Translating Dip-Coating into a Continuous Technique for Thin-Film Composite Production

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Twente membranes

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Motivation

Thin Film Composite (TFC) hollow fiber membranes are essential for applications such as gas separation, water treatment, and wastewater purification. The increasing industrial demand for longer fibers necessitates a shift from laboratory-scale dip-coating methods to continuous coating techniques. The continuous coating process is crucial for achieving consistent and scalable application for both gutter and selective layers.

Transition from dip-coating to continuous coating can be achieved through the fine-tuning of critical parameters such as withdrawal speed, solution viscosity, and coating time, ensuring optimal coating uniformity and performance maintaining an optimal balance between permeance and selectivity to meet industrial requirements.

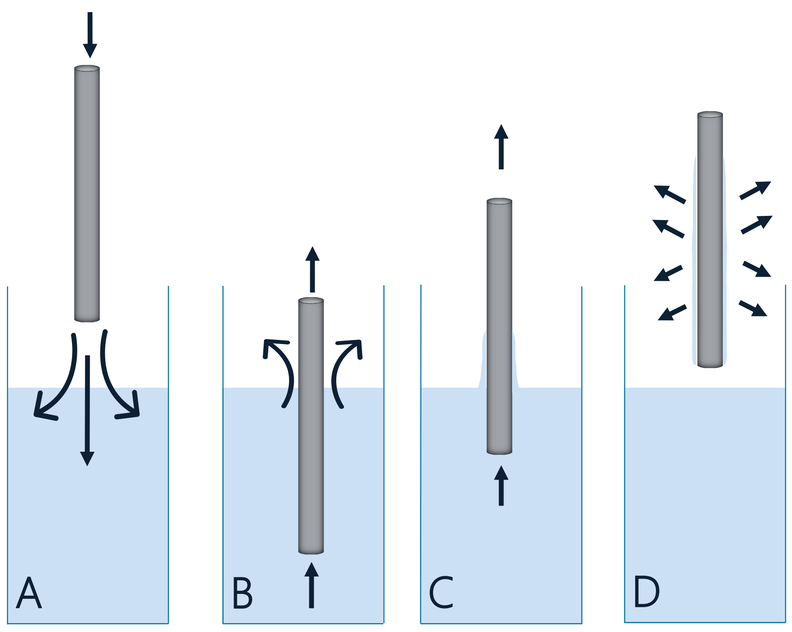
Dip coating

• Dip coating is a simple method where a hollow fiber is immersed in a solution **(A)** containing the coating material **(B)** and then withdrawn **(C)**. A thin film adheres to the fiber and is cured by evaporating the solvent **(D)**.

• Allows for the preparation of **very thin permeable** layers by adjusting coating parameters and solution viscosity.

• Suitable for **laboratory-scale** applications.

• **Challenging** to achieve **consistent coating** across longer fibers or larger production volumes.



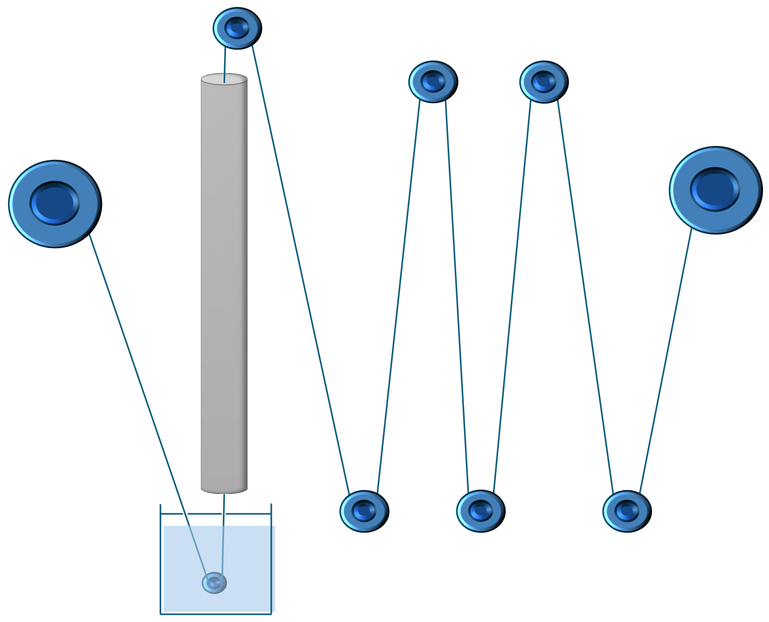
Continuous coating

EMI Twente Continuous Coating Setup:

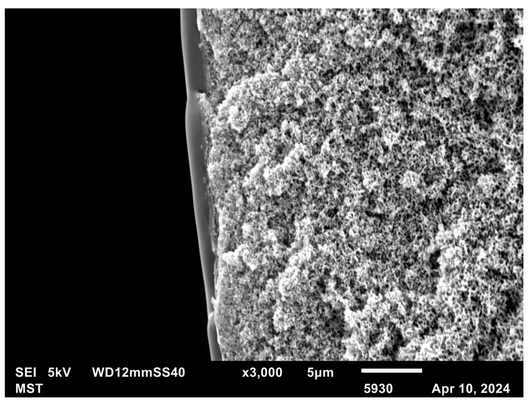
- Features a 7-meter fiber path from spool to spool in the continuous coating system for in-line processing.
- A chimney for solvent evaporation, capable of reaching temperatures up to 60°C
- Successfully transitioned from dip coating by optimizing parameters such as withdrawal speed, solution viscosity, and coating time.

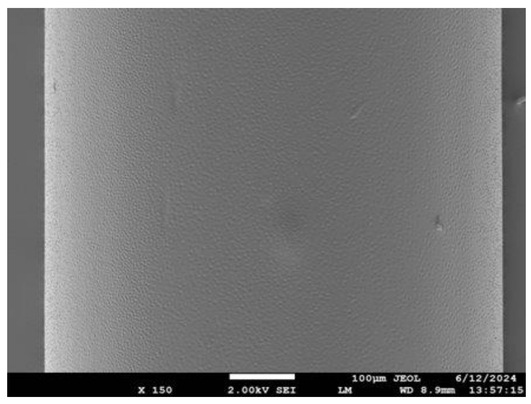
Industrial Scale Capability:

- Capable of coating lengths 80-100 meters.
- High throughput and consistency in production.



Results





- Transition from dip coating to continuous coating has a success rate of approximately 90% in terms of the gas permeance performance.
- A defect-free layer is achieved, resulting in a perfectly uniform coating that varies from 200 nm to 4 µm depending on the required application and coating conditions.

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