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EFFECTIVE

Maximizing the Mould Life**e**ycle in Manu**f**acturing through Advanced Sur**f**ace T**ec**hnology, Predic**tive** Early Intervention


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ORGANISATION PROFILE

Sistematik Atölye™ is an innovative technology and consultancy SME located in the ULUTEK Technology Development Zone of Bursa Uludağ University. The company develops advanced technology in robotics, artificial intelligence, custom machine technologies, and provides consultancy on Horizon Europe and Eureka projects, including concept development, proposal writing, and project management.

Figure 1. ULUTEK Technology Development Zone, Bursa Uludag University / Türkiye

VISION

The main project goal is to enhance the manufacturing of rubber sealing parts by eliminating chemical release agents and enabling a zero-defect, self-adjusting smart production process. This vision is built on two core strategies:

Chemical-Free Moulding: To develop and apply a durable, smart surface coating on rubber moulds that completely eliminates the need for solvent-based release agents, thereby ensuring process consistency and preventing production stoppages.

Predictive Maintenance: To create a fully digitized and autonomous injection moulding process using in-mould sensors and AI, enabling the system to predict process deviations and automatically adjust machine parameters to prevent scrap formation.

Figure 1. Rubber sealing component sample

MOTIVATION

The project addresses critical inefficiencies in current rubber moulding processes that lead to significant production losses and environmental concerns.

- **Dependency on Manual Processes:** The manual spraying of chemical release agents onto compression moulds is inconsistent, causing rubber to stick and forcing production halts for costly and time-consuming cleaning. This reliance on hazardous solvents also poses environmental and health risks.

- **Reactive and Wasteful Production:** In injection moulding, variations in rubber batches often lead to scrap parts. Operators reactively adjust machine settings only after defects are identified, resulting in significant material waste, lost production time, and dependency on operator experience. The lack of predictive systems prevents proactive intervention.

CONTENT

The project will develop and integrate three key technologies:

- **A Novel Anti-Adhesive Surface Coating:** An innovative and durable coating for compression moulds, specifically designed for 200-220°C operating temperatures, that provides excellent rubber release properties without any chemical agents.
- **An AI-Powered Self-Adjusting System:** An intelligent control loop for injection moulding, utilizing in-mould pressure sensors to detect real-time process deviations and an AI algorithm to automatically optimize machine settings to prevent defects.
- **A Predictive Machine Health Module:** A predictive maintenance system for injection machines, using ultrasonic sensors to monitor critical components, anticipate potential failures, and prevent unexpected machine downtime.

EXPECTED OUTCOME

The project will deliver three core technological solutions:

- **A Permanent Mould Surface Coating:** A validated coating technology that eliminates the use of chemical release agents, leading to a reduction in production stoppages for cleaning, and a decrease in solvent consumption.
- **A Smart Mould & Self-Adjusting System:** A functional hardware and software package for injection machines that reduces scrap rate, minimizes the need for manual operator intervention, and shortens machine setup times.
- **A Predictive Maintenance Module:** An AI-powered software module that accurately forecasts injection machine failures, providing early warnings and increasing overall equipment effectiveness.

IMPACTS

The implementation of these technical outcomes will generate:

- **Increased Competitiveness:** Providing European manufacturers with a highly reliable, automated, and consistent moulding process, significantly increasing production efficiency and product quality.
- **Higher Profitability for Manufacturers:** Directly increasing profit margins by eliminating the cost of chemical release agents, drastically reducing material waste (scrap), and maximizing machine uptime.
- **Enhanced Environmental Sustainability:** Eliminating the use of solvent-based chemicals, contributing to a safer workplace and a greener manufacturing footprint.

Project Schedule:

Start Date : 01 July 2026
End Date : 30 June 2028
Duration : 24 months

PARTNERS

#	Partners (Current)	Type	Country	Contribution
1	Sistematik Atölye Ltd. Şti. Link	SME	Türkiye	Coordinator, system integrator, closed loop controller design
2	Freudenberg Sealing Technologies Link	IND	Türkiye	Use case provider - rubber sealing manufacturer, requirement definition, end user, validation
3	**Seeking expertise:** Surface Technologies and Materials Science	University / Research Institute		Durable surface coating development and characterization that will eliminate mold release chemicals
4	**Seeking expertise:** Control, automation, mechatronics	SME / Research Institute		Development/selection of in-mold pressure sensors and injection machine ultrasonic sensors, establishment of data acquisition system
5	**Seeking expertise:** Data Science and Artificial Intelligence (AI)	SME / IND / University / Research Institute		Development of AI/Machine Learning models that will process data from sensors, detect anomalies and send adjustment signals to the machine.

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