Izvirni znanstveni članek *Original Scientific Paper*

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Obdelava tkanine poliester/bombaž-Lycra s plazmo Ar/N_2

Polyester/Cotton-Lycra Fabric Treatment with Ar/N_2 Plasma

Za nanos tržnega protimikrobnega sredstva Ruco-Bac AgP (RbAg) je bila tkanina iz mešanice poliester/bombaž-Lycra (PET/CO-Lycra) dve minuti izpostavljena nizkotlačni plazmi (26,6 Pa) z mešanico plinov Ar/N_2 (50 % / 50 %). Koncentracija srebra na tkanini je bila določena z analizo ICP-MS. Bakterijska redukcija RbAg-impregniranih, plazemsko obdelanih in RbAg-impregniranih ter enkrat in desetkrat pranih vzorcev je bila določena na podlagi dinamične stresalne metode ASTM E 2149-01. Opravljene so bile meritve pretržne sile in raztezka ter narejeni mikroskopski posnetki morfoloških sprememb neobdelanih in plazemsko obdelanih vzorcev. Vsebnost srebra na plazemsko obdelanih in RbAg-impregniranih vzorcih je rahlo večja kot pri neobdelanih. Rezultati bakterijske redukcije kažejo, da vse RbAg-impregnirane tkanine zavirajo rast vseh štirih testnih bakterijskih vrst. Enkrat in desetkrat prani plazemsko obdelani in RbAg-impregnirani vzorci kažejo boljšo odpornost proti Escherichia Coli in Staphylococcus Aureus kot neobdelani prani vzorci. Obdelava tkanine s plazmo nima posebnih učinkov na specifično pretržno napetost in raztezek prej.

Ključne besede: plazma Ar/N_2, Ruco-Bac AgP, srebro, protimikrobna učinkovitost, SEM

In the research, a woven polyester/cotton-Lycra (PET/CO-Lycra) fabric was treated with low pressure Ar/N_2 (50%/50%) plasma for two minutes at pressure 26.6 Pa. The fabric was further on coated with the lowest prescribed concentration of Ruco-Bac AgP (RbAg) to obtain antimicrobial properties. The silver content on samples was evaluated with the ICP-MS analysis. The antimicrobial activities of RbAg-impregnated, plasma-treated RbAg-impregnated, and once and ten times washed samples were investigated according to the ASTM Designation E 2149-01. The effects on the mechanical properties and morphological changes of untreated and plasma-treated samples were studied in the research. The results show that the silver content present on plasma-treated RbAg-impregnated samples is slightly higher in comparison to the untreated samples. The results of bacterial reduction of all RbAg-impregnated fabrics show growth inhibition to all four tested microorganisms. Once and ten times washed plasma-treated RbAg-impregnated samples show better resistance to Escherichia Coli and Staphylococcus Aureus, compared to the untreated, washed samples. Plasma treatment has no influence on specific stress and elongation of yarns.

Keywords: Ar/N_2 plasma, Ruco-Bac AgP, silver, antimicrobial effectiveness, SEM

Izvirni znanstveni članek *Original Scientific Paper*

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Primerjava instrumentov za merjenje fasadnih barv z uporabo treh enačb za določanje barvnih razlik

Comparison of Instruments for Measuring Facade Colors Using Three Color Difference Equations

V raziskavi je preučevana uporabnost treh enačb za izračun barvnih razlik – CIELAB, CIE94 in CIEDE2000 – za fasadne površine, ki imajo strukturirano površino, podobno kot tekstilni izdelki. Meritve so bile izvedene z dvema spektrofotometroma z različnima merskima geometrijama, Spectraflash SF600 (Datacolor) in Eye-One (X-Rite). Ocena ujemanja fasadnega vzorca s predlogo v barvni karti je bila podana tudi na podlagi vizualne ocene s pomočjo devetstopenjske sive skale. Iz rezultatov raziskave je razvidno, da je najprimernejša enačba za izračun barvnih razlik na fasadnih površinah enačba CIEDE2000, najmanj primerna pa enačba CIELAB. Ugotovljeno je bilo, da je spektrofotometer Spectraflash SF600 (Datacolor) ustreznejši za primerjavo barve hrapavih fasadnih površin in predloge v barvnih kartah ter da je vizualno vrednotenje barvnih razlik na podlagi sive skale dokaj zanesljivo.

