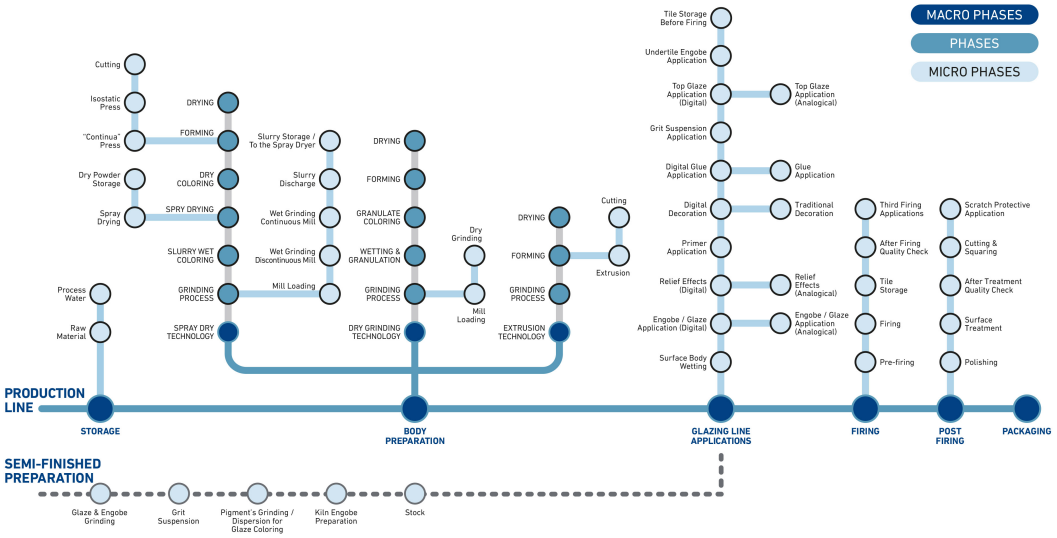
ZSCHIMMER & SCHWARZ
CERAMCO

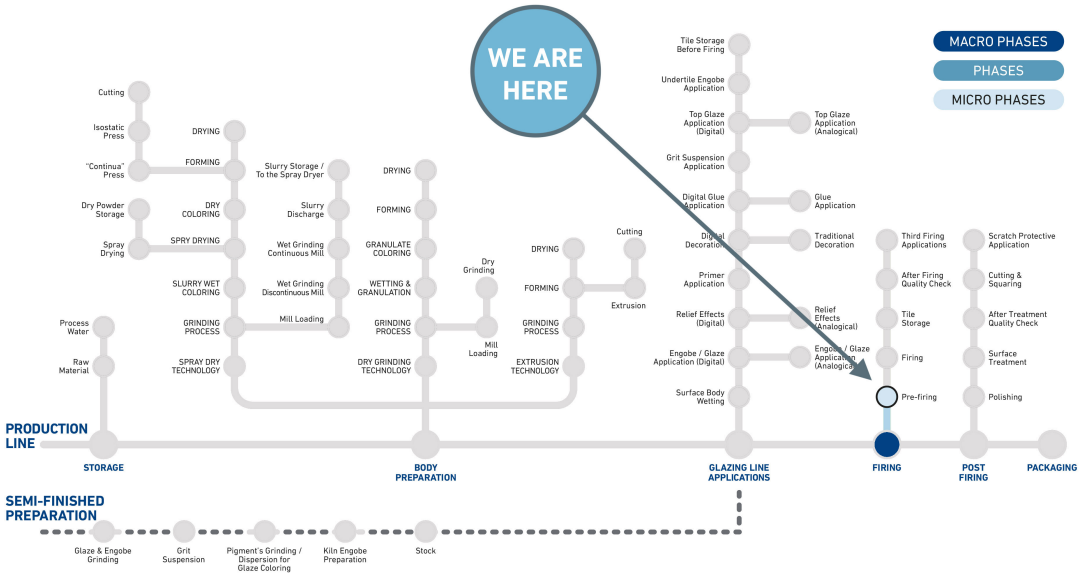
APPARENTLY INVISIBLE YET CONSTANTLY PRESENT

At every stage of the ceramic production process

A journey through problems & solutions



#25 FORMALDEHYDE, CERAMIC PRODUCTION & ENVIRONMENTAL IMPACT



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1. INTRODUCTION

The Italian ceramic industry has been involved for years in a very important goal: the reduction of environmental impact. For this reason, it is constantly under examination to check its performance as well as to ensure compliance with the strictest standards.

