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FLAME RETARDANT FINISHING OF FABRICS BY DIAMMONIUM HYDROGEN PHOSPHATE USING
PLASMA GENERATED FROM A THETA-PINCH DEVICE

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A Thesis Submitted in Partial Fulfillment of the Requirements
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Department of Materials Science

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รัชพงศ์ หอทิมาวรกุล : การตกแต่งห่วงไฟฟ้าด้วยไดแอมโมเนียมไฮโดรเจนฟอสเฟตโดยใช้พลาสมาที่กำเนิดจากเครื่องที่ตาพินช์. (FLAME RETARDANT FINISHING OF FABRICS BY DIAMMONIUM HYDROGEN PHOSPHATE USING PLASMA GENERATED FROM A THETA-PINCH DEVICE) อ.ที่ปรึกษา : รศ.ดร.วิมลวรรณ พิมพ์พันธุ์, อ.ที่ปรึกษาร่วม : ผศ.ดร.รัฐชาติ มงคลนาวิน 125 หน้า.

งานวิจัยนี้เป็นการศึกษาวิธีการตกแต่งห่วงไฟฟ้าพอลิเอสเตอร์ ผ้าฝ้าย และผ้าพอลิเอสเตอร์ผสมฝ้ายด้วยไดแอมโมเนียมไฮโดรเจนฟอสเฟตซึ่งเป็นสารห่วงไฟฟ้าที่สามารถละลายน้ำได้ โดยใช้เครื่องที่ตาพินช์สร้างพลาสมาในโตรเจนแบบห่วงเพื่อเหนี่ยวนำให้เกิดปฏิกิริยาระหว่างไดแอมโมเนียมไฮโดรเจนฟอสเฟตกับผ้าทั้งสามประเภท ทั้งนี้มีการปรับเปลี่ยนจำนวนครั้งในการยิงพลาสมาเป็น 1 2 5 และ 10 ครั้งกับความเข้มข้นของสารละลายไดแอมโมเนียมไฮโดรเจนฟอสเฟตเป็น 5 10 15 และ 20 เปอร์เซ็นต์ ผลการวิเคราะห์สัณฐานวิทยาด้วยกล้องจุลทรรศน์อิเล็กตรอนแบบส่องกราดแสดงให้เห็นถึงการเชื่อมและการมีอยู่ของไดแอมโมเนียมไฮโดรเจนฟอสเฟตบนผิวผ้า ส่วนการวิเคราะห์โครงสร้างทางเคมีด้วยเทคนิค ฟลูออโรสเปกโตรเมทรีอินฟราเรดสเปกโทรสโกปีแบบเอทีอาร์ และความสามารถในการเปียกก่อนและหลังการซักแสดงถึงการเกิดหมู่ฟังก์ชันที่แตกต่างกันซึ่งขึ้นกับภาวะในการตกแต่งข้างต้น รวมทั้งประเภทของผ้า ซึ่งส่งผลให้ความสามารถในการติดไฟของผ้าทั้งสามประเภทที่ผ่านการดัดแปรด้วยพลาสมามีความแตกต่างกัน ผลการทดลองบ่งชี้ว่า ภาวะที่เหมาะสมในการปรับปรุงสมบัติห่วงไฟฟ้าของผ้าพอลิเอสเตอร์ผสมฝ้ายคือที่การยิงพลาสมาในโตรเจนแบบห่วง 2 ครั้ง และความเข้มข้นของสารละลายไดแอมโมเนียมไฮโดรเจนฟอสเฟตเป็น 5 เปอร์เซ็นต์ อย่างไรก็ตาม ในกรณีของผ้าพอลิเอสเตอร์ มีเพียงเวลาในการติดไฟดีขึ้น แต่เวลาในการเผาไม่ได้รับการปรับปรุง

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RUTCHAPONG HORTHIMAWORRAKUN : (FLAME RETARDANT FINISHING OF FABRICS BY DIAMMONIUM HYDROGEN PHOSPHATE USING PLASMA GENERATED FROM A THETA-PINCH DEVICE. THESIS ADVISOR : ASSOC. PROF. VIMOLVAN PIMPAN, Ph.D., THESIS COADVISOR : ASST. PROF. RATTACHAT MONGKOLNAVIN, Ph.D., 125 pp .

This research emphasizes on the method for flame retardant finishing of polyester, cotton and polyester-cotton fabrics by diammonium hydrogen phosphate which is a water soluble flame retardant. A theta-pinch device was used to generate pulsed nitrogen plasma for inducing the reaction between diammonium hydrogen phosphate and these fabrics. The number of plasma shot applied to the fabrics and the concentration of diammonium hydrogen phosphate solution were varied as 1 2 5 and 10 shots and 5 10 15 and 20%, respectively. The fabric morphology investigated by scanning electron microscope (SEM) showed etching effect and the presence of diammonium hydrogen phosphate on the fabric surface. Chemical structure characterized by Attenuated Total Reflectance Fourier Transform Infrared (ATR/FT-IR) Spectroscopy and wettability of plasma-treated and untreated fabrics before and after washing revealed that different functional groups were formed on the fabric surface depending on the above finishing conditions and also the type of the fabric. As a consequence, the flammability of these three plasma-treated fabrics was different. These results indicated that the optimum condition for improving flame retardancy of polyester-cotton fabric was at 2 shots of pulsed nitrogen plasma and 5% of diammonium hydrogen phosphate solution. However, in the case of polyester fabric, the improvement was observed only for the ignition time but not the combustion time.

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