Sustainability in chemical surface technology

High application quality, low risk potential and cost-optimized processes - these are the goals of sustainability in chemical surface technology. A good example of this is the use of low-temperature zinc phosphating in conjunction with automated process control.

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In the last 40 years, chemical surface technology has experienced three innovation boosts: First of all, the aim was to reliably achieve and constantly maintain the quality level required by users. Back then, the idea of sustainability arose, because high-quality and stable processes reduce rework and complaint costs, among other things. After that, safety in handling chemicals and environmental protection came to the fore. The reduction and avoidance of dangerous and environmentally relevant sub-stances were a further contribution to sustainability.

Once these innovation goals had been achieved and established, the focus was on optimizing process costs in order to allow the user to survive in global competition. Thus, sustainability in chemical surface technology today means cost-optimized processes that include chemical products whose application quality is high, and the risk potential is low. A good example of this is the use of low-temperature zinc phosphating in conjunction with automated process control.

Zinc phosphating with subsequent electro coating is still the standard process for meeting high quality requirements.

Issue: Phosphate sludge

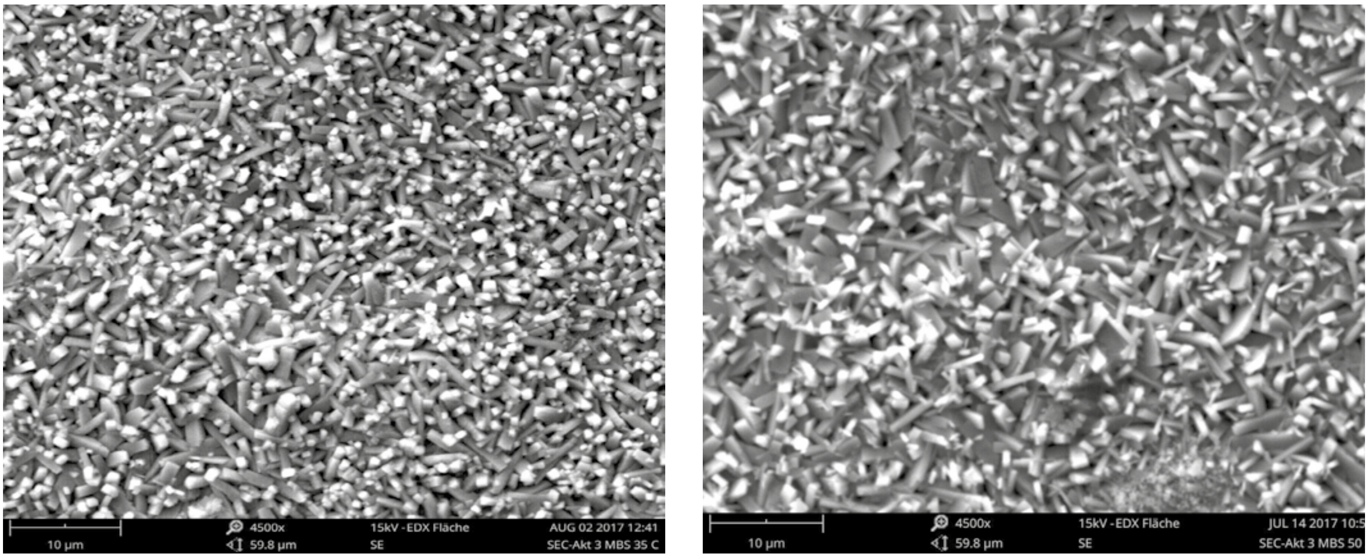
Zinc phosphating with subsequent electro coating is still the standard process for meeting high quality requirements, for example in the automotive industry or in the agricultural machinery sector. The zinc phosphate layer chemically bonded to the substrate surface offers more anchoring points for the paint due to its significantly larger surface than the base metal, which means that the adhesive bond of the paint layer to the substrate is increased considerably.

Depending on the system, zinc phosphating creates phosphate sludge, which has to be removed from the system as continuously as possible, for example by partial filtration using a plate filter press. Sludge remaining in the installation is mostly deposited in horizontal, flow-calmed zones and sometimes has to be removed chemically and/or mechanically in a complex manner (“miner’s dismantling”). It was therefore necessary to develop a zinc phosphating method which, with the available treatment times, only requires 35 °C instead of 45 to 50 °C application temperature. Here, however, the balanced ratio of a modern tri cation-low zinc phosphating regarding the concentration of the cations zinc, nickel and manganese among each other and in relation to the main anions nitrate and phosphate had to be observed.

