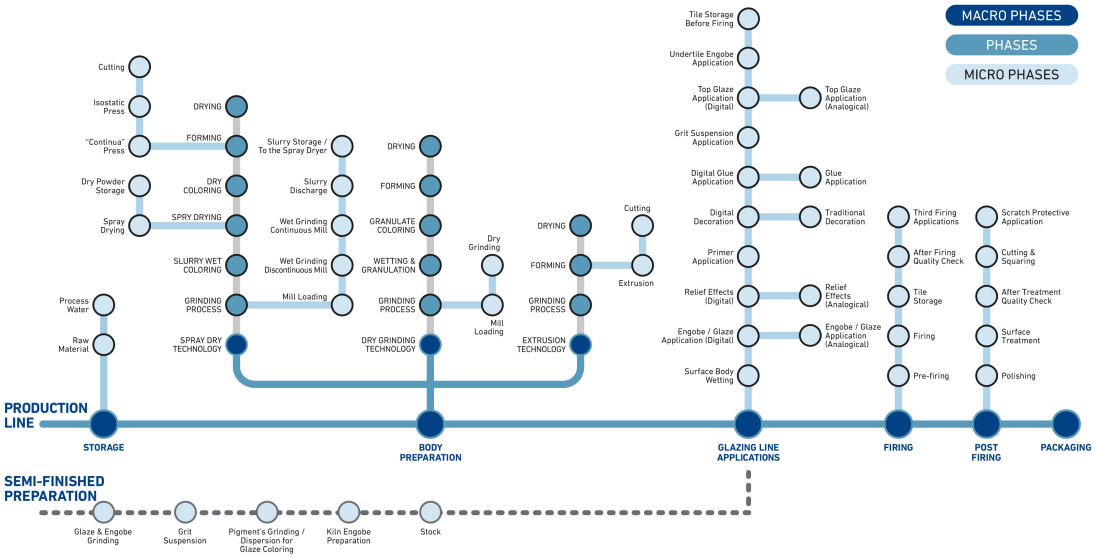
ZSCHIMMER & SCHWARZ
CERAMCO

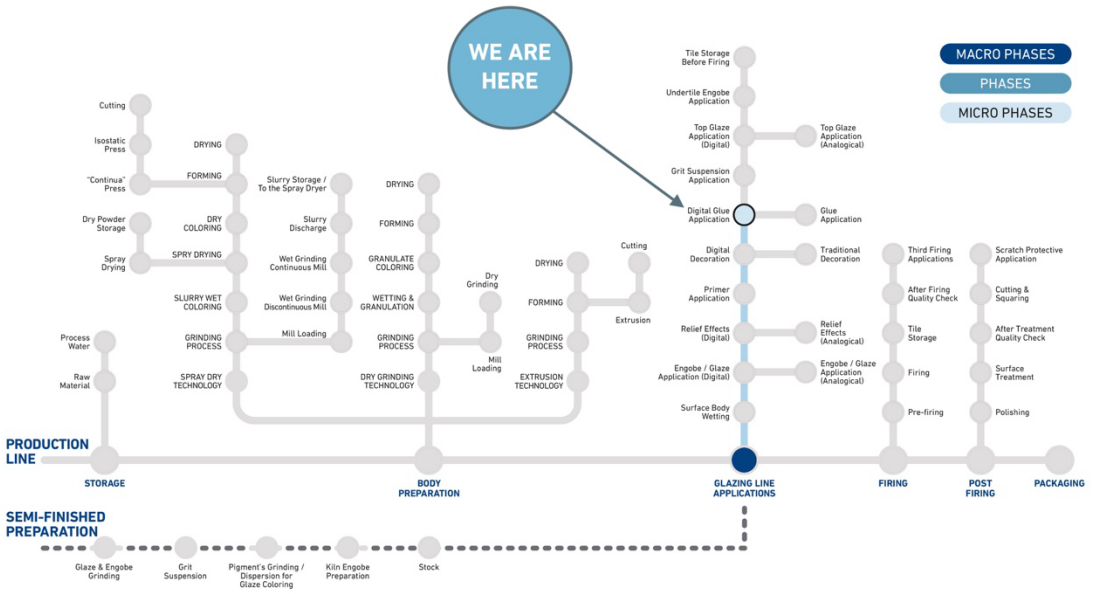
APPARENTLY INVISIBLE YET CONSTANTLY PRESENT

At every stage of the ceramic production process

A journey through problems & solutions



#19 CERAMIC GLAZES: APPLICATION SYSTEMS, RHEOLOGY & SYNTHETIC CHEMICALS



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01512870153 –
P.IVA 01600960361

CAPITALE SOCIALE -
€ 3.100.000,00 i.v. REA di Modena
199597 Mecc. MO 009298 –
NR. PART. EU. IT 01600960361

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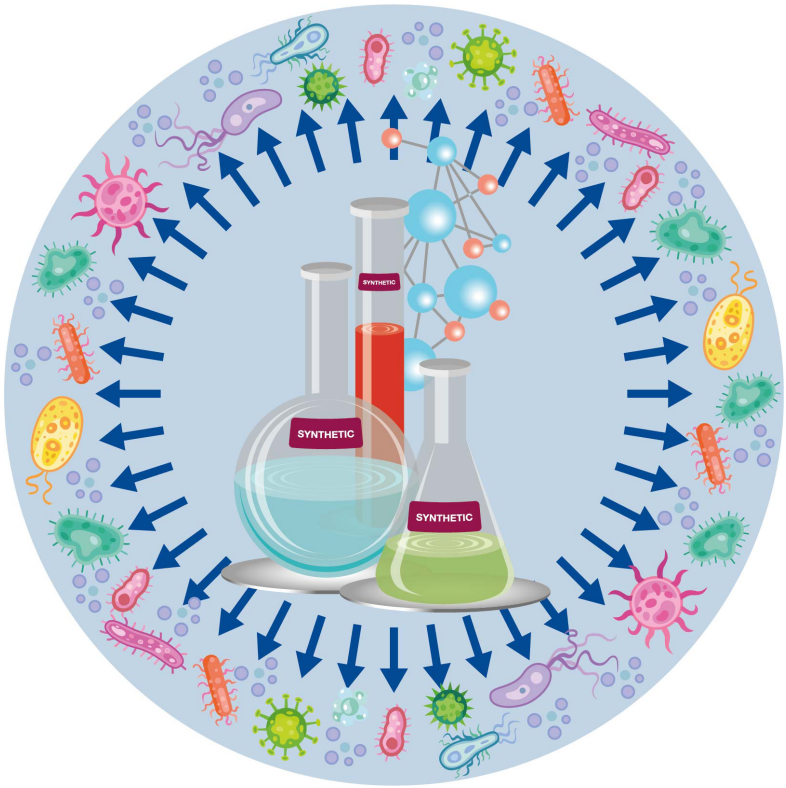
1. INTRODUCTION

Among the several issues that ceramic producers must face during production, **glaze and engobes'** microbiological degradation is one of the most frequent and difficult to solve.
These semi-finished products are usually grinded by means of grinding mills where CMC and DISPERSANTS are added to promote the proper development of the process, providing glazes and engobes with the right features.

However, sometimes both dispersants and CMC can be a nourishment for bacteria that, developing a bacterial degradation, reduce or even nullify the chemicals' action.

