# MILLS FIGHT PATHOGEN MICROORGANISMS

by Simona Digiuni and Emanuele Bigna

## Ocrim researchers find solution to bacterial growth on plansifters in flour milling

When cereals arrive at the milling plant, they carry a series of contaminations that can be divided into three main classes: physical, chemical and biological. The third class of biological contaminations may contain human pathogen microorganisms like E.coli, Salmonella and mycotoxin-producing fungi. These organisms are naturally present in the environment where the 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 of flour production. Many machines have been developed to remove physical contaminations from cereals like stones and straws or other biological contaminants such as insects and seeds from other plants. However, when it comes to microorganisms, due to their size, it is more difficult to detect and remove them. The amount of microorganism on the surface of the cereals can differ between batches. This phenomenon can lead to cross contaminations effects inside the mill because it is impossible to clean the plant every time a new lot is used.

### MICROORGANISM SOLUTIONS

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. Other methods include using 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 a new source of inoculation in the mill. The R&D team of Ocrim, in collaboration with the University of Parma, has investigated the last one in order to develop a new product for the mill.

Its 70 years of experience in building and maintaining mills all over the world has shown Ocrim that certain spots in the mill create an optimal environment for mold formation. The water activity in the milling plant is not optimal for the growth of microorganisms, but certain conditions may create ideal microenvironments for their development. The objective of the R&D team was to counteract the formation of these microenvironments and thus block 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 microorganism 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, Ocrim considered the pos-


New antimicrobial sieve designed by Ocrim.
Photos courtesy of Ocrim.

sibility of building sieves containing an antimicrobial compound that could prevent mold and bacterial formation. A fundamental step of the research was to find the appropriate material for the sieves that brings together antimicrobial activity and three other main features: compatibility with food usage, durability and mechanical reliability.

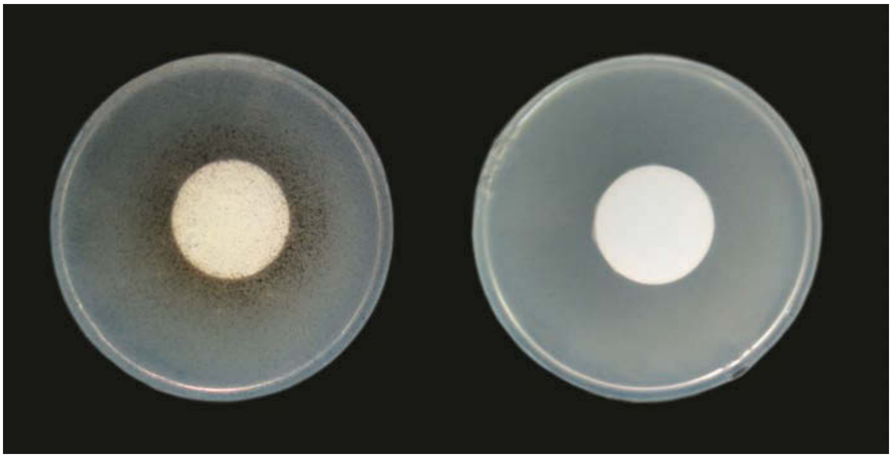
The Ocrim R&D team found a new composite material certified as food grade that contains an antimicrobial ingredient that can be used in milling plants. This substance is trapped inside the material; therefore, the antimicrobic is not released in the flour during sifting. This has the advantage of not interfering with the rheological and baking characteristics of the flour. Nonetheless, the antimicrobic is active on the surface of the sieves, blocking the development of molds and bacteria in the plansifter. Having a component incorporated in the material means 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 like 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 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 molds growth inside the plansifters.

In the mill plant, stopping molds proliferation is fundamental for human health. Mycotoxin-producing fungi are present on cereals. The development of these microorganisms can lead to the production of the toxins and subsequent release of them in the flour. For example, mold contamination 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 to compare the new material, right, and the wood multilayer.

This research aimed to compare the new material with the old ones used in plansifters. Traditionally sieves are built in 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 photo at the top of the page (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 wood surfaces.

In contrast, in the same experiment performed with the new material, there was no growth (picture above). This indicates once again that even when the conditions are optimal, the antimicrobial material is able to stop the proliferation of bacterial and fungi. Accordingly, the substitution of the old sieves with the new antimicrobial ones can increase mills' barriers against microorganism contamination.

Finally, the R&D team tested the mechanical characteristics of this composite material and its suitability to build sieves. Several tests performed in different milling plants showed that the new sieves with antimicrobial activity are reliable and resistant. They can be used in the stressful settings of the plansifters. Furthermore, the new material combined with new technological knowhow allows Ocrim to build sieves in different forms and for different machines.

The study, conducted in collaboration with the University of Parma, has led Ocrim to develop a new product to minimize the formation of new sources of contamination inside the mill and avoid cross-contaminations between different batches of cereals. The new antimicrobial sieves are able to block bacterial and mold proliferations, without altering the flour characteristics while maintaining a high quality standard. Ocrim is using this new antimicrobial composite material to produce sieves for plansifters, but further research is aimed at utilizing this technology in other strategic areas of the milling plant in order to increase the barriers against pathogen microorganisms from the inside the mill. WG

Simona Digiuni is a post-doctoral researcher at the Department of Industrial Engineering, University of Parma, Italy, and Emanuele Bigna is the plant production manager and R&D manager, Ocrim s.p.a, Italy.

We want to hear from you — Send comments and inquiries to worldgrain@sosland.com. For reprints of *WG* articles, e-mail reprints@sosland.com.