Milling industry

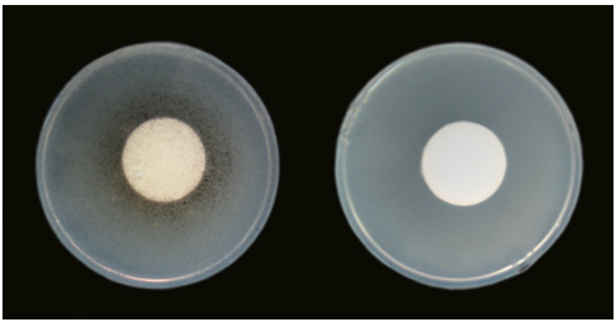
MICROORGANISM CONTAMINATION: avoiding new sources of inoculation

When cereals arrive at the milling plant, they carry a series of contamination that can be divided into three main classes: physical, chemical and biological. The third class of biological contamination may contain human pathogen microorganisms such as E. *coli*, *Salmonella* and mycotoxin producing fungi. These organisms are naturally present in the environment where cereals grow and several factors can increase their concentration leading to a threat to human health.
The first step of the milling process is actually the elimination of these contaminations. The cleaning of cereal prior to milling is therefore an essential step in flour production. In time, many machines have been developed to remove physical contaminations from cereals such as stones and straw or other biological contaminants such as insects and seeds from other plants. However, when it comes to microorganism, due to their size, it is more difficult to detect and remove them. Moreover, as said before, the amount of microorganism on the surface of the cereals can differ between batches. This phenomenon can lead to cross contamination effects inside the mill, because it is impossible to clean the plant every time a new lot is used.
The problem of microorganism contamination can be approached from different angles. One is to remove them mechanically from the surface by peeling or debranning during the cleaning. Another method is to drastically reduce their number with high temperature, chemicals (e.g. ozone, chlorine) or irradiation at different stages of the milling process. The third approach is to reduce cross contaminations by avoiding the formation of new source of inoculation in the mill. The R&D team of **Ocrim** in collaboration with the Italian University of Parma has investigated the latter in order to develop an innovative product for the mill.
The 70 years of experience in building and maintaining mills all over the world have shown Ocrim that certain spot in the mill create an optimal environment for mold formation. Although in theory,

the water activity in the milling plant is not optimal for the growth of micro-organisms, certain conditions may create ideal micro-environments for their development. The objective of the R&D team was to counteract the formation of these micro-environments thus blocking mold formation and bacterial propagation.
In the food industry, the use of materials with antimicrobial characteristics in strategic zones of the plants is largely diffused (e.g. packaging area). Thus, the idea was to transfer this technology to the flour milling industry. This research first identified the plansifters as one of the areas of the mill where microorganisms can develop and contaminate new batches of flour. This contamination can occur for a long period of time, until the growing molds are physically removed from the machines. Therefore, the possibility of building sieves containing an antimicrobial compound that could prevent mold and bacterial formation was considered. A fundamental step of the research was to find the appropriate material to build the sieves that brought together antimicrobial activity and three other main features: compatibility with food usage, durability and mechanical reliability.
The Ocrim R&D team succeeded in finding a new composite material certified as food grade that contains an antimicrobial ingredient that can be used in milling plants. This substance is trapped inside the material. Therefore, the antimicrobic is not released in the flour during sifting. This has the great advantage that it will not interfere with the rheological and backing characteristics of the flour. Nonetheless, the antimicrobic is active on the surface of the sieves blocking the development of molds and bacterial in the plansifter. Moreover, having a component that is incorporated in the material gives the benefit that it is not consumed over time and the antimicrobial effect is present and stable for the whole life of the sieves.
This new material is also certified to be active against major human pathogens such as *Escherichia coli*, *Salmonella enteritidis* and *Staphylococcus aureus*, according to the modified AATCC 100 method. To test the activity range of the compound, Ocrim performed ISO

The plansifter made with the new antimicrobial material (**Ocrim**).

16869:2008 and ISO 846:1997 methods. The results show that the new material has a fungistatic effect and that microorganisms are not able to grow on it. Therefore, the new sieves are able to stop bacteria and mold growth inside the plansifters. In the mill plant, stopping mold proliferation is fundamental for human health. In fact, mycotoxin producing fungi are also present on cereals. The development of these microorganisms can lead to the production of the toxins and subsequently release them into the flour. So mold contamination, for instance in plansifters, can become a source of mycotoxins contaminations. To be sure that the new material is effective also against these pathogens, the team repeated the ISO 16869:2008 and ISO 846:1997 tests using the strains of *Aspergillus flavus, Fusarium graminearum* and *Penicilium verrucosum*; three fungi that are able to produce aflatoxins B1 and G1, DON, ZEN and ochratoxin A respectively. This new material is active against all of them. Therefore, the sieves are creating a hostile environment against a wide spectrum of microorganisms including the ones that can produce dangerous mycotoxins.



Microbiological test on a wood frame (left) and the new antimicrobial frame material (right) (**Ocrim**).

This research also aimed at comparing the new material with the old ones used in plansifters. Traditionally sieves are made of wood, but wood can be a substrate for microorganism growth. Therefore, the same ISO tests were performed using round samples of multilayer wood and composite material placed on a substrate containing a mixture of bacteria and fungi. As shown in the image (microbiological test), after two weeks of incubation microorganisms are growing around and on top of the wood sample (black dots on the left). This demonstrates that if the microenvironment is optimal, microorganisms can develop on the surface of wood. In contrast, in the same experiment performed with the new material, there is no growth (count plate on the right). This indicates, once again, that even when the conditions are optimal, the antimicrobial material is able to stop the proliferation of bacteria and fungi. Accordingly, the substitution of the old sieves with the new antimicrobial ones can increase the mills barriers against microorganism contaminations.

Lastly, the R&D team tested the mechanical characteristics of this composite material and its suitability for making sieves. Several tests performed in different milling plants showed that the new sieves with antimicrobial activity are reliable and resistant. They are conformed to be used in the stressful settings of the plansifters. Furthermore, the new material combined with new technological know-how allows Ocrim to be flexible and build sieves in different forms and for different machines. This would consent any plant to be upgraded with the new antimicrobial sieves.

The study conduct in collaboration with the University of Parma has led the company to develop a new product that consents to minimize the formation of new sources of contamination inside the mill and avoid phenomena of cross-contaminations between different batches of cereals. The new antimicrobial sieves are able to block bacterial and mold proliferations, without altering the characteristics of the flour while maintaining a high quality standard.

Ocrim is now using this new antimicrobial composite material to produce sieves for plansifters, but further research is aimed at using this technology in other strategic areas of the milling plant in order to increase the barriers against pathogen microorganisms from the inside the mill.

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