

The 3D Observation of the Wet-Strength Resin in Paper by CSLM

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1. INTRODUCTION

Paper is made of pulp fibers, and paper strength is developed through a three-dimensional network of fiber to fiber hydrogen bonds at fiber crossings. Paper strength decreases in the wet state, because water molecules reduce the strength of the fiber-to-fiber bonds. In general however, papers such as recording paper, disposable diaper, wrapping paper and security paper, demand good wet strength performance in water. In this case, wet strength resin is introduced in paper to supply wet strength.

However, the distribution of the wet strength resin in paper has never been observed in detail. In this study, an observation technique of the distribution of wet strength resin in the paper was developed using confocal scanning laser microscopy (CSLM).

2. EXPERIMENTAL

Poyamideamine-epichlorohydrin (PAE) resin was used as a wet strength resin. Commercial hardwood bleached kraft pulp (HBKP) was beaten to 160ml CSF. Handsheets were prepared after 0, 0.3, 0.5, 1.0 and 2.0% PAE calculated on bone-dry pulp were added. Finally, handsheets were heated at 105 °C for 30 minutes.

The handsheets were then soaked in the sulforhodamine 101 acid chloride solution (0.02wt%) for 3 minutes and washed in the distilled water. Next, handsheets were soaked in the acridine orange (0.02wt%) for 3 minutes, washed with distilled water, and air-dried.

Multiple channel detection of the resin and base sheet structure was obtained through use of excitation wavelengths of 473nm and 543nm with corresponding detection ranges of 500nm-600nm and 570nm-700nm. The ability of the Leica TCS-SP2 to excite and detect through a sequential process was utilized to improve channel signal separation.

3. RESULTS

Fluorescence spectra of papersheets stained with sulforhodamine 101 acid chloride showed that PAE was selectively modified with this fluorescence dye. Pulp fibers were stained with acridine orange. The distribution of PAE in paper could be observed by CSLM with the double stain technique for the first time.

In the case of high amount of PAE addition, PAE tended to concentrate at fiber crossing. As a result of observing the reconstructed images from cross section side, PAE fixed on the pulp surface.

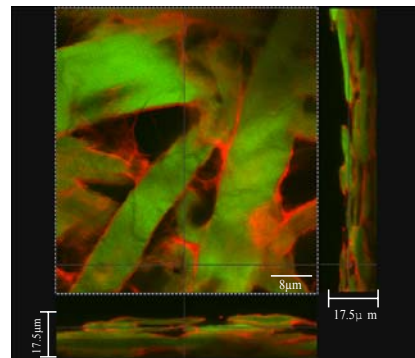


Figure1 The reconstructed image of paper added with PAE