

PHYSICAL CHARACTERISTICS OF TRANSPARENT CELLULOSIC NANOFIBER PAPER



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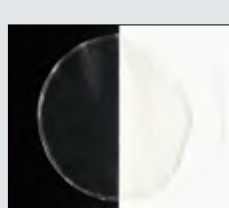
ABSTRACT

THE FOLLOWING RESEARCH ANALYSES THE PHYSICAL CHARACTERISTICS OF TRANSPARENT NANOFIBER PAPER AS AN ALTERNATIVE HINGING MATERIAL FOR TRANSPARENT OR OVERSIZED WORKS OF ART. FOR COMPARATIVE ANALYSIS A KOZO JAPANESE TISSUE WAS EXPOSED TO THE SAME TEST PARAMETERS AS THE NANOFIBER PAPER. THE OBJECTIVE OF THE RESEARCH WAS TO DETERMINE THE PHYSICAL AND CHEMICAL STABILITY OF THE NANOFIBER PAPER WHEN EXPOSED TO ULTRAVIOLET AND THERMAL ACCELERATED AGING.

EXPERIMENTAL

BACKGROUND

THE OPTICAL TRANSPARENCY OF NANOFIBER PAPER IS ACHIEVED THROUGH THE REDUCTION OF SCATTERED LIGHT. THIS PHENOMENON IS MADE POSSIBLE BY REDUCING THE FIBER WIDTH AND INTERSTITIAL CAVITIES OF THE PAPER, AND OBTAINING A SMOOTH SURFACE TEXTURE.



TRANSPARENT NANOFIBER PAPER



AFM IMAGE OF NANOFIBERS

ULTRAVIOLET ACCELERATED AGING

- ⊙ LIGHT SOURCE: SIMULATED NATURAL DAYLIGHT THAT HAD PASSED THROUGH A WINDOW
- ⊙ EQUIPMENT: Q-SUN XE-1-BC (XENON-ARC LAMP)
- ⊙ IRRADIANCE: 1.69 W/M² WITH A 420 NM FILTER
- ⊙ DURATION: 48 HOURS AT 41°C



SAMPLE PREPARATION BEFORE UV AGING



ESPEC THERMAL AGING CHAMBER

SAMPLE PREPARATION

THE NANOFIBERS USED FOR THIS RESEARCH WERE EXTRACTED FROM A SOFTWOOD SULPHITE PULP, HAD AN APPROXIMATE FIBER WIDTH OF 10 ± 5 NM, AND 85% OPTICAL TRANSPARENCY.

THERMAL ACCELERATED AGING

- ⊙ EQUIPMENT: ESPEC ESL-3CA
- ⊙ DURATION: 14 DAYS
- ⊙ CONDITIONS: 90°C AT 70% RELATIVE HUMIDITY

TESTING METHODS

- ⊙ **OPTICAL PROPERTIES:** OPACITY, BRIGHTNESS, YELLOW, AND TRI-STIMULUS L*a*b*
- ⊙ **PHYSICAL PROPERTIES:** ZERO-SPAN TENSILE TEST, SORPTION, MOISTURE CONTENT, AND CALIPER

- ⊙ **CHEMICAL PROPERTIES:** COLD EXTRACTION pH, AND FOURIER TRANSFORM INFRARED (FT-IR) SPECTROSCOPY
- ⊙ **IMAGING:** SCANNING ELECTRON MICROSCOPY (SEM), AND ATOMIC FORCE MICROSCOPY (AFM)

RESULTS & CONCLUSIONS

AFTER UV ACCELERATED AGING:

- ⊙ THERE WAS LITTLE OVERALL CHANGE IN HANDLING AND COLOURIMETRIC PROPERTIES

AFTER THERMAL ACCELERATED AGING:

- ⊙ SEVERE DARKENING OF SAMPLES OCCURRED
- ⊙ SAMPLES BECAME LESS DUCTILE AND MORE BRITTLE
- ⊙ THE pH DROPPED FROM 6.64 TO 5.88

OTHER OBSERVATIONS:

- ⊙ EXHIBITED A ZERO-SPAN TENSILE STRENGTH THREE TIMES GREATER THAN THE KUROTANI PAPER
- ⊙ MOISTURE SORPTION PROPERTIES WERE TWO AND A HALF TIMES GREATER THAN THE KUROTANI PAPER
- ⊙ THE PAPER FRACTURED AND SPLIT WHEN CUT WITH SHEARS
- ⊙ THE BROWN DISCOLOURATION IS PARTLY SOLUBLE IN WATER



CONCLUSION:

- ⊙ THE RESULTS REVEALED THAT THERMAL AGING INDUCED SIGNIFICANT DEGRADATION OF THE NANOFIBER SAMPLES
- ⊙ CONTINUED RESEARCH AND MANUFACTURING MODIFICATIONS ARE REQUIRED TO FURTHER ENHANCE THE PHYSICAL AND CHEMICAL PROPERTIES OF THE MATERIAL.

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