The correct layer formation during the dipping process is achieved using a zinc phosphate-based activating agent and a specially adjusted formulation of the phosphating process. In addition to the savings in heating energy of 25 to 30% and the respective reduction in the CO_2 footprint, the system generates around 25% less and softer phosphate sludge that is easier to remove. Additionally, 8 to 12% less phosphating replenisher solution is required, which contributes significantly to conserving resources and reducing process costs.

Constant parameters thanks to automated process control

The use of an automatic process control ensures that important process parameters are kept at a constant level and that the system only vibrates



SEM of zinc phosphating at 35 °C (left) and 50 °C (right) compared.

around very small concentration amplitudes. This reduces non-prodictive use, for example with the accelerator and the associated costs. Such a system also offers the option of linking processes: a "thinking" dosing pump sends a signal to the chemical store that a new container of a certain process component is required. In this way, supply chain processes can be optimized, and costly deliveries reduced. For example, in an automated control circuit, a sensor continuously measures the electrical conductivity of the activation bath and the pH value. If a pH limit value programmed in the control unit is not reached, a dosing pump is activated, which inserts a pH regulator directly from the delivery container into the bath. When the upper set-point is reached, the pump is automatically switched off. A central control unit with eight inputs for measuring sensors and eight outputs for controlling dosing pumps or valves costs around 4,000 Euros.

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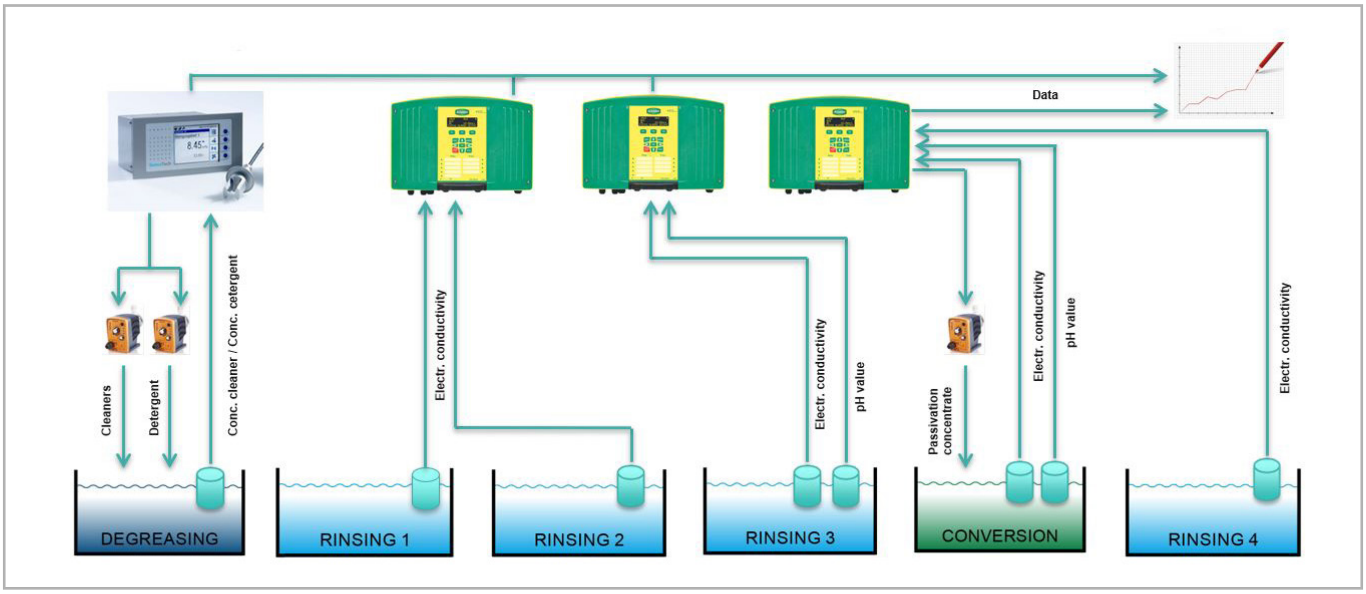

An automatic process control ensures that important process parameters are kept at a constant level and that the system only vibrates around very small concentration amplitudes.