DRYtraec® – From Laboratory to pilot scale production

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Eliminating the costly and energy-intensive drying process step of electrode production is crucial to obtaining a more **sustainable battery production**. Within the framework of the innovation modules, Fraunhofer FFB addresses the **dry processing** of electrodes by **scaling up** the Fraunhofer IWS patented dry transfer electrode coating (**DRYtraec®**) technology.

Conventional process

Conventional electrode manufacture is solvent-based, meaning that the active material, binder, and conducting additive are dissolved in a solvent. On the anode side, deionized water serves as the solvent, while on the cathode side, the toxic solvent N-methyl-2-pyrrolidone (NMP) comes into play. After mixing, the electrode suspension is applied to the current collector foil.
Drying removes the solvent and NMP can be recovered. The drying and solvent recovery step accounts for 39% of the total energy cost of battery production (Fig. 1). In addition to the high energy demand, the space required for the drying system in most "gigafactories" can be around 100 m long (Fig. 1).

- Avoiding the use of solvents by **dry processing** can be the solution for an alternative, **less energy demanding** electrode production.
- However, **the transition** from wet to dry processing is **not trivial** e.g. different film building mechanisms and thus, different choice of binder material

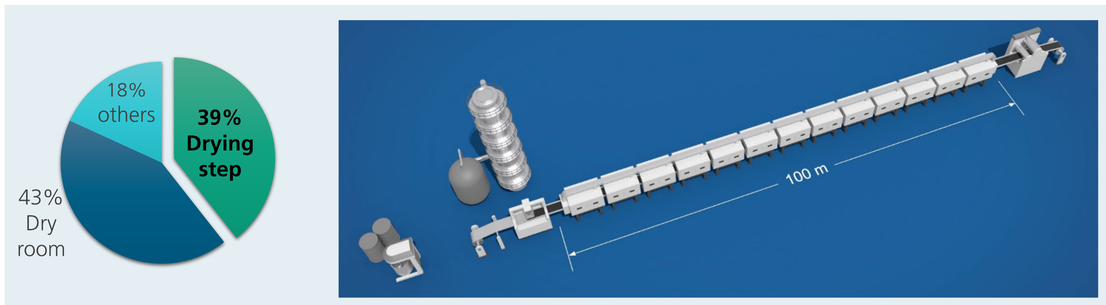


Figure 1. The drying step in the »slurry« process is one of the main drivers for the high energy and space demand of the conventional electrode manufacturing [1,2].

Alternative - Dry transfer electrode coating (DRYtraec®)

DRYtraec® is a dry process invented by Fraunhofer IWS currently elaborated on a laboratory scale

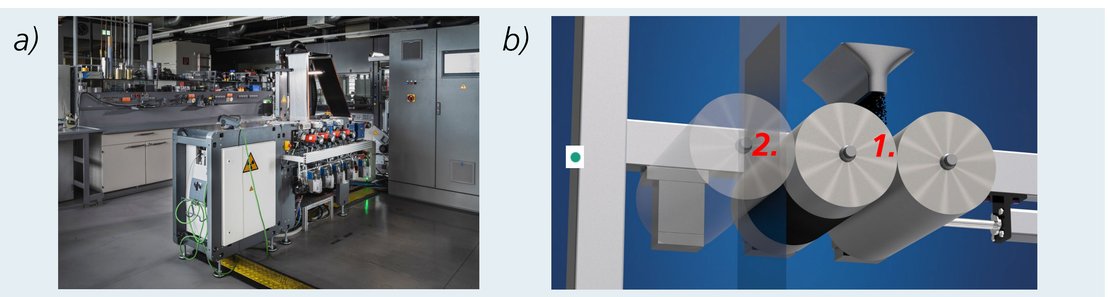


Figure 2 a) DRYtraec® plant at the Fraunhofer IWS. b) Two process steps: 1. electrode film formation in the 1st calender gap; 2. Lamination of the electrode film onto the current collector foil [2].