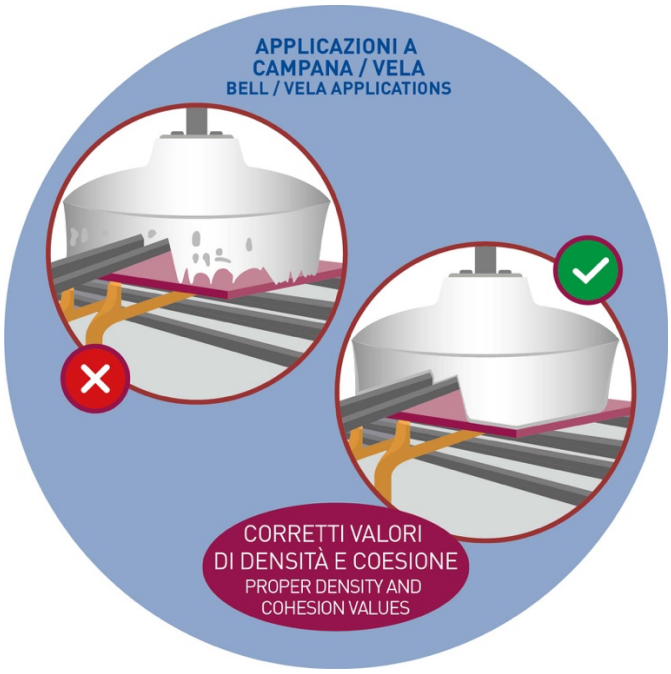


2. TO EACH SCENARIO A SPECIFIC SET OF CHEMICALS

Here is a list of the most important application systems. For each of them we will offer a general overview about the different chemicals involved, remembering that they can significantly change according to the glaze's features and the parameters of the production line, such as the glaze's working density, the rheology of the products or the application system.

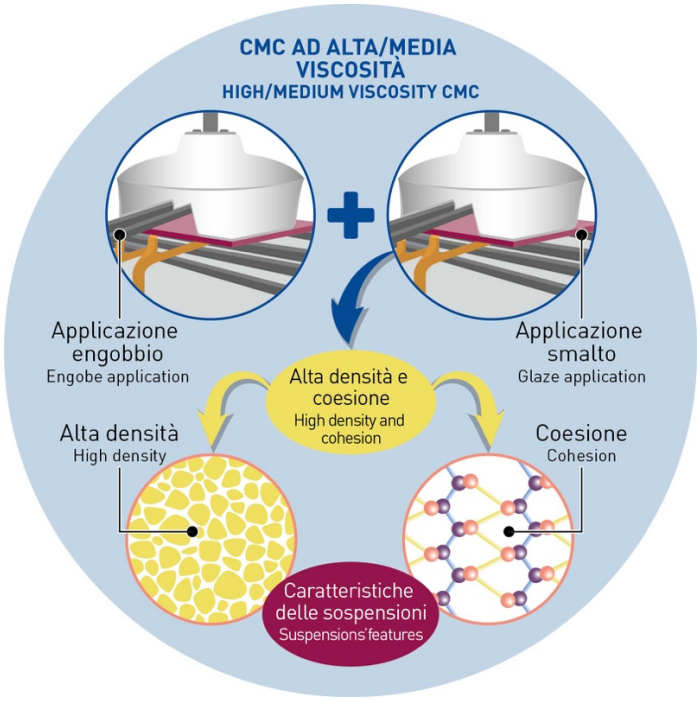
VELA and/or BELL APPLICATIONS

For example, glazes applied by means of vela or bell systems usually require chemicals able to reach a high-density (such as 1700 /1850 g/l at 25°C) and to provide the watery system with high level of cohesion, therefore promoting a homogeneous discharge of the glaze on the raw ceramic support.



This usually means working with high levels of fluidization, using CMC marked by a medium or high viscosity value. Dosages must be defined from time to time to develop a drying process suitable for multiple applications, that is an application of engobe and glaze by means of two application machines (both bells or vela systems).