In this regard, the areas which are usually taken into account are:

1. Water balance
   The law of water balance states that the inflows to any water system or area is equal to its outflows plus change in storage during a time interval
2. The materials in use
3. Energy consumption
4. Atmospheric emissions

Atmospheric emissions are the main critical issue under the attentions of legislators, industry and institutional research for a long time.
Among all the possible emissions, the most important compounds that the ceramic sector has to constantly check can be listed as follow:

- Particulate matte
- Fluorine
- Volatile Organic Compounds
- Aldehydes and Formaldehyde
- Lead
- Nitrogen Oxides
- Sulphur Oxides

Given these categories, which is the role and what are the features of FORMALDEHYDE?

2. ALDEHYDES FROM A CHEMICAL POINT OF VIEW

From a chemical point of view aldehydes are an important class of organic compounds marked by the presence of the chemical group C = O, so called Carbonylic Group.

[A chemical group is an atom or groups of atoms that impart specific chemical properties, mostly reactive, to all those compounds that contain them. According to the functional group of the molecule, organic substances can be classified in homologous series (such as alcohols, ketones, carboxylic acids, etc.) that show similarities in chemical behavior and physical properties, as they have the same functional group.]

Formaldehyde [CH_2O] belongs to aldehydes' category and it is the simplest representative of that type. It stands out for its high reactivity, biodegradability, high boiling point and its water solubility.

WHERE CAN WE FIND IT?

It is a naturally occurring substance in the form of colorless gas and, according to its water solubility, it can also be used in aqueous form. In both cases it is marked by a pungent smell, certainly unpleasant.
It is naturally produced by some combustion processes and by the oxidative metabolism of al lot of living organisms. Even humans produce - unknowingly - ridiculous amount of formaldehyde.

It is surely one of the most common chemicals and it is present in almost every environment, including the household.
It is produced in more significant quantities by car exhausts, some kind of heaters, incinerators as well as by cigarette smoke. It can also be found into paints, dyes, cosmetics, conditioners, shampoo, hairsprays, nails' products, smoked or fried food and, in very low percentages, in vegetables and fruit.

3. FUNCTIONS & USAGE

Formaldehyde, tank to its features, can performs various functions and for this reason it is used in rigid regulated concentrations in many different areas of which we list below, as an example, the most relevant.

Since it is marked by a powerful bactericidal action, it is used in hospitals (formalin), in aqueous solutions of domestic sanitizers and in textile's industrial production
It is also primarily used as a food preservative (additive known as E number 240).

When added to other compounds, it can be found in sound-absorbing ceilings and in binders for chipboard or laminate wooden panels (therefore, in general, in furnishing). By reaction with phenol, it polymerizes giving rise to Bakelite and it is finally used in textile dyeing processes in order to ensure stability to all the solutions

4. CRITICALITY & TOXICITY

Despite its widespread use, formaldehyde is also marked by toxic features that impose to pay carefully attention during manipulation as well as a rigid procedure in case of massive inhalation or contact.
The exposure to formaldehyde occurs mainly by breathing. The amount that can be ingested with a normal diet or absorbed through the skin is, in fact, entirely negligible. Among the immediate effects that can occur after a personal exposure to high rate of formaldehyde, airways and ocular irritation, tiredness and skin rash are the most frequent.

In recent times, and more precisely in 2016 January 1st, formaldehyde has been definitively classified as a carcinogen.