Ključne besede: merjenje barve, barvna razlika, fasadna površina, spektrofotometer, vizualna ocena po sivi skali.

Applicability of three color difference equations, such as CIELAB, CIE94 and CIEDE2000, for facade surfaces was investigated. Facade samples have structured surface similar to textile fabric. Measurements were made with two spectrophotometers with different measurement geometries, Spectraflash SF600 (Datacolor) and Eye – One (X – Rite). For evaluation of matching of the facade sample with the template in color chart, visual assessment based on the gray scale was also used. From the results of the research it is evident that the most suitable equation for calculating color differences of facade surfaces is the CIEDE2000, while the least appropriate proved to be the CIELAB equation. It was also determined that the spectrophotometer Spectraflash SF600 (Datacolor) is more suitable for comparing colors of rough facade sur-

faces with the templates in the color scale and that the visual assessment based on the gray scale is pretty reliable.

Keywords: color measurement, color difference, facade surface, spectrophotometer, gray scale visual assessment.

Izvirni znanstveni članek *Original Scientific Paper*

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Vpliv velikosti delcev srebra na baktericidno učinkovitost celuloznih vlaken

Influence of Particle Size of the Silver on Bactericidal Activity of the Cellulose Fibres

Namen raziskave je bil določiti vpliv velikosti delcev srebra in srebrovih spojin v različnih tržnih produktih na njihovo baktericidno učinkovitost. Uporabljeni so bili trije tržni produkti, in sicer disperzija srebrovega klorida (sredstvo Ag-1), elementno nanosrebro v prahu (sredstvo Ag-2) in koloidno srebro (sredstvo Ag-3). Disperzija sredstva Ag-2 je bila pripravljena tik pred uporabo. Sredstva so bila nanesena na bombažno tkanino po izčrpalnem postopku. Delci srebra tako v disperziji kot tudi na apretiranih vzorcih tkanine, ki so bili preučevani z vrstično elektronsko mikroskopijo, so bili po velikosti razvrščeni na naslednji način: sredstvo Ag-1 ≈ sredstvo Ag-2-a >> sredstvo Ag-3. Koncentracija srebra na vlaknih je bila določena z masno spektrometrijo z vzbujanjem v induktivno sklopljeni plazmi in je za sredstvo Ag-1 znašala 138 mg/kg, za sredstvo Ag-2 116 in 350 mg/kg ter za sredstvo Ag-3 130 mg/kg. Baktericidne lastnosti apretur so bile določene na podlagi bakterijske redukcije za bakterijsko vrsto *E. coli*. Iz rezultatov raziskave je bilo razvidno, da sta sredstvi Ag-1 in Ag-3 pri podobnih koncentracijah povzročili popolno redukcijo rasti *E. coli*, sredstvo Ag-2 pa le 36 % redukcijo. Slednja se tudi po trikratnem povečanju koncentracije srebra ni povečala do te mere, da bi presegla 60 %. Iz rezultatov sledi, da na protimikrobno aktivnost srebra v preučevanih sredstvih ne vplivata le velikost delcev in njihova koncentracija, temveč tudi kemijska oblika srebra.

Ključne besede: bombažna tkanina, protimikrobna apretura, srebro, oblika srebra, bakterijska redukcija.

