

Attaining Sustainable development by using Treatment with Titanium Dioxide to produce protective Clothing fabrics for Workers in the field of Self-Cleaning Inks

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Abstract:

The importance of the applications and uses of Nanomaterials in the field of textiles is increasing, and it has become a major and influential role with the progress of scientific research, and with the requirements of life, nanotechnology has raised the efficiency of traditional materials, making clothing fabrics more resistant to external factors and making them maintain the cleanliness of the environment to achieve sustainable development, as they resist Bacteria and fungi, in addition to the self-cleaning process for the clothes of workers in the field of inks, to adapt to the surrounding environment. Inks pose a greater risk to the skin of workers, so care must be taken The safety of workers through the use of ink-protective clothing fabrics, which must have special specifications to protect workers' skin and be characterized by ease of cleaning and preservation of the aesthetic appearance and consumable life of the fabrics, through the use of nanotechnology, which prepares the fabrics with titanium dioxide, with the use of natural materials such as cotton (Cotton Open end and Cotton Compact).

The research aims Achieving Sustainable development by using Treatment with Titanium Dioxide to produce protective Clothing fabrics for Workers in the field of Self-Cleaning Inks , they are self-cleaning, by achieving the best mixing ratio, the best spinning method, and the best implementation method. Sixteen samples were produced with a quilted implementation method and a decorative composition, with four mixing ratios with cotton material, ring end spinning, and various tests were conducted, namely measuring the thickness test and the air permeability test. The square meter weight, tensile strength, elongation and self-cleaning tests were tested, and most of the samples achieved the required results.

Statement of the Problem

The problem of the research lies in the lack of use of new materials manufactured using nanotechnology in the fabrics used by workers in the field of inks.

Increasing the problems faced by workers in the field of inks due to stains and dust

There is an urgent need to remove stains using detergents and continuous washing, which affects the useful life of fabrics

Therefore, solutions must be provided to these problems to produce fabrics for workers in the field of inks to achieve sustainable development using self-cleaning titanium dioxide treatment.

Research Significance:

Finding solutions to achieve sustainable development by using treatment with titanium dioxide to produce protective clothing fabrics for workers in the field of self-cleaning inks.

Research Objective

- Identifying the nature of nanotechnology, and studying the equipment with this property as a material that achieves intelligence in achieving sustainable development.
- Increasing awareness of the importance of this technology and its application among those working in the field of inks.

Research Hypothesis

- Chemical treatment using Nanotechnology affects the properties of fabrics of clothing used by workers in the field of inks
- The difference in the mixing ratio of wefts affects the extent of protection of the clothing of workers in the field of inks
- The type of spinning affects the self-cleaning property
- The execution method affects the self-cleaning property

Research Methodology

The research is based on the analytical method and the experimental method.

Search Results

The study proved that:

- The thickness decreases as the mixing ratio with ring-spun cotton decreases. This is due to the difference in the open-end spinning method and the bonding of the fibers to the twines from the inside out, unlike

ring-spinning. After treatment with titanium dioxide, the thickness decreases.

- The weight per square meter increases as the mixing ratio with ring-spin cotton decreases. Cotton Compact has a slightly higher weight per square meter than open-end yarn. Treating with titanium dioxide improves the properties of the fabrics, so the weight per square meter decreases.
- Air permeability decreases as the mixing ratio with ring-spin cotton decreases and is treated with titanium dioxide. The properties of the fabrics improve and air permeability increases.
- The Tensile strength increases in the direction of the wefts as the mixing ratio with ring-spin cotton decreases, and the treatment with titanium dioxide improves the properties of the fabrics. The tensile strength increases in the direction of the wefts.
- The Elongation in the direction of the wefts increases as the mixing ratio with ring-spin cotton decreases, and the treatment with titanium dioxide improves the properties of the fabrics. The elongation in the direction of the wefts decreases.
- The Degree of Self-Cleaning increases as the mixing ratio with ring-spin cotton decreases, and the degree of self-cleaning occurs after treatment.
- The Three Best samples characterized by the Self-Cleaning feature and all the functional properties, for the production of clothing fabrics for workers in the field of inks, sample No. 1 (3 Cotton ring spin: 1 Cotton open-end (decorative)), and sample No. 2 (3 Cotton ring spin: 1 Cotton Compact (decorative)) Sample No. 3 (1 Cotton ring spin: 1 Cotton Compact (lined)

Keywords :

Clothes for workers in the field of inks- self-cleaning- Nanotechnology

References :

