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Functional Dyeing of Cotton and Co/PES blends for health-care sector

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An innovative photoactive phthalocyanine based antimicrobial system used for textile barrier finishing was studied and optimized as a new tool for photo-initiated antimicrobial functionality of textiles. A range of reactive photoactive phthalocyanines containing Zn or Al and reactive groups capable to create a covalent bond with cellulosic fibres was synthesised and applied on the cotton fabric by the reactive dyeing process. Photoactivity of Zn, Al-PTCs is based on production of singlet oxygen 1O_2 when exposed to light. This highly reactive form of oxygen is able to kill majority of microorganisms and to destroy some pollutants. The lifetime of the singlet oxygen is only several microseconds and therefore its effect is limited to max 200 nm distance from the dyed fabric surface. These unique properties of photoactive PTCs were used for preparation of antimicrobial/self-cleaning textile materials with long-lasting wash-permanent barrier effect as an effective, safe and less environmentally risky alternative of conventional antimicrobial systems.

The synthesis and of the selected reactive photoactive phthalocyanine dye (AIFTC-PAFSES) has been optimized in pilot-plant scale. Its application for dyeing of mercerized cotton 120 g/m² and 50/50 cotton/PES blend 140 g/m² (plain weave shirting and bedlinen textiles) was verified in lab and pilot-plant scale. For improvement of colour-fastnesses and different colour-shades at reduced costs, combination of the photoactive phthalocyanine dyeing with vat dyeing (two-steps dyeing), and with reactive dyeing (one-bath) have been optimized in industrial scale (jigger dyeing).

Testing of photoactivity (velocity of the singlet oxygen production) of the finished textiles was conducted by means of an iodide method. Antimicrobial activity of the finished textiles was evaluated in the National Institute of Public Health, Prague according to the modified standard EN ISO 20743 (proper illumination needed) after dyeing and repeated maintenance cycles prescribed for health care sector: washing at 60 °C + chemo-thermo-disinfection. The antimicrobial activity of the dyed fabric is stable in minimum 50 maintenance cycles performed in commercial laundry. The dyed cotton and Co/PES fabrics show good mechanical-physical and physiological parameters (moisture management). The functional effect of the photocatalytic dyeing is compatible with wash-permanent flameproof, DWOR (FC6) and top (easy care) finishing. Results of testing of the dyed fabrics according to EN ISO 10933-10 (Biological evaluation of medical devices – Part 10 confirmed that the dyed textiles have no skin sensitizing or irritation potential. The finishing is not suitable for white goods.