

**PRODUCTION OF UV-PROTECTIVE COTTON FABRIC
BY SURFACE POLYMERIZATION**



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 แอดไมเซลาร์พอลิเมอไรเซชันบนผ้าฝ้าย เพื่อเตรียมผ้าฝ้ายที่มีสมบัติป้องกันรังสียูวี โดยได้มี
 การศึกษา การดูดซับของสารลดแรงตึงผิว และแอดโซลูบิลิไทเซชันของมอนอเมอร์ดังกล่าว พอลิ
 เอชเอบี ที่เคลือบลงบนผิวผ้าสามารถช่วยลดปริมาณการส่องผ่านของรังสียูวี ทำให้ผ้ามีสมบัติการ
 กันรังสียูวีของผ้าในระดับดีมาก 2-[3-(2H-เบนโซไทอะโซล-2-อิล)-4-ไฮดรอกซีฟีนิล]เอทิล เมธา-
 คริลเลต (บีอีเอ็ม) ซึ่งมีสมบัติการดูดซึมรังสียูวีในช่วงที่เป็นการเสริมกับเอชเอบี ได้ถูกนำมาทำพอลิ
 เมอไรเซชันร่วมกับเอชเอบี เพื่อปรับปรุงให้ผ้าสามารถป้องกันรังสียูวีในช่วงความยาวคลื่นที่กว้าง
 ขึ้น พร้อมกันนี้ได้ศึกษาส่วนประกอบของโคพอลิเมอร์และสัดส่วนความว่องไวของมอนอเมอร์ใน
 ปฏิกริยาดังกล่าวด้วย นอกจากนี้ที่กล่าวมาแล้ว ยังได้มีการศึกษากระบวนการเคลือบซ้ำ โดยวิธีแอด
 ไมเซลาร์พอลิเมอไรเซชัน เพื่อเตรียมผ้าที่มีสองสมบัติ โดยใช้เอชเอบีเพื่อเพิ่มสมบัติการป้องกัน
 รังสียูวี และใช้เมธาคริลอกรีเมทิลไทรเมทิลไซเลน เพื่อเพิ่มสมบัติกันน้ำให้แก่ผ้าฝ้าย พบว่าด้วยวิธี
 นี้ สามารถเตรียมผ้าฝ้ายที่ป้องกันรังสียูวีได้ในระดับดีมาก อีกทั้งผ้ายังสามารถกันน้ำได้ดีด้วย
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ABSTRACT

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2-Hydroxy-4-acryloyloxybenzophenone (HAB) was synthesized and polymerized through admicellar polymerization on a cotton fabric in order to prepare the UV-protective fabric. Surfactant adsorption on cotton fabric and adsolubilization of the monomer in the admicelle were studied. The poly(HAB) formed on the fabric significantly reduced ultraviolet transmission through the fabric resulting in a modified fabric with excellent ultraviolet protection. For further improvement in ultraviolet protection with broad spectral coverage, another monomer with complimentary ultraviolet absorbing moieties, 2-[3-(2H-benzotriazol-2-yl)-4-hydroxyphenyl]ethyl methacrylate (BEM) was copolymerized with HAB through admicellar polymerization. Copolymer composition and monomer reactivity ratio were investigated. Moreover, two-functional cotton fabric was produced by double coating via admicellar polymerization. HAB was first coated to improve ultraviolet protection and then methacryloxymethyltrimethylsilane (MSi) was coated to create a hydrophobic surface. The treated fabric was found to have very good ultraviolet protection together with high water repellency. Besides admicellar polymerization method, vinyltriethoxysilane was used to modify cotton surface to provide polymerizable vinyl groups on the fiber surface, which was polymerized with BEM. With a suitable process and the use of silane coupling agent, poly(BEM) was successfully coated on the fabric with good uniformity and good resistance to washing resulting in a cotton fabric with excellent UV-protection property.

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ABBREVIATIONS

AATCC	American Association of Textile Chemists and Colorists
AIBN	Azobisisobutyronitrile
AS/NZS	Australian Standard and New Zealand Standard
ASTM	American Standard Testing Method
ATR	Attenuated Total Reflection
BEM	2-[3-(2H-Benzotriazol-2-yl)-4-hydroxyphenyl]ethyl methacrylate
CMC	Critical Micelle Concentration
DBSA	Dodecylbenzenesulfonic acid, sodium salt
DMAC	Dimethylacetamide
FTIR	Fourier Transform Infrared Spectrometer
HAB	2-Hydroxy-4-acryloyloxybenzophenone
HPLC	High Performance Liquid Chromatography
MEK	Methyl ethyl ketone
MSi	Methacryloxymethyltrimethylsilane
NMR	Nuclear Magnetic Resonance Spectrometer
PFTEA	Poly(2,2,2-trifluoroethyl acrylate)
SEM	Scanning Electron Microscope
SPF	Sun Protection Factor
UPF	Ultraviolet Protection Factor
UV	Ultraviolet
VTES	Vinyltriethoxysilane

LIST OF SYMBOLS

A_λ	absorbance at a wavelength
b	path length
c_{BEM}, c_{HAB}	concentrations of BEM and HAB, respectively
$\varepsilon_{x,y}$	absorption coefficient of component x at wavelength y nm
E_λ	relative erythemal spectral effectiveness
F_1 and F_2	mole fractions of monomers BEM and HAB in feed, respectively
f_1 and f_2	mole fractions of comonomer units, BEM and HAB, in copolymers, respectively
k_{mn}	rate constant for a propagating chain ending in monomer m adding to monomer n
λ	wavelength in nm
$\Delta\lambda$	measured wavelength interval in nm
r_1 and r_2	monomer reactivity ratios of BEM and HAB, respectively
S_λ	solar spectral irradiance in $\text{Wm}^{-2}\text{nm}^{-1}$
T_λ	average spectral transmittance of fabric