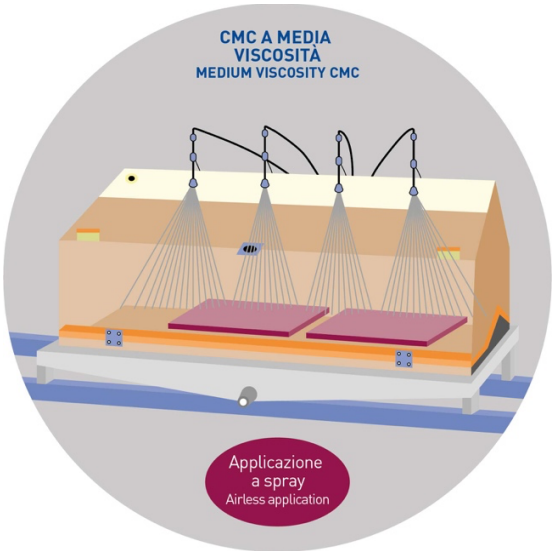
The engobe applied by the first machine must properly dry on the support before the tile reaches the second machine that discharge the glaze: this is very important to ensure the best integration between the two layers.

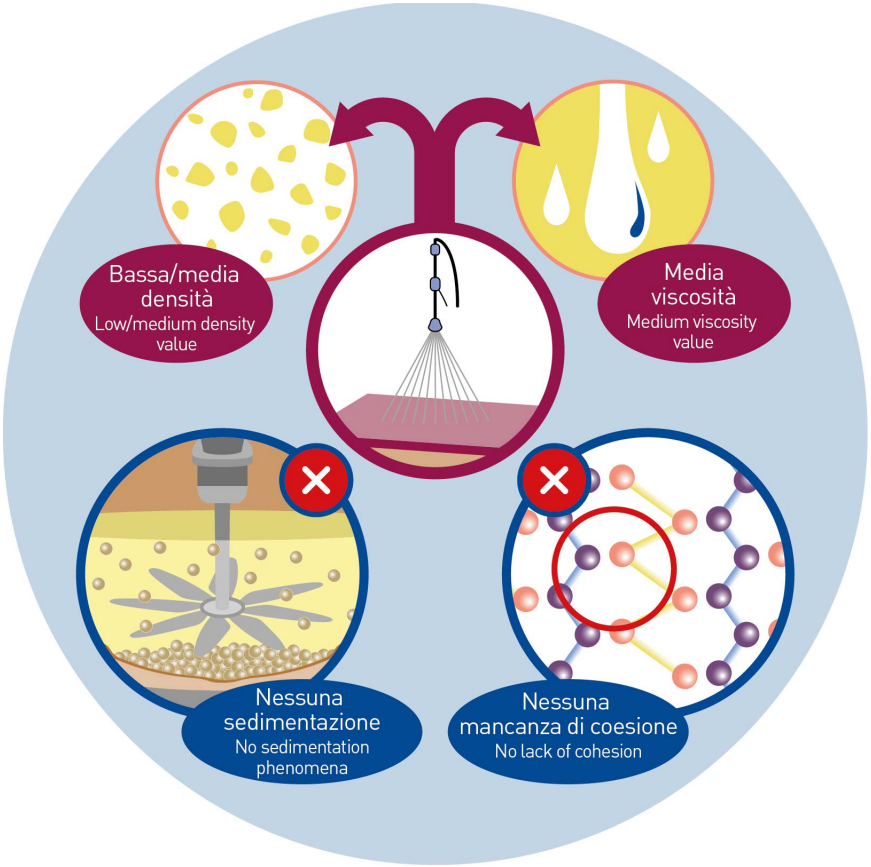


AIRLESS SPRAY APPLICATIONS

On the other hand, medium-density glaze applications by means of airless spray systems (such as 1450 g/l at 25°C), require during the grinding stage a different approach, to reach lower values of density and viscosity.
In this case, the fluidization shouldn't be too strong in order to avoid sedimentation phenomena as well as lack of cohesion. At the same time the CMC should be marked by a viscosity value able to promote a good leveling, according to the glaze (1) and to the tile's temperature (2).

What does that mean?



