

Press Release

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Roll Forming Can Shape with the Same Precision as a Press – at a Fraction of the Cost: Fraunhofer IWU and Partners Show How

Presses require a large footprint, and both operating and capital costs for machines and tooling are enormous. Is there really no alternative to a press when forming precision components? Martin Wagner, a specialist in metal forming machines, aims to prove otherwise with the smartROLL project. Together with the project partners, he is convinced that complex precision components – such as heat exchanger plates for data centers, cooling plates for electronics, or connector elements for the automotive industry – can in the future be formed using hollow embossing rolling at costs up to 70 percent lower, without any loss in quality.

The idea is as simple as it is compelling: when the line contact of a roll is used for forming instead of the much larger contact surface of a press tool, significantly lower forming forces are required. Rolling tools cost between 40 and 50 percent of a conventional forming tool and can be integrated into much more compact (and less expensive) machines. These are powerful arguments – provided the forming results meet the required quality standards.

smartROLL Aims for Hollow Embossing Rolling at the Highest Level

The initial goal of the smartROLL project is to develop a system for machine and process monitoring that enables near-tool, inline acquisition, analysis, and evaluation of all condition- and process-relevant parameters during the rolling of precision components. In the future, quality and process information will thus be available already during production, forming the basis for adaptive process control that sustainably improves product quality, overall equipment effectiveness, and operational reliability.

To achieve this, the domains of mechanics, process technology, and control engineering are considered together, and the overall system behavior is captured comprehensively. This integrated approach enables comprehensive analysis and evaluation of all factors that influence component quality.

The foundation of inline monitoring is the correlated evaluation of various data sources: retrofitted sensors in the machine (e.g., strain sensors on roll bearings), sensors integrated into the rolling tools (e.g., rotary angle, acceleration, or force sensors), as well as existing sensors such as torque or angular position measurement. The decisive factor is the use of suitable data-fusion methods to systematically combine and jointly evaluate these heterogeneous data streams. Only by “correctly” integrating all sensor data is it possible to

gain a comprehensive, data-driven insight into the condition and performance of both machine and process.

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To reliably assign anomalies in sensor data to specific events – such as fluctuations in quality – the project translates the operating mechanisms of hollow embossing rolling, as well as the machine and tooling technology used, into mathematical models. These models feed into a diagnostic system based on machine learning methods (e.g., support vector machines).

The evaluation logic and models, together with an optimized system architecture, are integrated into the machine control system of the pilot plant and executed in real-time. This results, on the one hand, in a digital twin that provides information at various levels of detail. On the other hand, it enables an adaptive control system that adjusts process control variables based on detected variations in process, machine, and quality parameters, and implements these adjustments within a closed control loop.

Putting It to the Test: Bipolar Plates for Electrolyzers and Fuel Cells

The efficiency of electrolyzers and fuel cells depends largely on the manufacturing quality of bipolar plates, which are considered a core component of both hydrogen systems. At the Reference-factory.H2, Fraunhofer IWU and its partners have already qualified hollow embossing rolling of bipolar plates for high-volume production.

The current project aims to further increase process quality and thus product quality, thereby establishing a foundation for applying this manufacturing process to numerous additional components and products.

The smartROLL project is co-funded by tax revenues based on the budget adopted by the Saxon State Parliament. Project partners of Fraunhofer IWU include Profiroll Technologies GmbH, AUTEZ GmbH, and TIQ Solutions GmbH.



Co-funded by
the European Union



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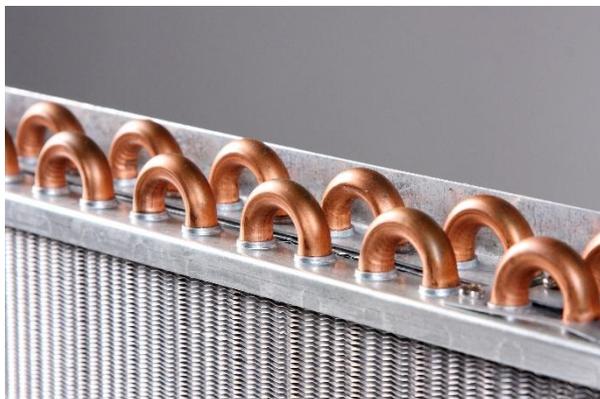


Fig. 1 Example of a heat exchanger for data centers: the cooling fins could also be manufactured using the hollow embossing rolling process.

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Fig. 2 The metal components of automotive connectors are also suitable for this manufacturing method.
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Fig. 3 Continuous production using hollow embossing rolling: highly precise, high-throughput, and energy-efficient.
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Fig. 4 Micro-structured semi-finished products manufactured on the BPPflexROLL at Fraunhofer IWU.
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