Dielectric Discharge Initiated Grafting onto Cellulosic Fibers

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ABSTRACT

This poster examines the use of dielectric discharge-initiated oxidation and grafting of cellulosic fibers as a means to impact fiber topochemistry. Research studies demonstrate that treatment dosages impact the extent of fiber modification.

EXPERIMENTAL: General Treatment Conditions

- All studies employed commercial unbleached TMP and BKP pulps.
- Bauer-McNett long fiber fractions were isolated, and acetone extracted.
- Sheets were dielectric treated in the presence and absence of additives.
- Sheets were exhaustively extracted, then analyzed using ToF-SIMS, ESCA, titration, elemental analysis, and SEM techniques.

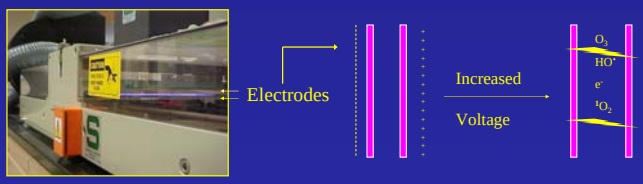

Figure 1. Dielectric discharge treatment apparatus.

RESULTS

- ToF-SIMS and ESCA indicate significant oxidation, including increases in carboxylic acid groups at the fiber surface due to dielectric discharge treatment.
- Elemental analysis, ToF-SIMS and SEM indicate dielectric discharge initiated fiber modification/grafting has occurred.

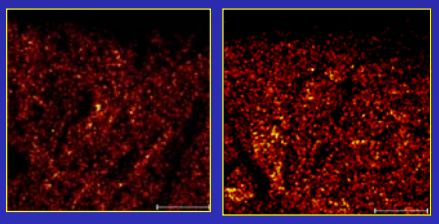

Figure 2. ToF-SIMS-generated image of negative ion spectra for $C_2H_3O_2$ on the surface of control (left) and dielectric discharge-treated (right) BKP samples, calibration bar = 100 µm.

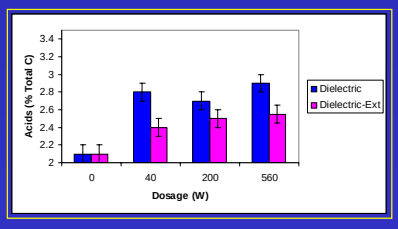

Figure 3. ESCA-generated plot of acid groups vs. dielectric treatment level of BKP fibers. Acetone extracting to wash fragments from surface of sheet reduces total available acid groups at fiber surface.

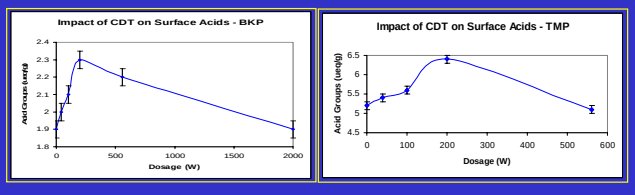

Figure 4. Standard polyelectrolyte titration technique confirms increase in surface acids with dielectric discharge treatment among BKP and TMP pulps.

RESULTS Continued.

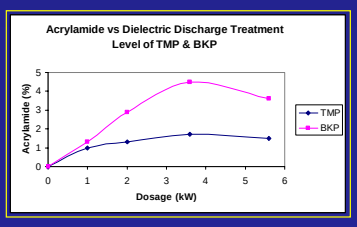

Figure 5. Elemental analysis generated plots of dielectric discharge treatment level vs. % acrylamide incorporated onto BKP and TMP fibers.

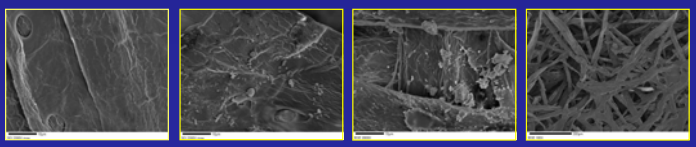

Figure 6. SEM images collected at 2000X showing increasing incorporation of acrylamide onto BKP fibers with increased dielectric discharge dosages. Control, 2 kW treatment, 8 kW treatment, 11.2 kW treatment, from left to right respectively.

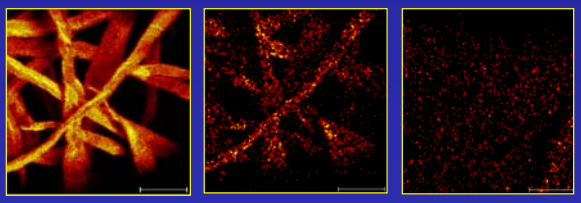

Figure 7. ToF-SIMS images of BKP dielectric treatment in presence of acrylamide at 4 kW dosage. Total ion spectra, CNO spectra on treated sample, CNO spectra on control from left to right respectively. (Bar = 100 µm).

	CNO	CN	$C_2H_3O_2$	CHO_2	O
Control	0.37%	1.8%	2.8%	4.0%	42.1%
CDT (4.0 kW)	0.47%	1.9%	3.8%	8.0%	44.0%
CDT (4.0 kW) w/acryl amide	3.4%	4.9%	6.5%	8.3%	44.7%

Table 1. ToF-SIMS quantitative data summarizing the oxidation of BKP due to dielectric treatment alone, as well as the incorporation of additives onto the fibers surface due to dielectric discharge-initiated reactions.

CONCLUSIONS

Dielectric treatment provides increased acid groups at the fiber surface in the presence and absence of monomers. By controlling treatment dosages, the surface charge of fibers may be modified. Furthermore, dielectric treatment in the presence of additives allows for further modification of the fiber surface, the level of which is determined by the dielectric discharge treatment dosage.

ACKNOWLEDGMENTS

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