Dialing-in the Process:
Automatic Slot-Die Adjustments for Precise, Uniform Coatings

a collaboration between Honeywell and Nordson

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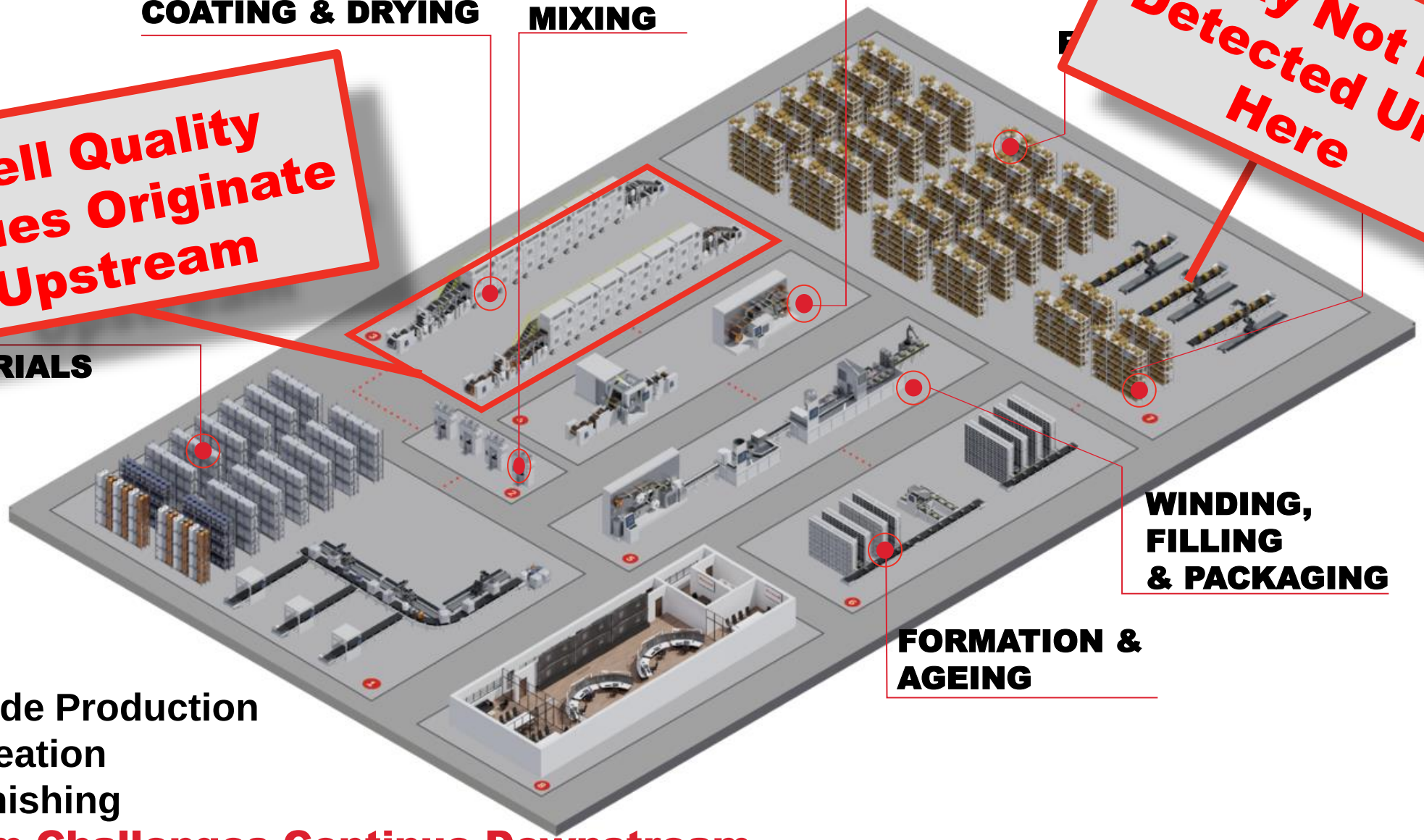
GIGAFACTORY FOOTPRINT

Functional Process Flow



- Electrode Production
- Cell Creation
- Cell Finishing

Upstream Challenges Continue Downstream

COATER START-UP AND RUN | Advanced Profile Controls (APC)

Challenge Understood:

Coating uniformity is **KEY** to achieve cell targets
Profiling wide strips ensures each coating strip or patch is in specifications regardless of viscosity or other factors

Traditional Slot-Die Coater

Challenges Met:

