

Inline Monitoring Replaces the Safety Buffer

How AI-supported real-time measurement in the spray jet can reduce material consumption

A process developed by VW, Volkswagen Commercial Vehicles (VWN), and AOM-Systems combines inline measurement of the spray jet with AI-based analysis. Since material consumption is recorded inline, it can be adjusted precisely to the specified quantities. This can reduce paint consumption and end-of-line inspections.

BY JAN GESTHUIZEN

In serial automotive body painting, local overcoating is a well-known phenomenon. Companies therefore often paint with a safety buffer. This is intended to prevent process influences from causing the minimum coating thickness to be undershot, which increases the risk of underfilm corrosion and corrosion damage. With the aim of economical, resource-efficient production, material consumption could be reduced if the required deposition quality could already be reliably ensured during paint application.

This is precisely where the patented process comes in, developed jointly by painting experts from VWN in Hanover, VW in Wolfsburg and Audi in Ingolstadt together with AOM-Systems. The basis is inline monitoring of the spray jet combined with comprehensive plant-wide process data acquisition and AI-based data analysis.

"Reliable measurement, monitoring and documentation of total and individual paint layer thicknesses on body structures is an essential component in ensuring sustainable corrosion protection performance. Against the background of future primer-free painting concepts, precise control of the coating thicknesses of individual layers, particularly the basecoat, is becoming increasingly important," explains Thorsten Ast from VW Quality Assurance.



The 'SpraySpy' measuring system monitors the paint in the spray jet and makes it possible to predict the final coating thickness. Photo: Volkswagen

Measurement in the Spray

The key difference compared with previous approaches is the measurement directly in the spray jet. Numerous factors influence the actual amount of paint applied. Measuring the volume flow in the material hose or at the pump is therefore insufficient. For example, it cannot detect the actual distribution of material and shaping air in the spray, changes in the paint, damaged sealing rings, or worn, incorrectly installed or contaminated nozzle equipment. "But monitoring in the centre of the spray jet provides this," explains Meiko Hecker, Managing Director of AOM-Systems. Based on the spray parameters in combination with other, mostly already available, process data, direct conclusions can be drawn about coating thickness. In a multi-layer build-up, this also makes it possible to monitor the individual paint layers qualitatively rather than only checking the total coating thickness after drying. Corrosion protection and appearance reach their optimum only when all individual layers are within a defined tolerance. Insufficient coating of one individual layer cannot be compensated for by applying more material in another layer. "Inline monitoring systems such as 'SpraySpy' from

AOM create the necessary process transparency by identifying deviations at an early stage. This enables a sustainable improvement in quality, process reliability and economic efficiency," confirms Thorsten Ast of VW regarding the relevance of the new process for users. The AOM-Systems sensor system used in the process monitors droplet size, velocity and count, as well as the spray volume flow and spray angle. The probe is approved for use in explosive atmospheres (ATEX) and for electrostatic application. The

recorded parameters are captured and processed in real time by evaluation software. Spray anomalies are detected from a deviation of 2 percent. Studies by Fraunhofer IPA show that error causes leading to coating-thickness deviations can be assigned to a specific source with more than 90 percent confidence - such as nozzle wear or contamination.

Learning Phase with End-of-Line Data

The correlation between spray data and the resulting coating thickness is established in a calibration. In addition to

the process data from the plant and inline spray data, conventional end-of-line coating-thickness measurements are also used. After this calibration has been completed, the coating thickness is monitored solely from inline spray data.

Two effects are achieved: First, corrective action can be taken during painting if a coating-thickness shortfall is imminent, making the additional paint consumption previously required unnecessary. Second, the applied coating thickness is already safeguarded by inline spray measurement and therefore no longer needs to be measured by other means.

This reduces both costs and production time. Jens Kaufmann and Jan Spiegel from VW's Manufacturing Digitalization department add: "Optimization measures such as the use of SpraySpy demonstrate how AI can be implemented with maximum effectiveness in our automated production systems. If we continue to scale this, we will have a positive impact on our factory costs." As a specific application example, the development team cites the primer-free coating build-up in the Volkswagen Group, where savings potential can be realized in the clearcoat area.

Higher Productivity

According to the developers, the process not only results in material savings but also increases the productivity of the paint shop. Process errors are detected in real time rather than only during downstream quality inspection. This includes, for example, incorrectly adjusted paint or contaminated or defective application equipment. Rework is reduced and the First-Run Rate is increased.

AOM also points to further possible uses for the data. Data storage creates documented quality control records that can be used for smart maintenance concepts, digital twins of the coating process and closed-loop control applications. Maintenance work such as nozzle cleaning or replacement of wear parts is intended to be scheduled on demand, based on wear prediction, rather than according to fixed intervals. In the longer term, integration of the process into higher-level process control and monitoring systems is envisaged.



The comparison shows the difference between the conventional process and the process with paint savings.

Graphic: AOM - AI-generated

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