- 1- Azza Ahmed Muhammad Abdullah - Taking advantage of nanotechnology to improve the functional performance of cotton fabrics - Journal of Research in the Fields of Specific Education - Volume Six - Issue Twenty-Nine - (July 2020) - p. 361
- 2- Muhammad Sharif Al-Iskandarani - "Nanotechnology" - Half a Century Between Dream and Reality" - Al-Arab Magazine - Issue 6 - Kuwait - (2009)
- 3- RAFAŁ BAUM, SUSTAINABLE DEVELOPMENT – A MODERN UNDERSTANDING OF THE CONCEPT, Annals PAAAE • Vol. XXIII • No. (2) m (2021), P.P 19-28
- 4- Kuhlman Tom, John Farrington. "What is sustainability? Sustainability" 2 (11): (2010),P.P 3436- 3448. DOI: 10.3390/su2113436.
- 5- Rist Gilbert,," Le développement. Histoire d'une croyance occidentale", (Development. History of a Western belief). Paris: Les Presses de Sciences Po, coll. "Monde et sociétés". (2013)
- 6- Robinson John B.," Squaring the circle? Some thoughts on the idea of sustainable development". Ecological Economics (2004) P.P 48 (4): 369-384. DOI: 10.1016/j.ecolecon.2003.10.017.
- 7- Rockström Johan, Will Steffen, Kevin Noone, et al "A safe operating space for humanity". Nature, (2009) P.P461: 472-475. DOI: 10.1038/461472a.
- 8- Asmaa Mohamed Galal Murad, "Nanotechnology Effect on Internal Architecture for Museums", Art and Architecture Journal V (5), ISSUE 1, (2023), P.P 27 – 59
- 9- Sylvia, Leydecker: Nanomaterials in architecture, interior architecture and design, Princeton Architectural Press, NY, USA, (2008).
- 10- B.P. Jelle, A. Gustaavsen, R. Baetensand S. Grynning," Nano Insulation Material Applied in The Building of Tomorrow". Proceedings of COIN Workshop on Concrete Idea for Passive House. Oslo. Norway. (January, 2010) P.P 26- 27.
- 11- Majid Montazer, A. B,"Superior Self-Cleaning Features on Wool Fabric Using TiO₂/Ag nanocomposite optimised by response surface methodology". Journal of Applied polymer Science, (2012, April 11), P.P 125, 356-363.
- 12- Characteristics of Amin Salama: Arab-American scientist Munir Nayfeh - Nanotechnology with a new industrial revolution, Asharq Al-Awsat newspaper - London, (March 2005), Science page
- 13- Reham Reda Desouki Allam - Applications of green nanotechnology to improve the quality of the indoor environment of residence units in university cities - International Arab Journal of Digital Art and Design - Volume One - Issue Two - April 2022 - p. 19:50
- 14- A. Ebru Tayyar, G. A. "Outdoor usage performances of woven fabrics dyed with self-cleaning dyes". The Journal of The Textile Institute, (2014, April 24) P.P 106(3), 303–310. Retrieved from <https://dx.doi.org/10.1080/00405000.2014.919064>
- 15- Chenghui Zheng, Z. Q." Self-cleaning Bombyx mori silk: room-temperature preparation of anatase nano-

- TiO₂ by the sol–gel method and it’s application”. Coloration Technology, (2014, Febraury 19) P.P 130(4), 280-287.
- 16- Kumar, B. ”Self-Cleaning Finish on Cotton Textile Using Sol-Gel Derived Tio₂ Nano Finish”. IOSR Journal of POlymer and Textile Engineering, (2015, Febraury) P.P 1-5. Retrieved from www.iosrjournals.org
 - 17- Ghada Mohammed Al-Sayyad: “The effect of the difference in weave structure and the percentage of excess weft backing on some performance properties.“Career for Curtain Fabrics” - International Design Magazine – (2013)
 - 18- Saadia Omar Khalil Ibrahim: “The effect of different types of materials on the natural and mechanical properties of fabrics” - Arts and Sciences Magazine - Faculty of Applied Arts - Helwan University Volume Fourteen - Third Issue - July (2022)
 - 19- Faten Muhammad Abdel Tawab Muhammad: “Criteria for achieving the comfort property of summer clothing fabrics” - Doctoral dissertation – College Applied Arts - Helwan University - (2008)
 - 20- Manal Al-Bakri: “Clothes and Health in the Twenty-First Century” - Cairo - World of Books - (2011)
 - 21- Felcher, EM, "The Consumer Product Safety Commission and Nanotechnology" – (2008).
 - 22- Shaima Ismail Ismail Muhammad Amer - “The effect of change in the structural compositions of shirt fabrics on comfort properties” - Journal of Applied Arts and Sciences - Volume Four - Issue Three - pp. 125-138 - (July 2017)
 - 23- Maha Talaat Al-Sayyed Khalfallah: “Improving the functional performance of fabrics used in the medical field by preparing them to resist Bacteria and removing dirt” - Master’s thesis - Faculty of Home Economics - Menoufia University - (2009)
 - 24- ASTM (American Standards on Textile Materials, Designations: D, 1777-96).
 - 25- ASTM (American Standards on Textile Materials, Designations: D, 3776-75).
 - 26- ASTM (American Standards on Textile Materials, Designations: D, 1682-75).
 - 27- ASTM (American Standards on Textile Materials, Designations: D, 737- 97).
 - 28- ASTM (American Standards on Textile Materials, Designations: D, The colour parameters of the dyed textiles were determined using an UltraScan PRO spectrophotometer (HunterLab, USA) with a D65 illuminant and 10 standard observer.).

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