- Historically no active profile controls
- Address manual “shim” adjustments
- Inter and Intra-batch viscosity variation from active material changes
- Slot dies are custom built to specified viscosity range
- Slot Dies require numerous shut-downs to “shim” the die for profile, both time and material consuming at after each start-up
- Coating and raw materials are costly
- Coating IS critical for every cell: **Cell-level operation validation is long after coating process**

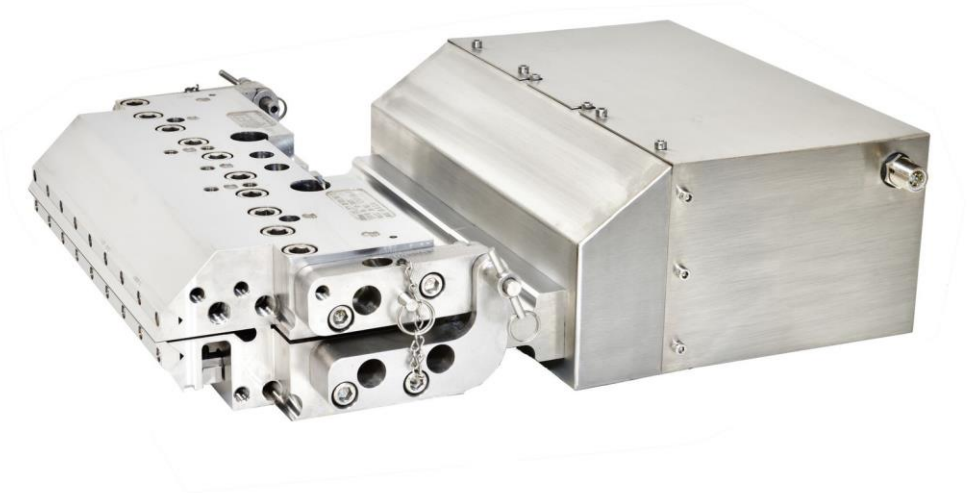
Consistent Uniform Coatings thru Active Adjustments (APC)

COATER START-UP AND RUN | Advanced Profile Controls (APC)

Honeywell & Nordson's Solution: Data-Driven Automated Coating Control

- Automated actuator-driven, slot-coating control
- Active feedback control from scanners and calipers for "real-time" slot-die responsive adjustments
- 40+ years of controlling coating profiles and extrusion hardware working with a variety of vendors

