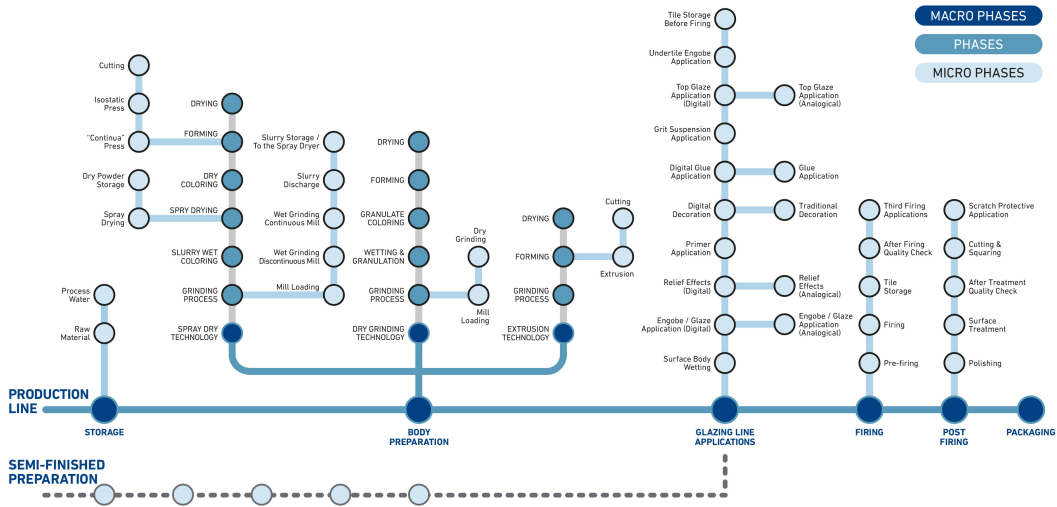




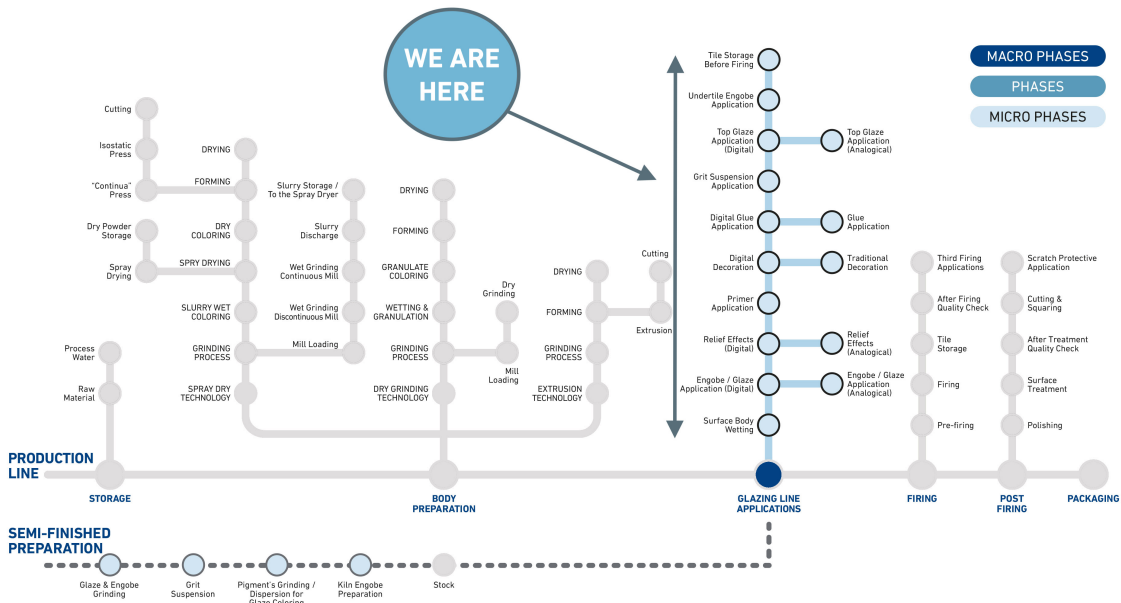
**ZSCHIMMER & SCHWARZ
CERAMCO**

APPARENTLY INVISIBLE YET CONSTANTLY PRESENT
At every stage of the ceramic production process

A journey through problems & solutions



#27 CERAMIC GLAZES, SURFACE TENSION & CHEMICALS





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1. SURFACE TENSION: DEFINITION

Surface tension is the tendency of liquid surfaces at rest to shrink into the minimum surface area possible.

*Thanks to their cohesive force, glaze particles at the interface*** liquid-air are bound, developing an invisible film. Such force is precisely called surface tension.*

***The area where two immiscible phases of a dispersion come into contact. It may involve the same or different states of matter.

