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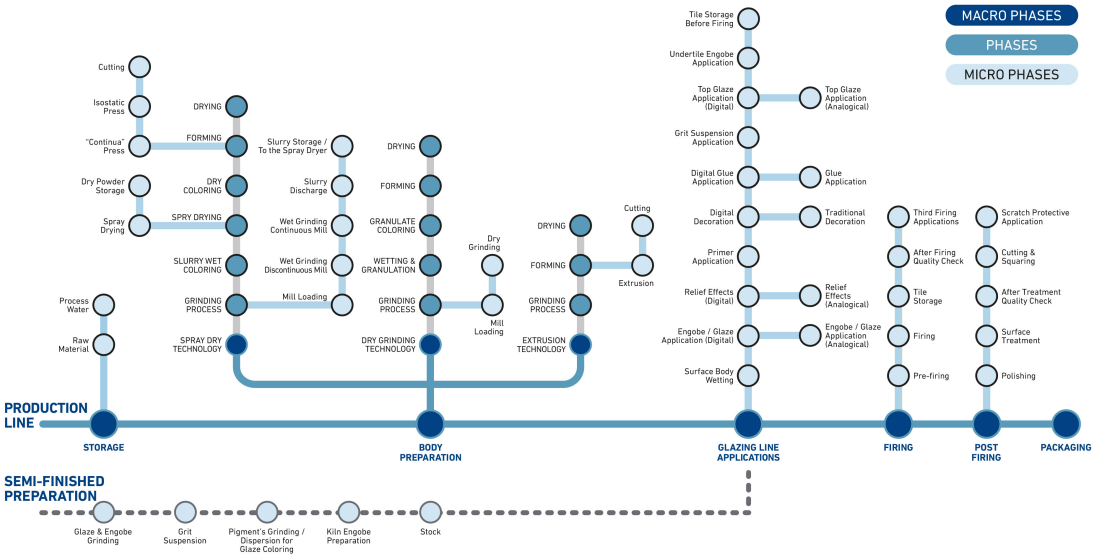
CERAMCO

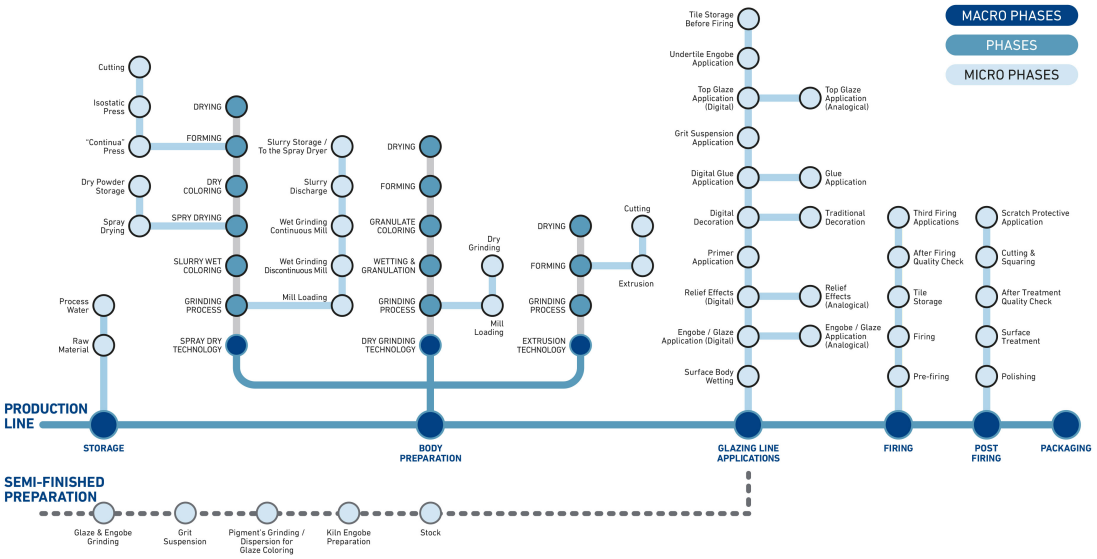
APPARENTLY INVISIBLE YET CONSTANTLY PRESENT

At every stage of the ceramic production process

A journey through problems & solutions



#59 WATER CONDUCTIVITY & INDUSTRIAL PRODUCTION



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Contents

1. Water conductivity: what is it?

Electrical conductivity, commonly referred to as EC, describes how well water can carry an electric current. This depends mostly on the amount of dissolved ions present, such as mineral salts, metals, carbonates, chlorides, and sulfates. In general, the more ions in the water, the higher its conductivity.

Conductivity is measured in micro siemens per centimeter (µS/cm) or milli siemens per centimeter (mS/cm), depending on the range. For example, ultra-pure water used in laboratories has a conductivity below 1 µS/cm, while drinking water typically falls between 100 and 800 µS/cm. In industrial settings, the levels can be much higher and may even exceed 5,000 µS/cm, depending on the process or application.