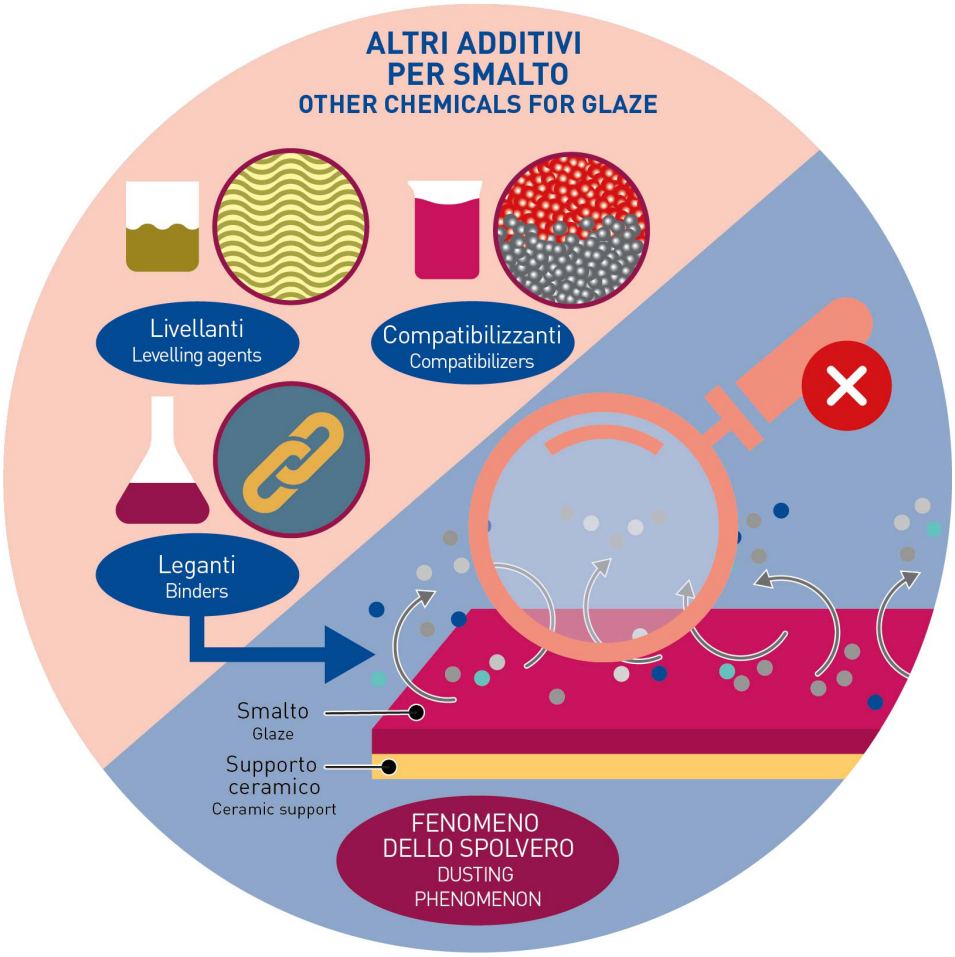


1. THE GLAZE

Each CMC can be marked by different properties, and this is the reason why it is very important to choose them according to the features of the glaze involved in the production process.
For example, in case of a very plastic glaze (intrinsically marked by high cohesion and viscosity values), a low-viscosity CMC or a lower dosage is recommended.
On the other hand, a low-plastic glaze (that is poor in clay) would require CMC with a higher viscosity value to ensure a good cohesion and a proper drying process on the tile.