1st calender gap: Two counterrotating rollers with different speed	-> **Friction** elongates a fibrous network of the PTFE binder within the electrode mixture -> Creates an **electrode film**
2nd calender gap: Two counterrotating rollers with same speed	-> **Lamination** onto the current collector foil

Process chain for electrode manufacturing using DRYtraec® and conventional wet proessing

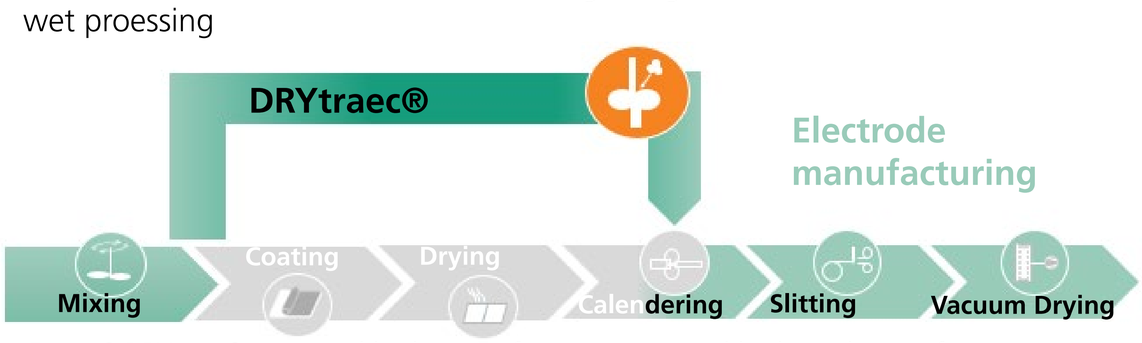


Figure 3 DRYtraec® as a possible altenative for a more sustainable electrode manufacturing.

DRYtraec® process is established on a laboratory scale
- However **scale-up** and several process related topics remain challenging and are thus part of further development

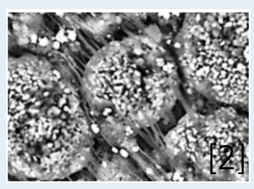
Scaling up – DRYtraec® at Fraunhofer FFB

Within the FoFeBat TP3 AP2, one of Fraunhofer FFB's **innovation modules** focuses on dry processing of battery electrodes. A collaboration between the FFB and the Fraunhofer IWS aims to scale up the dry transfer electrode coating (**DRYtraec®)** technology.

	Temperature Rollers [°C]	Roller Speed [m/min]	Coating Width [mm]	Production scale
IWS	150	0.1 – 10	50 – 100	Laboratory
FFB *(Q2/Q3 2025)	150	0.1 – min. 20	100 – 400	**Pilot**

For process optimization two major topics will be addressed

Dry mixing – First requirement for dry processing



- **Pre-fibrillized Mixture** consisting of AM, CA and binder
- Poly-tetrafluoroethylene (**PTFE**) as a binder

→ **Mixing process** creates a fibrous network, so called **fibrils**

Calandering: Afterwards the pre-fibrillized mixture is ready for use in the DRYtraec® technology

- Adaption of process parameters for high coating speed aiming at high quality electrodes

Integration of DRYtraec® into the whole electrode manufacturing process and a comprehensive development are major goals for the innovation module. Therefore, the FFB and IWS intent to collaborate with industry partners from different areas to address topics such as: **material variations**, **mixing** and **dosing** technologies, **cell manufacturing** and **analytics** to lift the full potential of the **new pilot plant**.

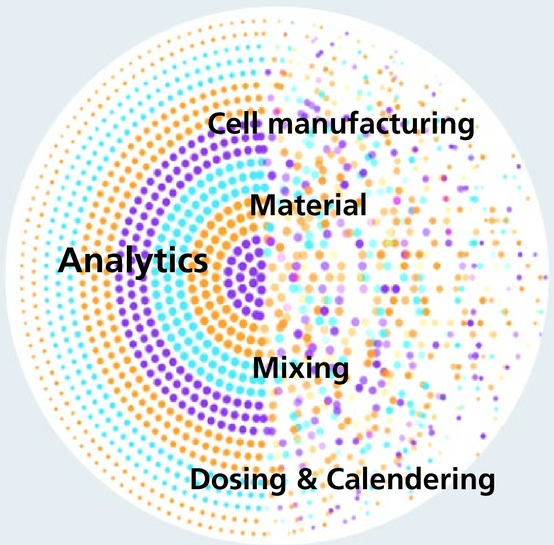


Figure 4 Process environment and their interdependency for DRYtraec®

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[2] Schumm, Benjaming; Forytta, Markus (2022): "Fraunhofer IWS DRYtraec® soll Technologieplattform werden", Presseinformation des Fraunhofer IWS https://www.iws.fraunhofer.de/de/newsundmedien/presseinformationen/2022/presseinformation_2022-08_drytraec-technologieplattform.html

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