The aim of the study was to determine the influence of the particle size of silver in different antimicrobial agents on its bactericidal activity. Three commercial products were used, a dispersion of silver chloride (agent Ag-1), an elemental nanosilver in the form of a powder (agent Ag-2) and a colloidal silver (agent Ag-3). A dispersion of the agent Ag-2 was prepared just before its use. The agents were applied on cotton fabric according to the exhaustion method. As determined by scanning electron microscopy, the size of the silver particles in dispersion as well as on the finished samples of the fabric was classified as follows: agent Ag-1 ≈ agent Ag-3 >> agent Ag-2. The concentration of silver on the fibres was determined by the inductively coupled plasma mass spectroscopy and amounted to 138 mg/kg for agent Ag-1, 116 and 350 mg/kg for agent Ag-2 and 130 mg/kg for agent Ag-3. The bactericidal activity of the finishes was studied by bacterial reduction for the bacteria species Escherichia coli. The results showed that at resembling concentrations on the fibres, agents Ag-1 and Ag-3 caused a complete reduction of growth of Escherichia coli, while only 36% of bacterial reduction was determined for agent Ag-2. Even after increasing the concentration of silver by three times, the bacterial reduction did not increase to such an extent to exceed 60%. Therefore, it can be concluded that the antibacterial activity of silver in the studied agents it is not influenced only by the particle size and their concentration, but also by the chemical form of silver.

Keywords: cotton fabric, antimicrobial finishing, silver, silver form, bacterial reduction.

Pregledni znanstveni članek *Review*

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Izdelava dvonitne preje na prstanskem predilniku

Two-Ply Yarn Production on Ring Spinning Machine

V prispevku sta podani teorija in tehnologija izdelave dvonitne preje, spredene po postopku SiroSpun® na klasičnem prstanskem predilniku in po postopku EliTwist® na kompaktnem prstanskem predilniku. Opredeljene so tehnološke zmožnosti posameznih postopkov izdelave dvonitne preje na prstanskem predilniku z različno modifikacijo trivaljčnega dvojermenčnega raztezala.

Analiziran je vpliv predilnega in sukalnega trikotnika na kakovost dvonitne preje SiroSpun in EliTwist® iz različnih vrst prediva.

Za klasično sukane dvonitne preje in dvonitne preje EliTwist® različne finoče iz različnih vrst bombažnega in volnenega prediva so primerjalno raziskane strukturne, mehanskofizikalne in Uster lastnosti spredenih prej.

Ugotovili smo, da postopek predenja EliTwist® omogoča uporabo cenejše surovine za dosego enake kakovosti preje v primerjavi s klasičnim postopkom izdelave dvonitne sukane preje.

Zaradi bolj urejene strukture in sodelovanja vseh vlaken v strukturi dvonitne preje EliTwist® postopek predenja EliTwist® omogoča izdelavo finejših prej iz enako finega prediva.

Postopek izdelave dvonitne preje EliTwist® je edini predilni postopek, ki omogoča gospodarno in kakovostno izdelavo dvonitnih prej na prstanskem predilniku tudi iz kratkovlaknatega prediva.

To je postopek, ki glede kakovostnih in gospodarnih parametrov izdatno presega vse dosedanje postopke izdelave dvonitnih SiroSpun® in klasičnih dvonitnih sukanih prej.

Ključne besede: predilni in sukalni trikotnik, dvonitna preja, dvonitna sukana preja, preja SiroSpun®, preja EliTwist®

The purpose of this report is to present the theory and technology of manufacturing two-ply yarn spun with the SiroSpun® method on a standard ring spinning machine and with the EliTwist® method on a compact ring spinning machine. The technological abilities of single processes of manufacturing two-ply yarn on a ring spinning machine with different modifications of double-apron three-roll drafting system are also categorized.

Moreover, the impact of the spinning and twisting triangle on the quality of SiroSpun® and EliTwist® two-ply yarn made from various types of fibres was analyzed in the research.

For standard two-ply yarn and EliTwist® two-fold yarn of different linear densities made from various types of cotton and wool fibres, various structural, mechanical-physical and Uster properties of woven yarn were compared.