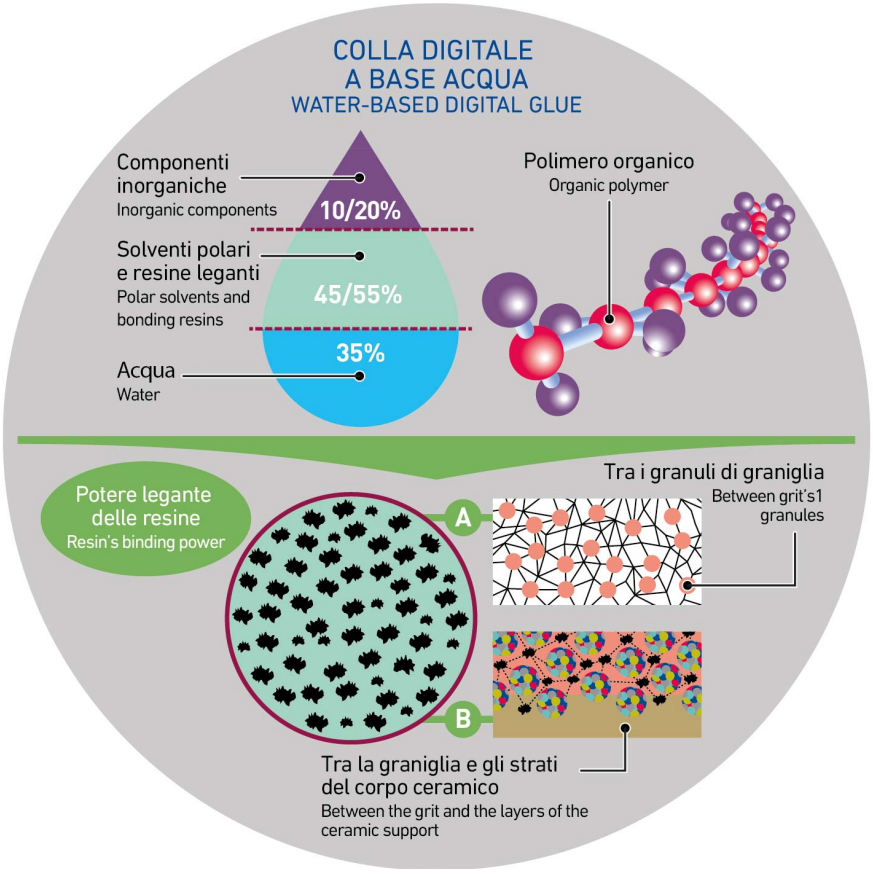
5. FORMALDEHYDE & CERAMIC PRODUCTION: WHAT FUTURE?

The formaldehyde's carcinogenic nature has imposed all labs that are in charge of the emissions' analysis to separate and measure it separately from other aldehydes in order to circumscribe and isolate its presence, precisely defining its percentages in the air.

As we know, the use in the ceramic field of specific solvent-based products within the digital decoration process (inks and glues above all) causes, during the firing cycle, the emission of substances that affect not only the sense of smell but also the air quality (in terms of pollution).

Although the values are constantly monitored and the ceramic district is showing a constant and rigorous attention in containing and complying with the limits laid down by the provisions in force, the research and the development of alternative solutions that can improve producers' standards and performances currently represent the first goal in the agenda of several companies involved in the field.

In this perspective, the replacement of specific products with low-invasive alternatives - which is still today timid and not predominant - seems to be played around the water-based topic. A complex issue that is both in evolution yet inevitable.



The use of water-based digital inks and glues within the digital printing process has led to an important decrease in SOV, aldehydes, formaldehyde and organic acid emissions, responsible for the poor air quality. Their different chemical formulation, in fact, it has specifically developed to acts in this direction. Without entering in complex technical details, we could simplify it as follo

The formulation has been developed in order to get the best combustion as possible during the firing cycle. This different process development is due to the features of the chosen polar solvent whose molecules - unlike those non-polar used within solvent-based digital inks/glues - burned more easily inside the kilns.
Water-based digital inks are also marked by a water content that correspond to the 40-50% of the liquid phase and therefore by a reduction of the 40-50% of the liquid organic components that are the basis of the environmental problems.

In general, we can say that even though the district has already achieved great heights, it is also to be hoped the implementation also important to increase in near future all those actions that can further improve the quality of the air we breathe.