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Microbiological control in water circuits

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| DESCRIPTION AND SPECIAL FEATURES |

Process waters of the paper and cardboard machines are ideal media for the development of microorganisms given their pH, temperature, presence of nutrients and residence times in the circuits. These microorganisms form biofilms and deposits that not only affect the operation of the equipment and the machine productivity but also alter the quality of the final product. This phenomenon is more relevant in plants than use paper recovered as raw material and that work with closed water circuits.

Traditionally, biofilm associated problems were controlled avoiding the growth of microorganisms in the system with the application of biocides and dispersants and by means of a good scheduling of the machine cleaning. The current limitations in the use of biocides have made it necessary to search for alternative biofilm control systems, more environmental friendly as, for example, enzymatic treatments.

The Cellulose and Paper Research Group of the Chemical Engineering Department of the UCM has developed a methodology for biofilm monitoring that combines different disciplines such as biotechnology, physics, chemistry and process engineering:

- Determination of the initial microbiological status of the paper mill through an exploration of all production processes.
- Identification of those microorganisms especially problematic for their biofilm formation capacity, from the characterization of samples taken from the mills.
- Evaluation of new control systems to degrade or inhibit the formation of biofilm.
- Study of biofilm formation and reproduction of the same biofilm in the laboratory for later identification of its constituent polysaccharides and their structure with the purpose of detecting common functional groups to develop new enzymatic biofilm treatments.
- Evaluation of the effects of traditional and novel different treatments for the control of biofilm formation in the paper industry employing microbiological techniques and microscopy.
- Development and optimization of techniques that allow identifying the problematic species in a rapid way or in real time: flow cytometry and Fluorescent In Situ Hybridization (FISH probes, fig. 1).
- Development of a new on-line method to monitor slime growth in earlier stages, based on a Particle Vision Measurement (PVM) probe.

| INNOVATIVE ASPECTS |

The main innovative aspects of this methodology are 1) the development of new specific enzymatic treatments for the paper industry, 2) a fast way to evaluate the products efficiency at lab scale, 3) the development of new Fluorescent in Situ Hybridization probes (pat. ap. No. P200703105) to detect specific bacterial strains that are especially problematic for the paper industry. These probes enable a more precise evaluation and development of new control systems to prevent the formation of biofilm by these microorganisms, and 4) the development of a new methodology for fast detection of biofilm growth based on a PVM probe.

Specific flourescence
Enterobacter cloacae
Enterobacter sp

Non-specific fluorescence
Klebsiella planticola
Enterobacter aerogenes

No fluorescence
Pseudomona aeruginosa
(negative control)

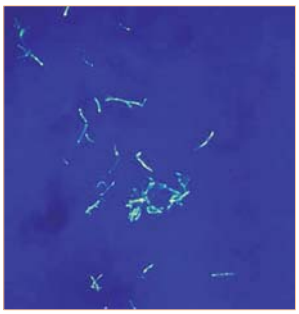

Figure 1.- *Results obtained with a FISH probe specifically designed to detect problematic bacterial strains typically found in the process waters of a paper mill.*

| COMPETITIVE ADVANTAGES |

Increase the competitiveness of the mills by reducing their treatment costs, the machine maintenance time, the machinery life time, the products out of specifications due to bad odors, holes, spots, etc.,

The evaluation of new control systems would allow the chemical companies to provide chemical and enzymatic treatment agents to develop new products.

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