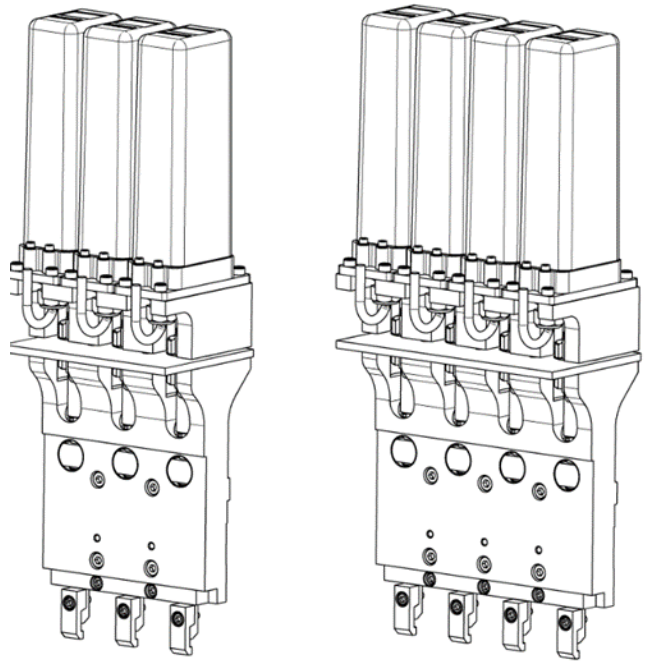
EDI® Prodigi™ Coating Slot Dies

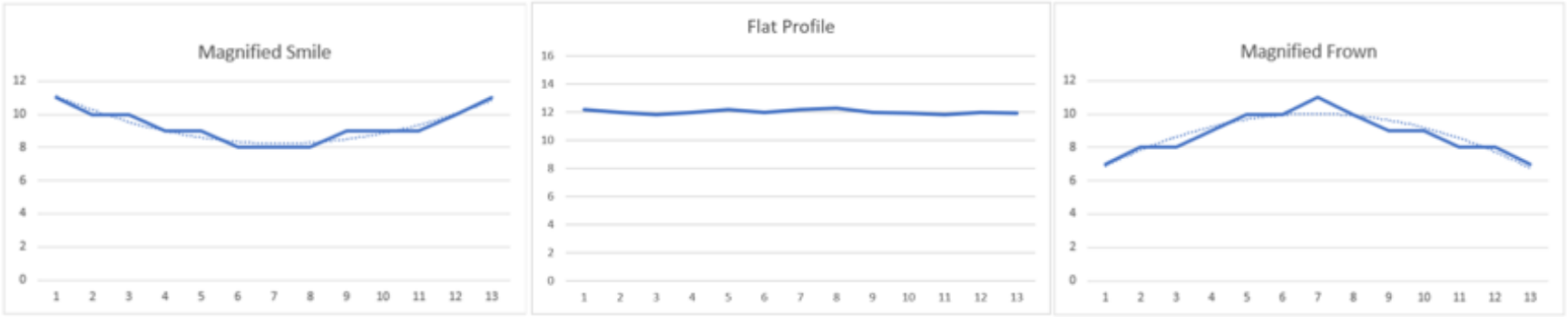


Industry Leading Technology to Achieve Consistent Coatings to Your Specifications

FLUID SLOT-DIE USING ACTUATOR CONTROLS | How it Works

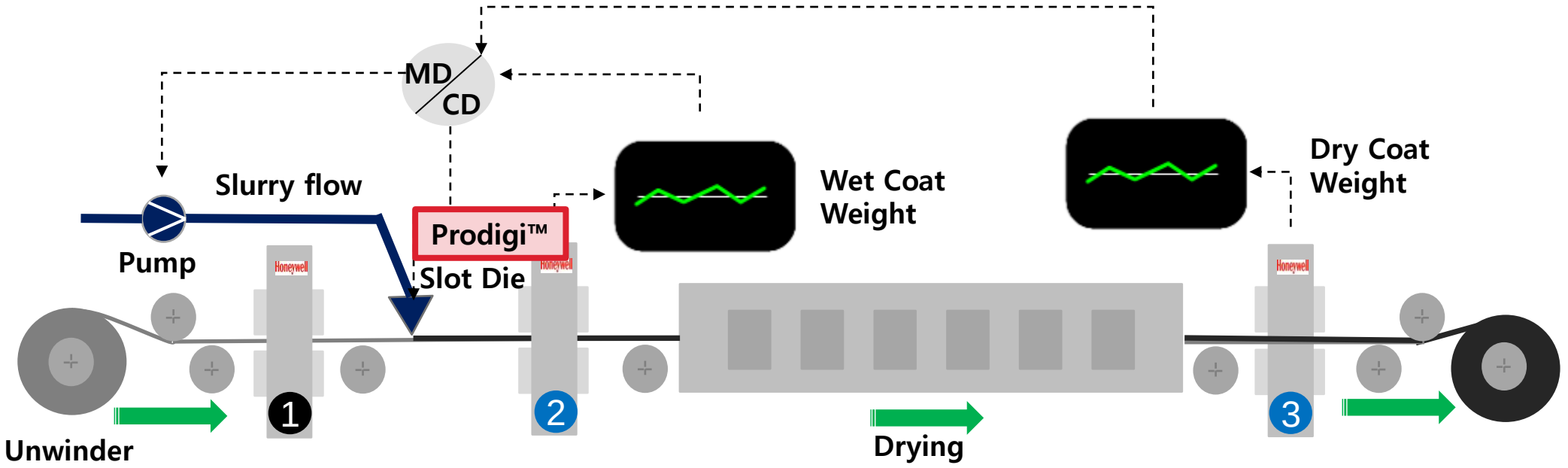
- The Prodigi™ system features a series of motorized actuators, which are connected to the adjustment bolts.
- As profile corrections are determined by the gauging system software, or saved recipes are launched, the actuators rotate and engage adjustment bolt threads to profile the die's flexible lip in the designated area.
- The system allows for full remote control of the die lip gap articulation, removing the need for any direct-contacting tuning by an operator or technician.
- Allows for quick adjustment of the lip gap, to control the coating uniformity, and the fast relaunch of saved recipes when production requirements change.