2. THE TEMPERATURE

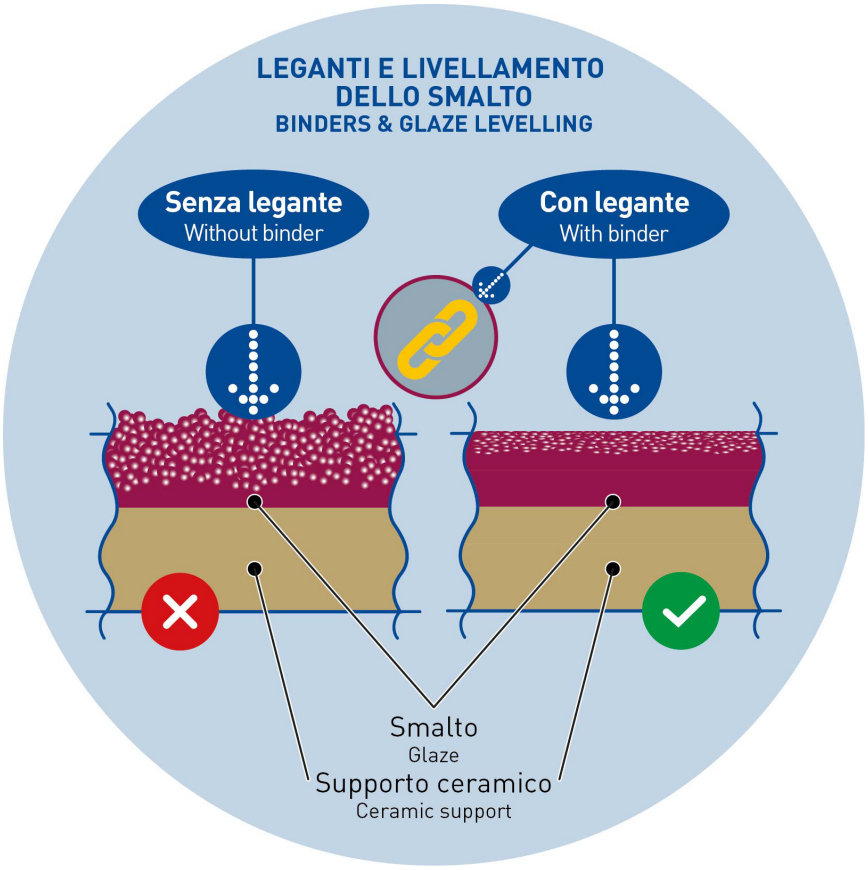
In general, both the selected CMC and the dosage can affect the drainage as well as the evaporation times of the water of the glaze suspension. This is the reason why the temperature of the ceramic support on which the glaze is discharged (operating temperature) is a very important parameter that must be considered when choosing the CMC.



In case of airless spray system applications, together CMC, other kind of chemicals must be usually added to ensure a proper application, that is for example a good leveling of the glaze.
In case of glaze applications after the digital printing process, instead, it is important to use compatibilizers to match the different chemical nature of solvent-based inks and water-based glazes.

In general, binders are always required, both during the grinding process and along the glazing line, since they provide the glaze with the proper cohesion, the right rheology and a reasonable binding power between the glaze's particles. These parameters are essential to avoid the so called "dusting phenomena" that usually arise due to the lack of cohesion between the glaze's inorganic particles.