The main contributors to water conductivity are positive ions such as calcium, magnesium, sodium, potassium, and iron, along with negative ions like chlorides, sulfates, nitrates, and bicarbonates. While conductivity doesn't directly reveal the presence of pollutants, it's still an important indicator of water quality. It reflects the overall level of dissolved salts, and therefore the degree of mineralization in the water.

2. The importance of water in industrial processes

Water plays a vital and highly adaptable role in industrial settings. It serves many purposes, from cooling machinery and reactors, to cleaning surfaces and equipment, rinsing parts and materials, and even acting as an active component within production processes — as in the food, chemical, and pharmaceutical industries.

However, to perform these functions effectively, water must meet certain quality standards. Conductivity is especially important, since a high concentration of dissolved ions can lead to serious problems. These include corrosion, scaling, or disruptions to the physical and chemical processes involved in production.

3. The role of conductivity in process control

In industrial processes, conductivity is closely monitored across many applications. For instance, when water is used as a direct component in production — such as in doughs, mixtures, or solutions — an excessively high conductivity can signal the presence of aggressive ions like chlorides or nitrates, which can corrode pipes and metal equipment.
It may also point to unwanted contamination, whether from residues left behind by previous production cycles or from accidental inflows of wastewater.
In addition, a high ion concentration can alter the physical properties of water-based mixtures, affecting factors like viscosity, stability, and dispersion — all of which depend heavily on the liquid's ionic composition.

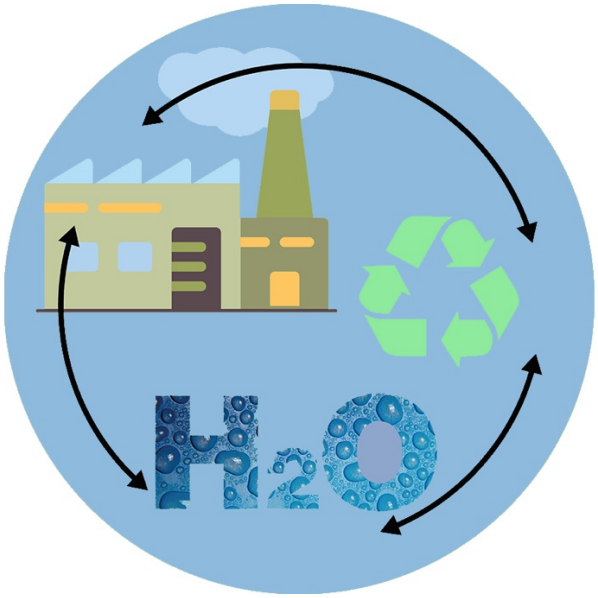
4. Case study: the ceramic industry

One industry where monitoring water conductivity is especially critical is ceramics. In this sector, water is used to prepare mixes, slurries, and other semi-finished materials that play a central role in production. Any shift in conductivity — for example, due to bacterial degradation — can disrupt the even distribution of particles within suspensions. This affects the rheology of the materials, particularly their viscosity, and ultimately impacts the quality of the finished product.

When it comes to glaze application, water with a high salt content can react with compounds in the mixture. This may cause unwanted precipitation or the buildup of deposits that interfere with the application process, leading to defects in the final coating.
High conductivity is also a concern during equipment cleaning. In spray nozzles and pipelines, for instance, it can encourage the formation of scale, leading to blockages that reduce system efficiency and increase maintenance needs.

Fluctuations in water conductivity can stem from a variety of factors. These include the water source—whether it comes from surface water, groundwater, or a municipal supply—environmental contamination, evaporation in open circuits, and chemical interactions between the water and the

materials of tanks or pipes. Even small changes in the composition of raw materials can upset the delicate balance of the process, affecting key physical and chemical parameters.



To keep conductivity under control, many industries use inline sensors that provide continuous, real-time monitoring. Alternatively, manual sampling and laboratory testing with portable instruments may be carried out.

When conductivity levels exceed safe thresholds, corrective actions can be taken. These might include water treatment, system regeneration, or replacing contaminated components to restore proper operating conditions.

5. Levers to influence conductivity

In theory, there are physical techniques, such as osmosis-based systems, that could bring water conductivity down to very low, precisely controlled levels. In practice, though, these methods are extremely costly and therefore not feasible for most industrial operations.

A more practical and cost-effective strategy is to act preventively by adding certain chelating agents during the grinding process. These substances help bind and neutralize multivalent metal ions, replacing them with simpler monovalent ions like sodium.

So why does this matter?
Through a combination of ion exchange and chelating action, these additives strengthen the electrical double layer that naturally forms around clay particles. This creates stronger repulsive forces, which push the particles further apart. As a result, they move more freely and slide past one another, leading to a notable drop in the mixture's viscosity and a smoother, more workable material.

It's worth pointing out that this treatment doesn't lower the water's electrical conductivity. Instead, it optimizes particle dispersion, which greatly improves the flow properties and overall handling of the clay mixture.