Extremely Rapid, Repeatable, and Remote Adjustments

COATING AND DRYING | More Closed Loop Process Control Needed



Conventional – Manual Startup

- Shim the die
- Start slurry flow
- Check the loading readings
- Stop & re-shim
- Repeat until targets achieved
- Repeat for backside

Automated Slot Die

- Load Recipe & start slurry flow
- After a few seconds wet scanner reads MD-CD loading and initially adjusts die actuators
- Dry scanner reads loading and fine tunes die actuators
- Repeat for backside

Reduce Startup Time from Hours to Minutes

MODELLING COATING PROFILES | Automatic Profile Adjustments

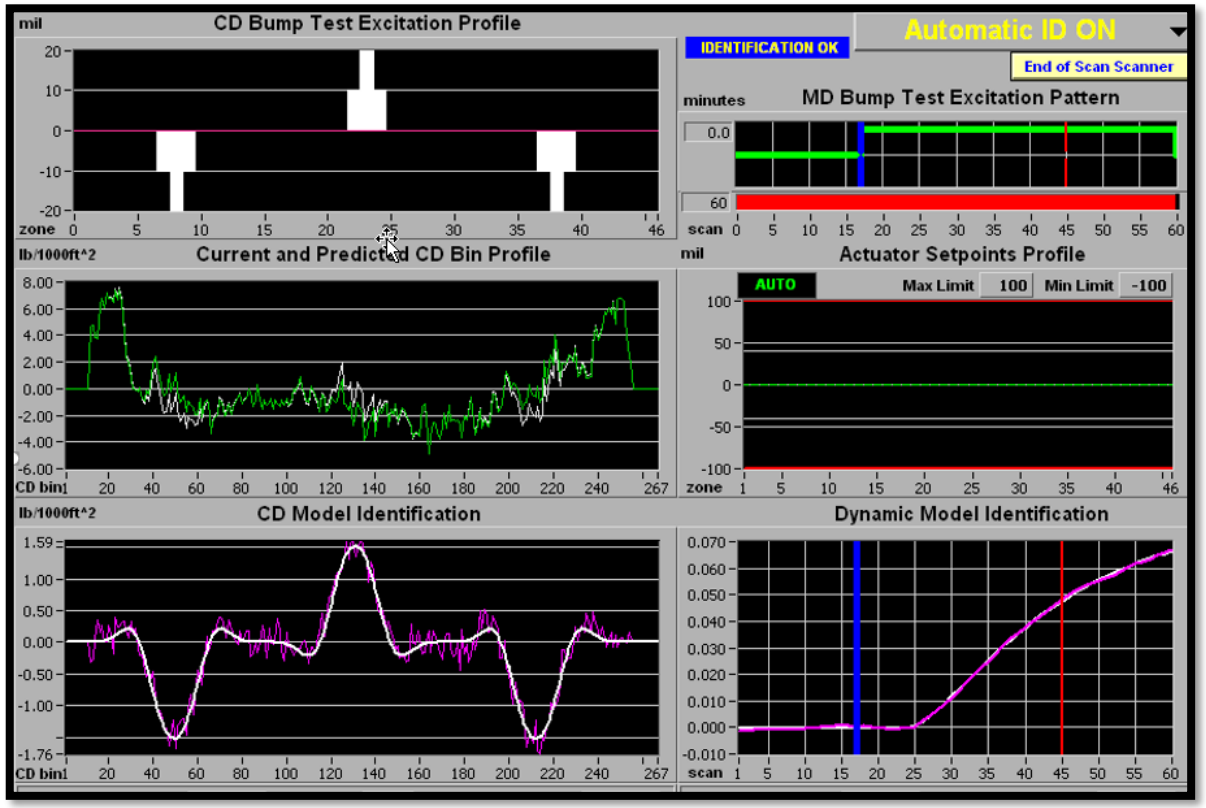
- **>80% reduction in start-up losses from Manual Shimming**
- **Trials have achieved targeted coating profiles within 3 minutes of coating**