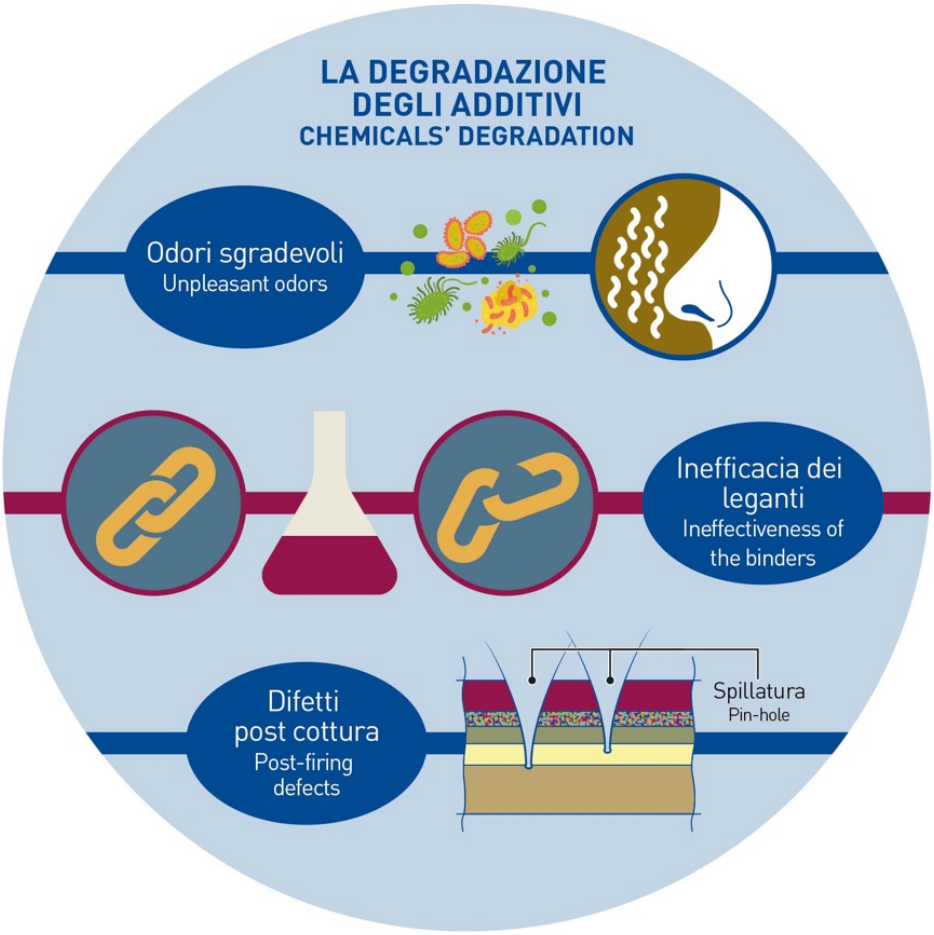
In this regard, binders are able to increase the binding power of the glaze and its drying times, improving the leveling process on the support and avoiding the formation of non-standard drop of glaze (too big) that would negatively affect and compromise the tile.



3. MICROORGANISMS & BINDERS' DEGRADATION

Density, viscosity and rheology values of the glaze can be always managed and adjusted according to the process parameters. The presence of microorganisms (and more specifically of bacteria) is instead much more difficult to handle, especially because bacteria are detected only when unpleasant odors deriving from metabolites arise, that is when the degradation is already underway.

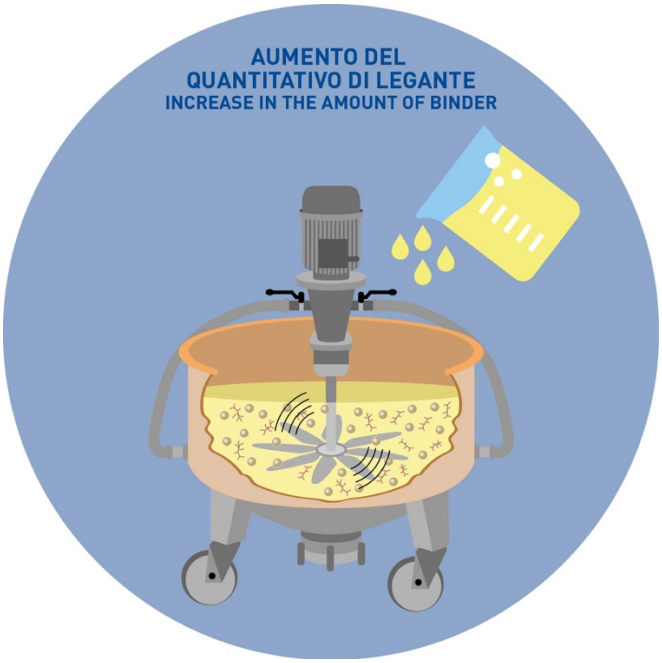
Bacteria do not produce only bad odors. They also negatively affect the action of binders, by decreasing or even nullifying their power. Moreover, the metabolic waste inside the glaze may often lead to application problems and to technical or aesthetical defects of the tile that can be visible even after the firing process (such as, for example, pinholes).



