New intermitting concepts for slot die coating of Li-ion battery electrodes (Talk)

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Introduction

Creating Li-ion Battery electrodes involves three film-forming steps: coating, drying and calendering [1]. Calendering allows higher energy and capacity densities in the final cell stack. Here, higher line forces affect stresses between the uncoated and coated parts of the web. Amplified by heavy edges in the film, these stresses may create wrinkles (*Fig. 1*; *left*). One possibility to avoid these problems is to coat intermittently, slit off the edge regions and place the current arresters in the uncoated gaps between the film patches.

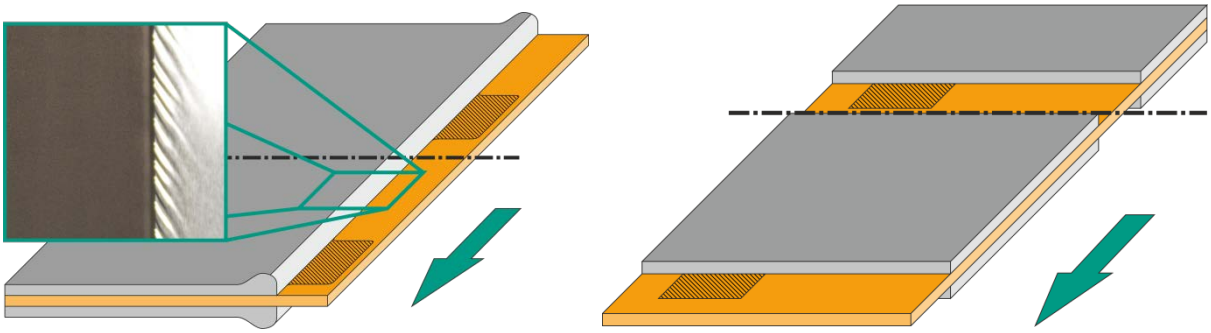

Fig. 1: Continuous coating with heavy edges and wrinkles in the uncoated area (left); Intermittent coating without uncoated areas (right).

Intermittent coatings are often realized by means of a bypass valve and/or an alternating coating gap. The disadvantages of these concepts are vibrations and the limitation of speed due to the gap alternation and mechanical moves in the valve. In this work, we therefore investigate intermittent coating concepts without gap alternations.

To reduce the mechanical effort around the coating step, it is also necessary to get a better understanding of the whole dynamic fluid system. Thus we calculated and measured fluid pressures before and in the slot die and compared them to the resulting pattern profiles considering switching times at high coating speeds.

Experimental methods and results

In principal slot die coating is a unit operation transforming a pipe flow into a gap flow [2, 3]. The distributional force behind this step is the applied pressure drop inside the die.

In a first step of understanding the mechanisms of intermittent coatings we assumed a link between the current system pressure and the resulting film thickness. Proofing this assumption, we installed pressure transducers inside the slot die and profiled the coated film by the means of a 2-dimesional laser triangulation sensor. In a related experiment the intermitted coating was realized just by using a bypass valve, without any alternating gap.

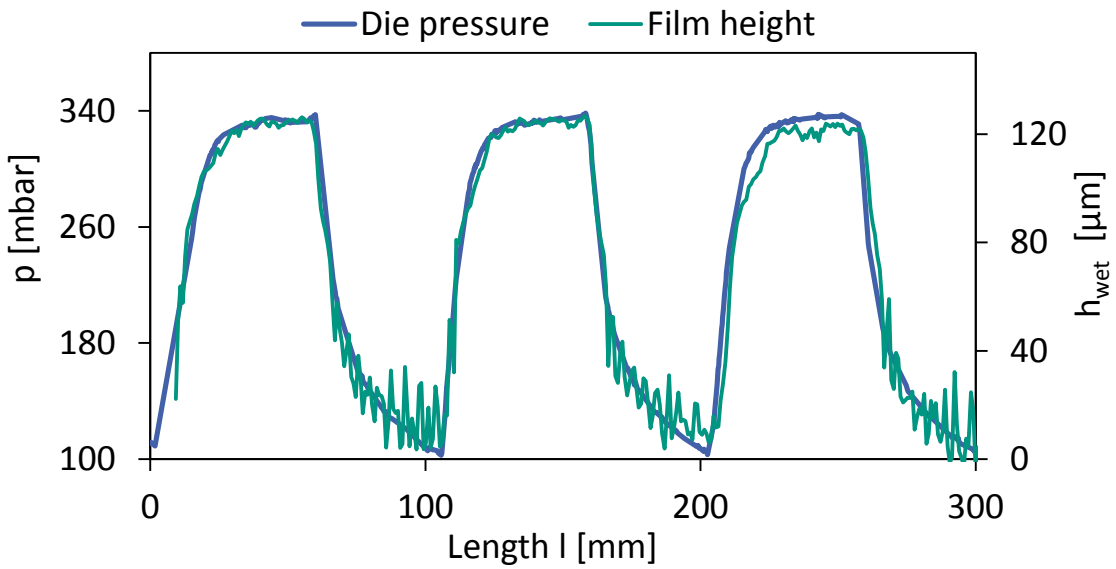

Fig. 2: Comparison of die pressure and film height at bypass valve controlled intermittent coatings.

In *Fig. 2* the results confirm our assumption, showing a proportionality of fluid pressure in the die and coated film thickness. Furthermore they also show that there is a relaxing and a compressing state for the fluid between the coating plateaus.

Controlling not only the pressure in the die but also in the whole system can be important. Different pressure drops in the slot die and in the bypass may cause long acceleration times and prevent a steady state during the coating stage. Therefor we developed some calculation rules for the fluid pressure in every position of our system, to adjust the pressure drop in our

In a second step with an optimized feed system we developed a new concept which manipulates the die pressure. Without any gap variation this process holds back the relaxing fluid after each coating stage and applies it additionally onto the next pattern.

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