2. THE PROPER CHEMICAL

In general, to get a proper glaze application, it is always important to work on the fluid's surface tension by decreasing or, more generally, adjusting it, until you reach the proper values according to the chosen application system (spray, vela or bell).

To do that, there are on the market several chemicals that, depending on their chemical nature and their formulation, are able to affect the surface tension acting – for example – as leveling agents (surfactants and wetting agents), anti-foaming (defoamers) or compatibilizers (in case of repellency phenomena), solving many kinds of problems.

Regardless their specific action, they all directly or indirectly act on the surface tension.

Before addressing these different categories of chemical, it is important to underline that many organic molecules in aqueous solution are generally able to decrease the water's surface tension within which glaze particles are suspended. Some glaze dispersants, for example, beside their main dispersant action, are also marked by significant wetting properties.

3. WETTING AGENTS

From a chemical point of view, wetting agents are made up of organic molecules partially or slightly water-soluble. We are talking about block copolymers, acids, modified natural fats, etc.).



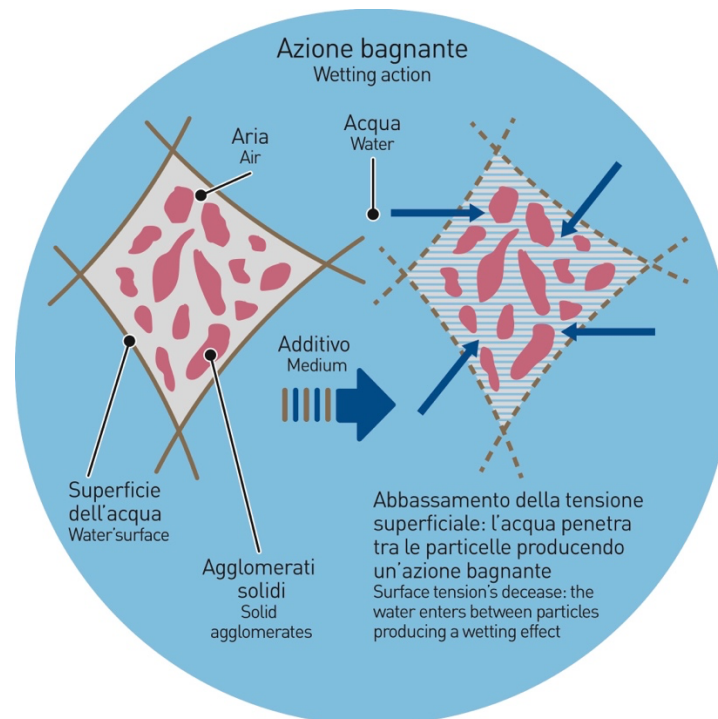
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They are able to act at the interface between ceramic support and glaze and at the same time at the interface between glaze and air: the leveling action they promote precisely derives from the decreasing of the surface tension's value at the interface glaze/air.

The lowering of surface tension promoted by wetting agents usually turns into a deagglomeration of the suspended solid particles, helping their homogeneous dispersion within the system and therefore developing an outstanding leveling action on the glaze.

What kind of mechanisms do they develop?



The lowering of the surface tension's values causes the water to enter between the suspended and agglomerated solid particles that keep air trapped inside. The very high-water surface tension prevents the water molecules to enter between agglomerates, limiting or even avoiding the particles' hydration process. In other words, water does not wet the solid particles.

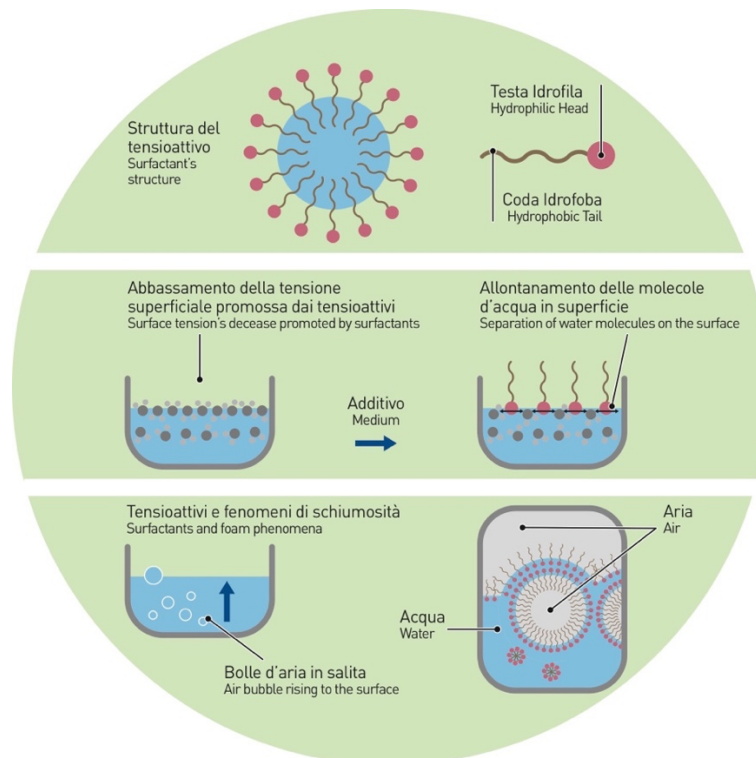
The wetting action on the particles, makes them to be free and to move and slip within the system, properly leveling on the raw ceramic support.

