The paint build-up on a BIW as it travels through the e-coat line

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electrochemical intelligence

A typical Computer Aided Engineering (CAE) e-coat project starts with the collection of all relevant information, including geometrical data (BiW and e-coat tank including different anode groups), process data (voltage programs delivered by the different rectifiers, flow conditions, shuttle speed, vehicle trajectory etc.) and determination of the electrochemical paint bath characteristics.

For a paint sample as supplied by the customer to Elsyca, paint characteristics are obtained by means of laboratory scale experiments. The Design of Experiment (DoE) has been developed in order to allow for the determination of the physic-chemical bath parameters to be used in Elsyca's EcoatMaster.

The CAD model of the BiW is prepared for the simulations and its trajectory through the e-coat tank is defined. The simulation is launched and a number of time steps along the trajectory are sequentially computed.
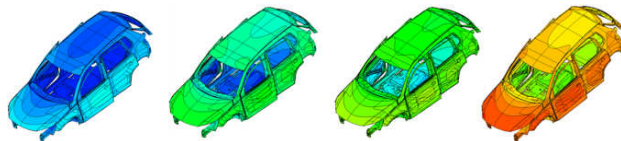
In the early stages of the process the paint film start to develop in more exposed areas and only in the last stages of the process paint begins to deposit in more recessed areas. This is clearly visible from the figure above (dark blue = no paint; red = thick paint layer), where 4 stages in the e-coat process are depicted, ranging respectively from a very early (left) to a very late stage (right).

Simulation results are presented for the fully detailed geometry, including structural cavities and inner structures. The figure below presents simulation results for the B-pillar structure (after full process time). The accuracy that can be obtained from Elsyca EcoatMaster simulations is demonstrated in this figure.

The absolute deviation (in micron) between simulated results and physical measurements is indicated for several locations over the B-pillar inner structure.
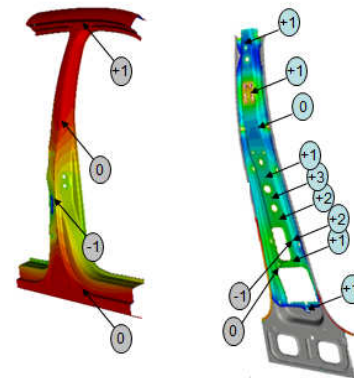
Once a first simulation is performed, the car manufacturer can decide on design changes (typically adding / removing / relocating holes) and re-run the simulation to investigate the change or improvement of such design changes.

Elsyca simulation results for a design iteration can be delivered in a matter of days, a fast response time which allows OEMs to perform a wide range of tests in short timeframe. A short response time is crucial during the development stages, in order to allow for a comfortable number of virtual iterations.