### Real-Time Process Optimization with Ir Mold Sensors and Machine Learning

SPE Webinar | May 25, 2023





#### WHO IS BEHIND sensXPERT?



As a recognised *industry expert* with 50+ years of experience in material science and sensor technology, it is the NETZSCH Group that transforms industries with next-level intelligence for increased efficiency, quality assurance and process reliability for the *plastics industry*.



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Corporate Venture: NETZSCH Process Intelligence GmbH

Enhancing productivity through advanced process analysis technology for the industry 4.0



Parent Company: NETZSCH

Family-owned global technology leader with 4100+ employees present in 36 countries









#### THE sensXPERT PRODUCT



PERT

- edge device to evaluate machine and material data for automated data analytics to increase overall equipment efficiency in real-time
- monthly subscription model with low initial setup cost

#### **Real-Time Material Characterization with Dielectric Sensors**

- Measuring material behavior
  - resin viscosity, degree of cure, glass-transition, material condition (mixing ratio, ageing, shrinkage, contamination)
- Combined with third-party measurement devices (pressure transducers, thermocouples, and more)

#### MATERIALS

- Thermosets and thermoplastics
- Fiber reinforced polymers
- Sands or natural stones bonded with resin

#### PROCESSES

- (Reaction) Injection Molding
- Thermoforming & Compression Molding
- Transfer Moulding Processes
- Vacuum infusion & Autoclave Curing

## **Electronics Encapsulation Industry**

# Use Case

#### sensXPERT USE CASE: OPTIMIZING ELECTRONICS ENCAPSULATION FOR E-MOBILITY

<u>Component:</u> High-power electronics circuit board

Material: Epoxy molding compound

<u>Quality criterion:</u> Degree of cure > 90%

Initial cycle time: 3 minutes



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## ROI Calculator - single machine Output Output</th



# Let us dive deep into the material behavior during production







## Small series production in collaboration with Schwarz Plastic Solutions

### influence of **shearing** on the **curing**

PF highly filled





EXPAND your sense of the possible

#### Variation in gate and injection time





#### **Consolidated summary of process variations and cure behavior**





## Small series production in collaboration with Schwarz Plastic Solutions

### influence of **shearing** on the **curing**

PF highly filled (isotropic)





EXPAND your sense of the possible

#### Variation in gate and injection time





#### **Consolidated summary of process variations and cure behavior**





# **Aviation Industry**



Use Cas



#### sensXPERT USE CASE: COMPOSITE AEROSPACE STRUCTURES

<u>Component:</u> Composite structures

<u>Material:</u> Infusion epoxy / carbon fiber

<u>Quality criterion:</u> Degree of cure > 90%

Initial cycle time: 400 minutes



#### sensXPERT USE CASE: COMPOSITE AEROSPACE STRUCTURES

#### 30% Cycle Time Reduction

- Shows Process Step 3 is stable before 300 minutes
- Reduce cycle time by over 1.5 hours



#### **ROI Calculator** - single machine

Setup Details

Manufacturing Details





### How does it work?







#### **Dielectric Sensor Information**



- Introduction of the material
- ) Minimum resin viscosity

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- Progression of cure / gelation / crystallization
- ) Completion of cure / crystallization



#### **MACHINE LEARNING AND PROCESS OPTIMIZATION**





### **Simulation and Optimization**

#### A data driven solution.

- AI model calculates and predicts
  material properties
- Dynamically control and adapt the process to ensure constant quality



#### **CLOUD SERVICE**





- Process data transparency
- 24/7 access on any device
- Customizable dashboards
- OpenAPI: flexible data handling

### **RESULTS OF sensXPERT®**

Up to **50%** of existing scrap reduction



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Up to **30%** cycle time reduction

Reduce

(re)commissioning time

## sensXPERT Pipe

NO-DIG Sewer Renovation











Sensors measure the curing process to determine the required velocity of the UV Light Source





## We are looking forward to welcoming you into the *sensXPERT community*!

Dr. Alexander Chaloupka alexander.chaloupka@sensxpert.com

www.sensxpert.com







