



# ACCEPTABILITY OF UV PROTECTIVE PRODUCTS DEVELOPED USING NANOTECHNOLOGY

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**Abstract:** Nanotechnology is the utilization of structure and energies inherent in materials at the atomistic level, at the dimension of  $10^9$  nm, to build novel textile materials with enhanced performance/functional properties. The application of Nanotechnology in the finishing of textiles has always helped to improve quality and performance of textile materials by adding new functions on textile material without compromising on its existing functions like durability, its feel and its original texture. This study focuses mainly on application of  $TiO_2$ , hence application was done using different concentrations of  $TiO_2$ , while concentration of Binders was kept constant. The extraordinary photocatalytic activity, non-toxicity, high availability and biocompatibility makes  $TiO_2$  nanoparticles the preferred material for this study. The two types of  $TiO_2$  nanoparticle material are present in the market, first is imported (Sigma brand) and second one is available under local brands. The present study was conducted to evaluate acceptability of products developed using such application among consumers. Different physical properties like tensile strength, GSM of the fabric, abrasion resistance and Fabric count were found good as compared to normal cotton fabric while some functional properties like water repellency, UV protection factor were few properties that helped consumers make their choice. Final Protective Textile Products were developed on the basis of UV protection and Anti-microbial activity. The survey also shows awareness and increasing demand among consumers for such products.

**Key Words:** Nanotechnology, Titanium Dioxide Nanoparticle, UV Protection Finish, Summer coat, Kids tent house, cushion cover, Protective Textiles.

## 1. INTRODUCTION :

The word Nano means small in size. The Nano in technology comes from the Greek word meaning "Dwarf". Nanotechnology was defined as the study of different structures whose size ranged between 1 to 100 nanometers. This is too small to even be visible to the human eye. This is equal to 100000 smaller than human hair diameter. The study shows that particles at this level show tremendous properties than their original macro size form. Dealing with this size, understanding, manipulating and controlling matter at Nano-size level so that many chemical, physical, or biological properties of the material can be improved or in better word engineered to develop the next level of advanced materials.

Nanotechnology brings enormous promising applications in the field of textiles. The unique and new properties can be introduced into fabric to increase the functional properties of the fabric. As Cotton is losing its importance due to synthetic materials available at cheap price, some additional properties were added by using Titanium Dioxide nanoparticles. As latest technology develops it becomes costly for the general public to afford so this study was done by using locally available Titanium Dioxide ( $TiO_2$ ). From the present study it was concluded that domestically available Titanium Dioxide showed great variation in size. The crystallinity % of Titanium Dioxide was less than amorphous % so it can be stated that finish applied using this nanoparticle cannot be used for water repellency finish. When GSM of the fabric was compared with coated sample with different concentration, it was found that GSM of cotton fabric decreased with an increase in concentration on  $TiO_2$ . Tensile strength was improved weft-wise when treated with Acrylic Binder, but when compared to polyurethane Binder it doesn't affect warp-wise tensile strength and in weft-wise same behavior was observed. Least tensile strength was observed with 10% concentration with Polyurethane Binder.



Abrasion resistance was good for all samples.

The functional properties like antimicrobial activity were not observed as desired. Water repellency was not seen for all samples. The UV protection Factor was evaluated for both and was found significantly good. The durability of UV Protection was also observed satisfactory for 5 and 10 washes.

As global warming is increasing day by day there is a strong need for changes in textile processing to be adopted. By using Nanotechnology many processes can be shortened and water which is wasted in heavy laundering can be saved. This is possible with finish applied through Nanomaterials. For example, Australia is one of the top countries which have highest rates of cancer due to great UV exposure. So, there is a strong need to develop UV Protected Textiles.

The Titanium Dioxide (TiO<sub>2</sub>) was applied on the 100% Cotton fabric using Pad Dry-Cure method, using Polyurethane Base Binder as it showed best results when compared with Acrylic binder. The treated samples were then tested for UV Protection Factor, Tensile Strength, GSM, Anti-Microbial activity and Water repellency. The sample that gave the best result was then evaluated for Durability against 5 and 10 washes. The method that gave the best result was chosen for product development. The fabric was printed using stencils for beautification purposes.

