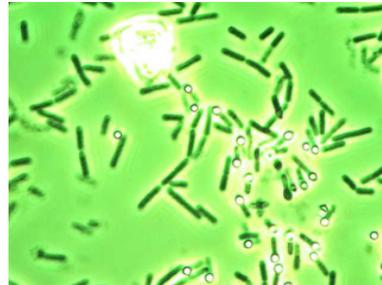
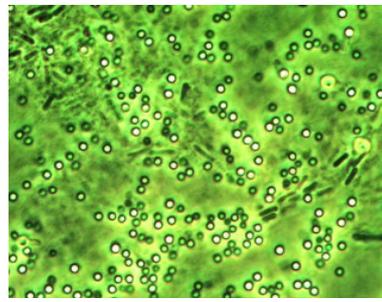
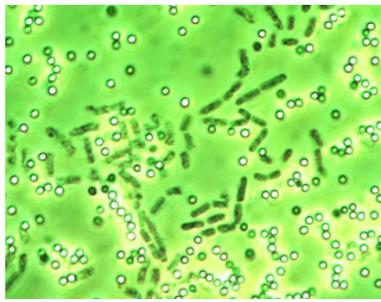


Positive microorganisms, added to water in spore form, can combat negative organisms



## Positive Organisms in Process Water Systems

Negative microbes generally cause production breaches, endotoxins and off odors. For the first time, microbial communities are able to combat this without the use of biocides.

### Classical problems

During paper production processes, highly favorable conditions are set for an uncontrolled microbial growth:

- high process temperatures (35 – 45°C)
- recycled water and
- raw materials

are food ingredients for microorganisms.

Additionally, a lot of aerosols are produced, unfortunately full of endotoxins and volatile organic compounds due to the growth, metabolism and death of these microorganisms.

### About Endotoxins

The term endotoxin comes from the Greek endo (inside) and toxin (poison).

Endotoxins are substances found in the outer membranes of Gram-negative bacteria and consist of mainly lipopolysaccharides. In humans, the inhalation of endotoxins may cause acute symptoms like dry cough, fever and general malaise.

Prolonged exposure to endotoxin may lead to chronic bronchitis and diminished lung function.

In the Netherlands, an occupational exposure limit value of a maximum of 90 endotoxin units (EU/m<sup>3</sup>) during eight hours exposure to light is set, in Germany there is currently no limit.

Endotoxins are thermally stable and even survive sterilization.



Fig. 1: At Van Houtum, typical sweaty odors were detected which had developed under anaerobic conditions

When off-odors are present, BioOrg, a Biotech Engineering Company, immediately looks for microorganisms producing these volatile organic compounds. At Van Houtum BV, Swalmen/Netherlands (Fig. 1) a typical sweaty smell was perceptible in the surrounding, coming from microbial metabolism of amino acids in the process water under anaerobic conditions.<sup>1</sup> Under these conditions, microorganisms produce organic acid such as isovaleric acid and propanoic acid, responsible for the typical body smell from sweat.

Gram-negative microorganisms, such as Enterobacteriaceae, release endotoxin on cell lysis and growth, a hazardous compound for humans.

### Holistic approach

After consultation, BioOrg started a holistic approach to counter the presence of these Gram-negative organisms and especially Enterobacteriaceae in the process and the production environment. These organisms are also responsible for slime forming through biofilm formation on installations (Fig. 2).

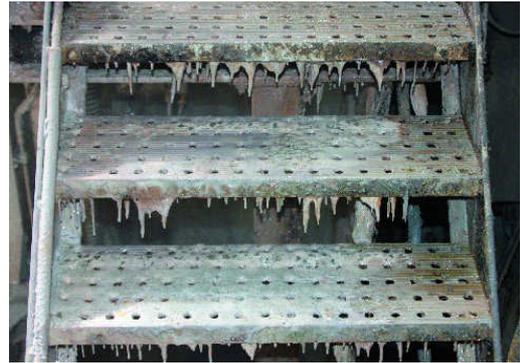


Fig. 2: Gram-negative organisms are also responsible for slime-forming biofilms on installations

When analyzing the problems described above, microbial samples were taken to define the number of negative organisms such as Gram-negative and Enterobacteriaceae into pulp, process water and process environments.

Initially high numbers of Enterobacteriaceae were found in the process water, already starting at the pulper throughout the whole production process. Numbers were counted up to 15,000 Colony Forming Units (CFU)/ml water, whereas the total aerobic count (TAC) was only 10x more, indicating that a relative high number of negative microorganisms constitute the total microflora in the process, and explaining the problems encountered such as off-odors and endotoxin.

The engineered solution of BioOrg consists of a synergistic approach and creation of hurdles to manage the microflora in the process water. To cope with slime forming on the surfaces of tanks and piping, a continuous low voltage and low power ultrasound is used to prevent adhesion of microorganisms and consecutive biofilm formation.

In order to control the microflora in the process water a 100 fold of positive microorganisms in spore form are added to the water. The principle is to outcompete negative organisms in a ratio of 100 good ones to 1 bad one. Concurrently, a number of experiments were set up whereby several parameters were measured such as odor, the number of positive and negative organisms and the endotoxin concentration in water and air (Fig. 3).