Since they are partially soluble, wetting agents provide the glaze with leveling properties without producing side effects such as, for example, foaming phenomena. On the other side, the low solubility of the system may sometimes lead to the formation of pinholes or tiny surface depression.



4. SURFACTANTS & DEFOAMERS

Surfactants are high performing soluble products that, however, can also lead to foaming phenomena. By definition, these are products able to lower the surface tension due to their molecular structure that consist of a hydrophilic head and hydrophobic tail.



After a surfactant has been added to a solution, this is what happens on the fluid's surface: the tail, because of its hydrophobic nature, remain outside the water (exposed to air), while the hydrophilic head is soaked in water, separating and creating a distance between the water's superficial molecules, therefore decreasing their surface tension.

Since they are totally water-soluble (unlike wetting agents), surfactants usually do not give rise to defects such as pinholes or dimples. However, they are highly foaming and not very easy to manage: this is the reason why they are not usually involved in ceramic production, being replaced by wetting agents that can be more easily handled according to production requirements.

How do surfactants produce foam?
What is the structure of a foam bubble?

To avoid sedimentation phenomena, glazes and ceramic suspension are usually under constant stirring by means of specific system that tend to incorporate air within the fluid, thus facilitating foaming phenomena.

Foam bubbles produced by surfactants are nothing but spheric films made up of water molecules that are bound (or linked together) by surfactants.



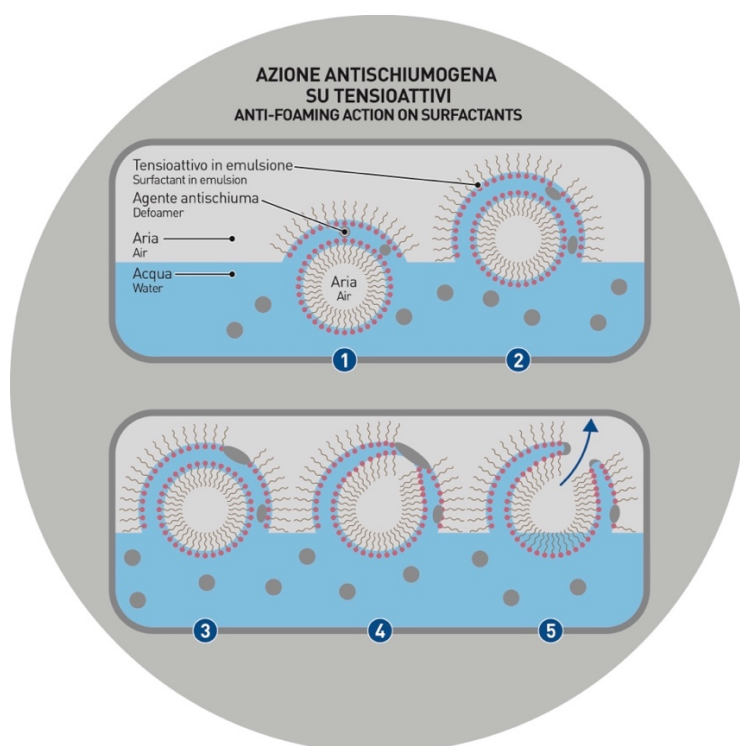
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In ceramic, when the glaze watery suspension is under stirring, the air enters the suspension (especially with high-speed) and bubbles rise up to the surface.

The use of defoamers against surfactants' actions can partially or totally solve the problem but the equilibrium is quite unstable. On one side, in fact, defoamers work on the foaming promoted by surfactants and on the other side defoamers must be controlled and carefully managed to avoid defects due to its water-insolubility.

How can foam be eliminated?



All defoamers, unlike water, are non-polar and therefore water insoluble. Once they have come in contact with the foam bubble, they break the bubble's stability, acting on the surfactant's molecules, breaking their tails and therefore exploding the bubble.