speeds
- Verify that the achievable adhesive strength is sufficiently high even at higher process speeds and therefore higher peeling stresses

Project Management

projektträger jülich

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