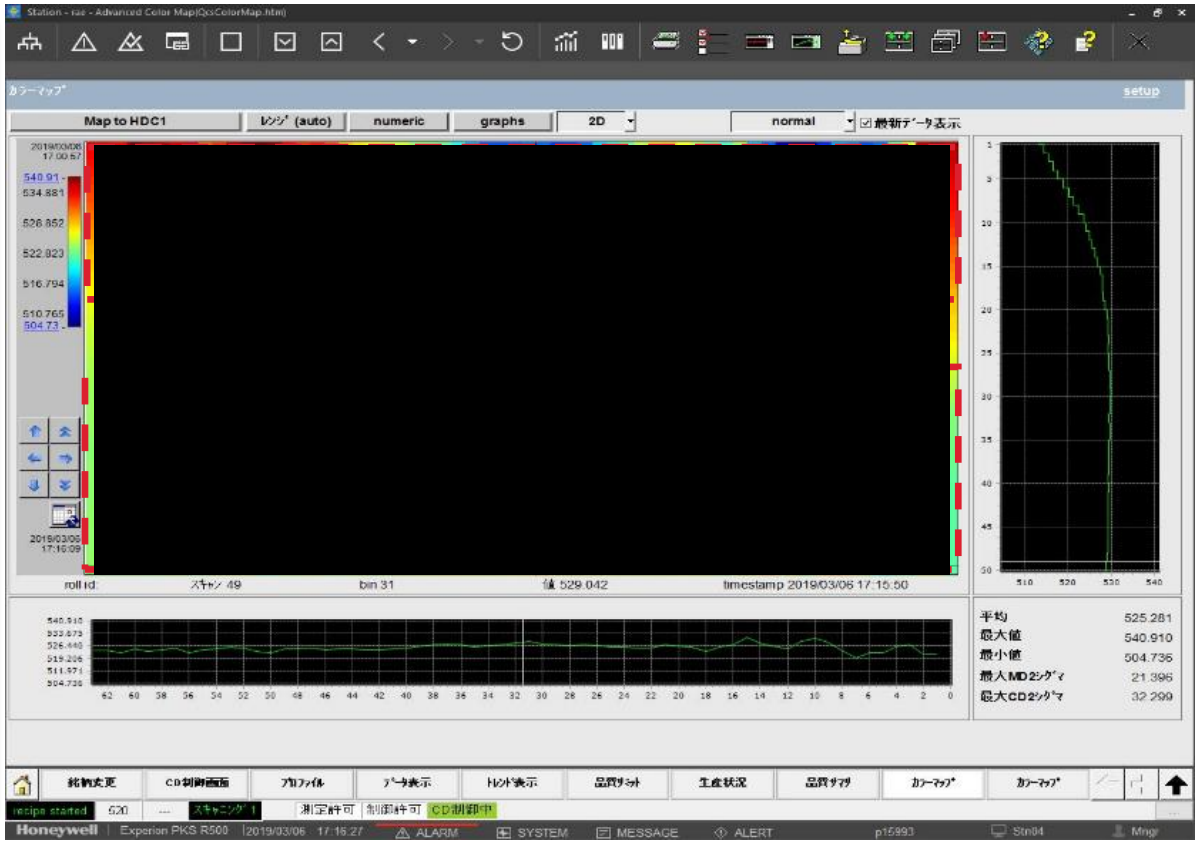
Setup Scanner/Actuator Models:

- Used to Identify the Process Model in MD & CD

Run real-time modeling of the coating fed to actuators

- Before/After control test illustrates increasing coating uniformity



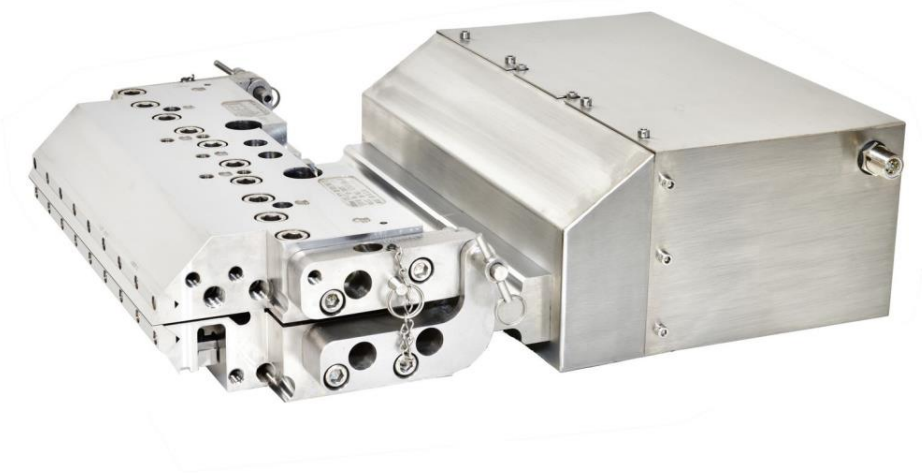


Closed Loop Feedback Control + 80% Reduction in Startup Losses!!

AUTOMATED BATTERY MANUFACTURING | Industry Implications

Data-Driven Approach to Electrode Coating Improves Production Efficiency

- **Automating slot-die coating streamlines the coating start-up process achieving targeted coating profile sooner**
- Reduces manual operations during the electrode coating process
- **Reduces scrap in the production process with uniform electrodes = More “Grade A” Cells**
- Aligns with U.S. domestic and global initiatives to increase battery manufacturing capacity
- **Accelerates production cost reduction trend ($/kWh) towards ICE parity**



INDUSTRIALIZING CELL PRODUCTION THROUGH COLLABORATION

THE FUTURE IS WHAT WE MAKE IT

THANK YOU

Questions?? Reach out to us!

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Slot-Die Coater Located in Booth 1651 (Honeywell)

Honeywell