According to the findings, the EliTwist® method of spinning allows the use of a cheaper material to achieve the same yarn quality in comparison to the standard-making process of two-ply twisted yarn.

Due to a better structural order and cooperation of all fibres in the structure of EliTwist® two-ply yarn, EliTwist® spinning process allows manufacturing of finer yarn made from fibres of the same linear density.

The EliTwist® process for the production of two-ply yarn is the only process that also allows the economical and qualitative production of two-ply yarn on a ring spinning machine made from short staple fibres.

The EliTwist® process is a method which according to its quality and economical parameters surpasses all previous production methods of SiroSpun® two-ply yarn and standard two-ply twisted yarn.

Keywords: spinning and twisting triangle, two-ply yarn, two-ply twisted yarn, SiroSpun® yarn, EliTwist® yarn

Strokovni članek *Professional Paper*

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Izdelava prototipa tekmovalnega dresa smučarja skakalca

Ski–Jumper Suit Prototyping

Rezultati športnikov so odvisni od športne usposobljenosti in telesne pripravljenosti posameznika, kot tudi od opreme, ki jo zahteva športna disciplina. Dres smučarja skakalca je z aerodinamičnega vidika poleg smuči najpomembnejši del opreme. Obliko in velikost tekmovalnega dresa smučarja skakalca je treba prilagoditi vsakemu športniku posebej, glede na zahteve Mednarodne smučarske zveze (Fédération Internationale de Ski, FIS). Konstruiranje dresa smučarja skakalca je z inženirskega vidika zelo zahtevno, saj se pravila mednarodne smučarske zveze vsako leto spreminjajo zaradi zagotavljanja varnosti športnika med samim skokom ob sočasnem doseganju vrhunskih rezultatov. Sodobne računalniške tehnologije omogočajo hiter in natančen razvoj prototipov oblačil na podlagi povečane učinkovitosti in natančnosti pri konstruiranju krojev, pomerjanju in prileganju oblačila na virtualnem modelu telesa. V prispevku je prikazan razvoj prototipa tekmovalnega dresa smučarja skakalca po pravilih FIS s pomočjo računalniškega sistema OptiTex. Sistem je namenjen izdelovanju prototipov 3D-tekstilnih izdelkov od konstruiranja in modeliranja krojev do virtualne simulacije videza sešitega izdelka, pri katerem so upoštevane tudi dejanske mehanske in fizikalne lastnosti tekstilije. Rezultati prikazujejo proces virtualnega oblikovanja dresa smučarja skakalca po pravilih FIS, ki je bil potem primerjan z realnim modelom. Spoznanja in rezultati izvedenega razvoja kroja z uporabo programskega paketa Optitex kažejo na hitro in zanesljivo prilagajanje dresov športnikov glede na mednarodna pravila.

Ključne besede: smučarski skoki, dres smučarja skakalca, FIS, konstrukcija in modeliranje, CAD sistem OptiTex, virtualna izdelava prototipa

Excellent results do not depend solely on sportsmen's physical condition, but also on the sport suit required by a specific sports discipline. From the aerodynamic point of view, a ski-jumper suit can be, next to the jumping skis, regarded as the main part of the equipment. The jumpsuit shape and size need to be individually adapted to each ski-jumper taking into account precise re-

quirements by FIS (Fédération Internationale de Ski). Constructing a ski-jumper suit is a demanding process, since the FIS rules change annually in order to assure ski-jumpers safe yet competitive ski jumps. Modern technologies enable rapid and precise development of prototypes of garments by ensuring higher efficiency and accuracy of the construction process. The article presents the development of the prototype of a ski-jumper suit in accordance with the FIS rules. The results demonstrate the process of virtual prototyping of a ski-jumper suit and a comparison with a real jumpsuit.

Keywords: ski jumps, ski-jumper suit, FIS rules, jumpsuit construction, CAD system, OptiTex, virtual prototyping