## 2. Product Development :

Selection of products was also done on the basis of suitable application according to the results obtained. The fabric was printed with blocks using pigment dyes before application of the finish. The technique of tie dye was also used to beautify products. These products were stitched with a full shuttle manually operated machine.

The product developed are listed below:

- **Cushion Cover:** The cushion cover developed was 16X16 inches in size. The main purpose of selecting this product category was to explore application on home furnishing division and find its functional acceptability among consumers. Two techniques were used for making cushion covers.
- **Summer coat:** The summer coat was of L Size. This was selected on the basis of application and functional benefits to the wearer. It was also for preventing wearers from harmful UV rays.
- **Kids Tent House:** The kids tent house was made for 3- 5-year-old kids. The fabric was dyed first with direct dye and then some beautification was done to beautify the product according to kids. The stencil printing technique was used for printing Panda motifs.

## 3. Product Survey Discussion :

Product survey was carried out to get feedback from 50 respondents. All respondents in the survey were female with age between 20 to 50 years. Survey was based on a rating from 5 to 1.

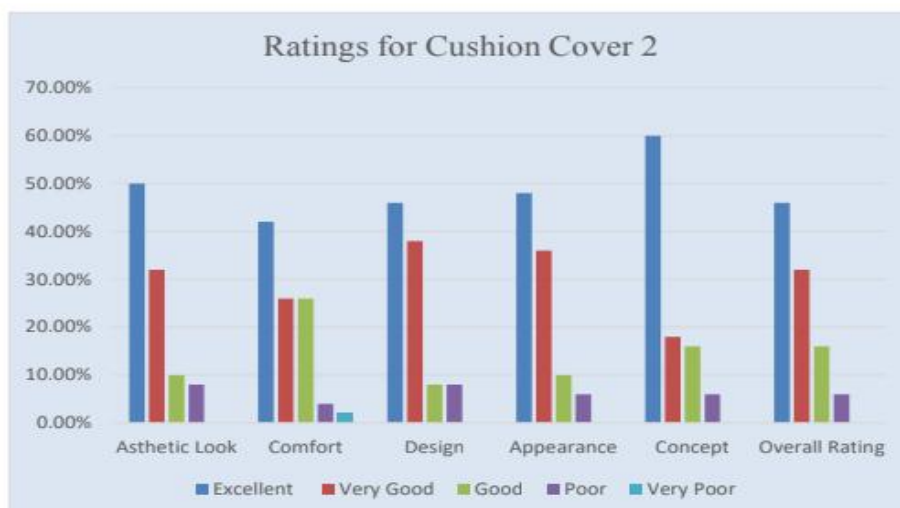


Figure no:1 Rating for cushion covers



From above data, the concept (UV Protection and Anti-microbial Finish) was rated with the highest rating. Aesthetic look, design, and appearance was also found good.

The Comparison was made between suncoat developed and suncoat already available in the market. The comparison was made on the basis of Aesthetic look, Comfort, Design, Appearance, Concept (UV Protection and Anti-microbial Finish) and Overall Rating.