Figs. 4 and 5 show the evolution of the microflora at the pulp input at the PM3 together with the concentration of endotoxin in the air, measured in bioaerosols in the workplace.

Fig. 3: Parameters in water and air were measured

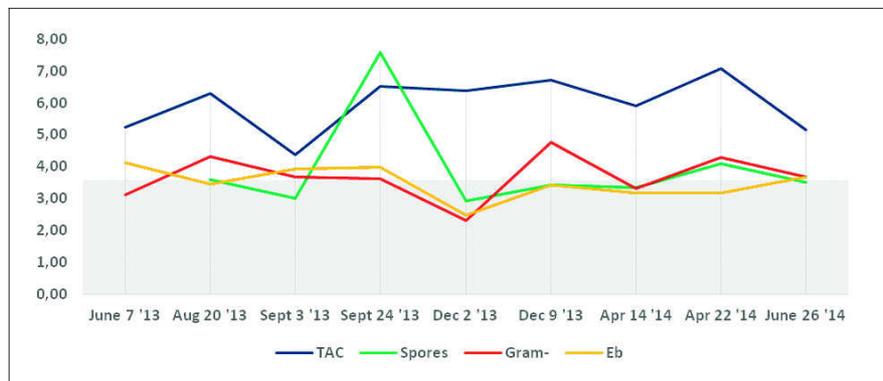
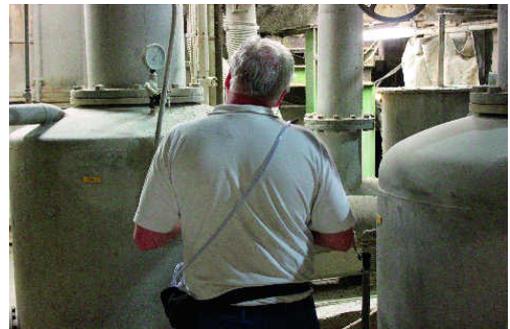


Fig. 4: Evolution of the microflora at the pulp input at the PM3

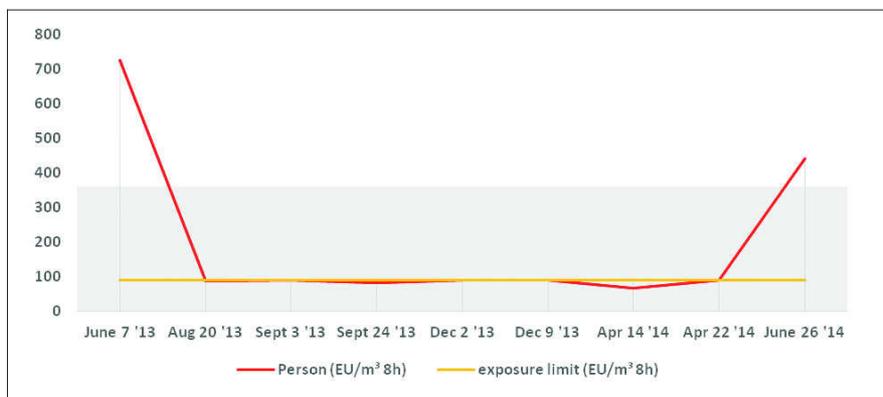


Fig. 5: Development of endotoxins in the air (EU/m³)

### About Van Houtum

For more than 75 years, hygiene paper has been produced at Van Houtum BV, Swalmen/Netherlands. 200 employees produce approx. 42,000 tons/year. Annual turnover is around € 60 million. Van Houtum produces the environmentally friendly toilet paper under the brand name Satino Black. The company is a market leader in the area of CSR management.

### About BioOrg International

The Belgian company Bioorg International, with its headquarters in Niel, was founded in 2009 by Koen De Koster and Filip Willocx. Together with universities and research institutes, the company investigates the influence of benign micro-organisms in installing and maintaining the biodynamic balance. The company only works with positive organisms and without hard chemicals. The BioOrg technology is nationally and internationally patented.

### Successful results

A drop in the total aerobic count (TAC) in September 2013 was achieved by using a violet and green colorant in the paper process, destroying Gram-positive organisms. When adding a 100 fold positive organisms to the water process, the typical sweaty smell was absent and the number of endotoxin measured in the air was below the OE Limit. Although the relative number of Gram-negative microorganisms in the bulk of the process water was not significantly lowered, their metabolic activity was stopped and the biofilm formation was inhibited.

In April 2014, the addition of positive microorganisms was stopped to check the effect of the approach. Both the odor and endotoxin measurement showed a higher activity of Gram-negative microorganisms and presence of endotoxin in the bioaerosols.

Given the successful results on smell and exposure of endotoxin, direction of Van Houtum BV decided to expand the application of the combined hurdle technology also to PM4 and create a living community of positive organisms in their production environment.

[www.bioorg.de](http://www.bioorg.de)

#### References

- 1 Kanto Öqvist, C.: (2008) Microbial life and deposits in paper machine circuits. hD. Faculty of Agriculture and Forestry of the University of Helsinki, Finland. Department of Applied Chemistry and Microbiology