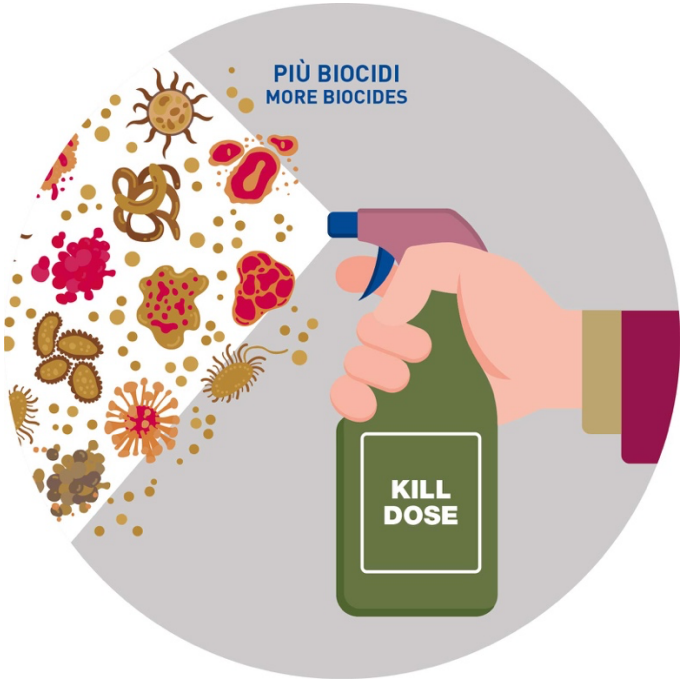
4. PREVENTIVE & CORRECTIVE ACTIONS (STANDARD)

How to prevent and dealing with the problem?
Following here the main important actions.

A.
One of the less invasive actions is to add the glaze, along the glazing line, with an additional amount of binder, just before the application. However, even if this is usually useful to restore the features of the suspension, it is not able - sometimes - to avoid post-firing defects. In addition, this kind of intervention must be rapidly developed, since the degradation action promoted by bacteria is usually very fast.



B.
A second action able to keep the features of the glaze, it is the addition of a huge amount of biocide (Kill-dose) to kill and to get rid of ALL microorganisms, therefore restoring the chemical's binding power.
Even if biocides protect and preserve the glaze, sometimes they are not enough strong to avoid tile's defects.



C.
The third action is a real preventive action since it is developed when bacteria do not have attacked the glaze yet. The solution consists in adding the glaze, during and/ or after the grinding stage, with a proper mix of biocides/preservatives. However, this is a solution that in some cases is difficult to put in practice, since it is almost impossible to 100% check the presence of bacterial proliferations within all the production areas of the plant.

5. THE NEW SCENARIO: THE SYNTHETIC CHMICALS

If this is the scenario, it would be important to find a different way or strategy to face the reduction of chemical's effectiveness, finding a solution able to solve the problem at its root. This means developing different categories of chemicals that cannot be attacked and affected by microorganisms.
In this regard, R&D labs have been working on this topic for some time and even if they are still searching for definitive solutions, some interesting results seem to be already very promising.

This new approach based on **FULLY SYNTHETIC CHEMICALS**, of course, cannot exclude the presence of bacteria inside watery systems (such as glazes) but it can surely reduce and contain their proliferation.

What is the main feature of these new products and why do they not degrade?

In general, all products of natural origin (or natural-modified origin such as CMC) are usually a nourishment for microorganisms because of their molecular nature that can be easily degraded through many actions of biological nature.

The use of SYNTHETIC MOLECULES makes bacteria - that can affect and destroy molecules of natural origin - uncapable of finding the way to develop their degradation process (the word "synthetic" refers, in this case, to single monomers and/or oligomers that have been properly managed to get new molecules that do not exist in nature).

Here's a very simple example to clarify the difference between the two kinds of molecules. Think of the polymer (or of a natural molecule) as it was a wool yarn. Bacteria are provided with scissors (their mechanism of action) that cut the yarn in a lot of small pieces that can easily be eaten. Think, instead, of the synthetic molecule as it was a barbed wire that hampers bacteria (the scissors), remaining safe and active.