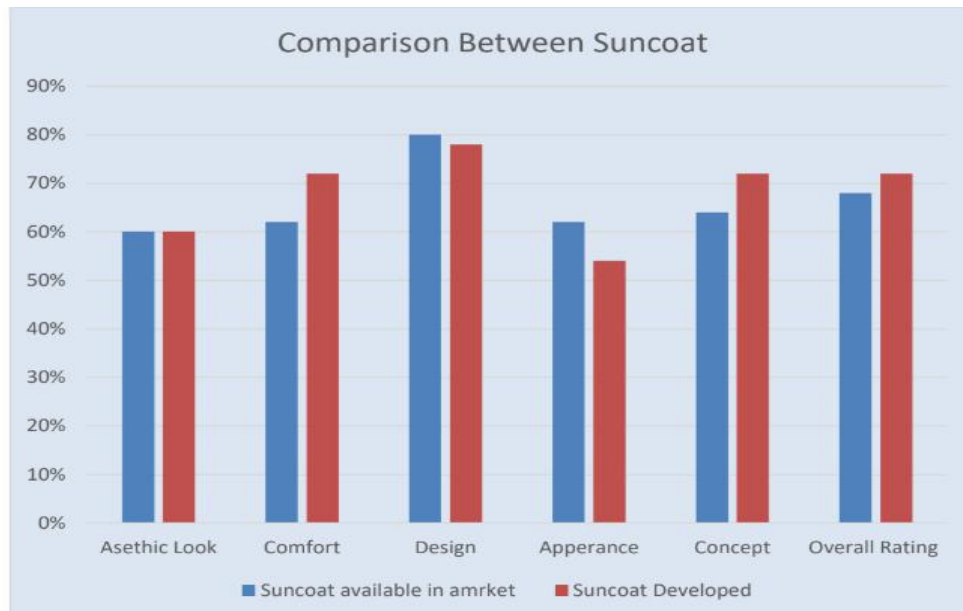


Figure no: 2 Comparison between market and developed suncoat

From the above figure, it was stated that the concept (UV Protection and Anti-microbial Finish) and comfort wise the Suncoat Developed was rated better than available in the market. The overall rating was also found to be good of suncoat developed. Aesthetic look rating was found to be the same for both. While, appearance wise suncoat available in the market were found to be better rated than developed.

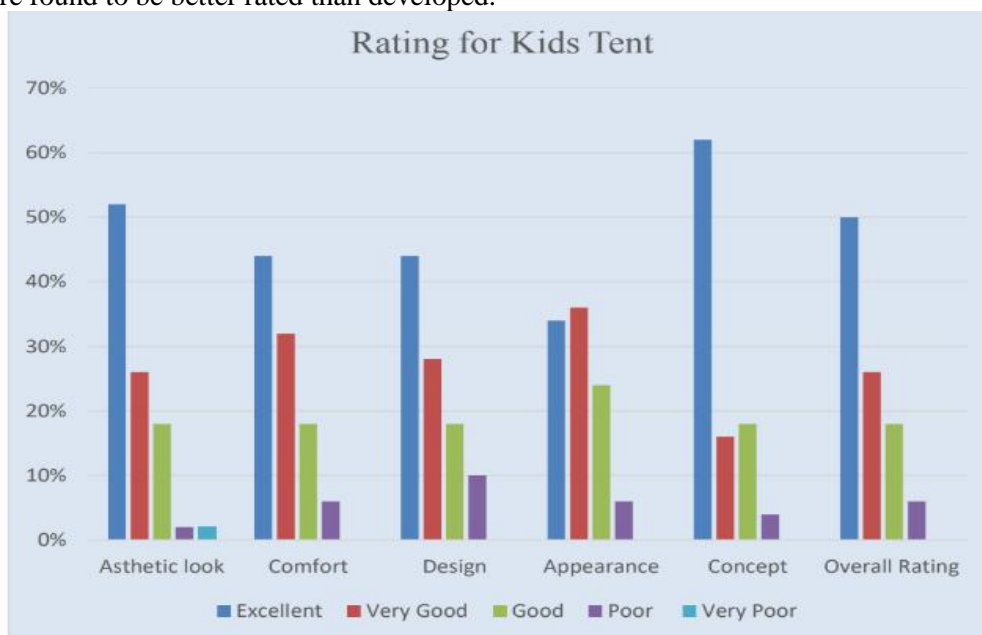


Figure No:3 Survey Rating for Kids Tent house

From Above figure it was calculated that the concept of making a UV Protected Tent House for kids was most accepted and liked by the respondents. The aesthetic look and Overall rating were also excellent. The comfort and design were also rated good.



#### 4. Summary and Conclusion :

The functional properties like antimicrobial activity were not observed as desired. Water repellency was not seen for all samples. The UV protection Factor was evaluated for both and was found significantly good. The durability of UV Protection was also observed satisfactory for 5 and 10 washes. So it was selected for development of products that are more often used in sunlight.

As we know the benefits of Nano applications, more and more products should be developed so that it can benefit society in terms of health and maintenance. The purpose of this study was to create awareness amongst consumers and also take their feedback on the developed products. The manufacturing companies should take it forward and provide consumers with more design options with good protective finishes so that the real consumers can benefit from technology.

Thus, the product developed finds great usage in the field of protection from UV rays. The UV Protection products were found appropriate for the end use of this study. Since more and more nanomaterials are released into the environment, further studies will be required on their behavior in the soil, their uptake and accumulation in plants and soil-dwelling organisms.

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