

Development of pollution and mosquito repellent protective curtains serving the aesthetic purpose

Vedanshee Mehta, Pranav Vora, Pradeep Kulshrestha, Nupur Chopra

Abstract: It is considered that Curtains serve as a means of insulation and regulation that plays an essential role in the overall aesthetics of a room as well as it can protect us from outside pollution and mosquitoes. The need of this Development is to serve people with better protection by keeping in mind the aesthetics of a room. The curtains are designed by integrating the air filters and mosquito repellent coating which is done using a mixture of natural repellent and cross linking agent. Test at different concentration of Neem leaves extract and neem bark extract were done to check the efficiency of mosquito repellent curtains. Air filters fabric is integrated in the middle layer which eliminates the invasion of harmful dust particles into the room. Curtains are embroidered using photo luminescent threads for the aesthetic purpose.

Keywords: Protective curtains, Air Filters, Mosquito repellent, air filters,

1 INTRODUCTION

The mosquito happens to be the world's deadliest animal. Mosquitoes act as vectors, transmitting deadly diseases such as malaria and dengue. The absolute numbers are still alarming – with malaria affecting over 338,000 people in India in 2019. Personal and household-level mosquito repellants in different form is needed for successful control of mosquito-borne diseases (MBD)(Divecha, 2019). Creating a protective layer on doors and window can stop the invasion of mosquitos as well as harmful dust particles. Curtains are one of the important elements in homes and workplaces. Dust particles can enter into the room when doors and windows are kept open. The air contains tiny particles that can enter the house through little openings. These dust particles settle on different surfaces and make the house look untidy and can cause different diseases. So, hanging a curtain protects the room from dust particles sunlight, as well as peeking eyes. Curtains can help reduce the temperature of the room. Thus, it's often recommended to keep them closed in summers, even when direct sunlight isn't a concern. Thick curtains are made so that the heat can be blocked helps in keeping the room cooler. It also provides security and privacy of an individual. Curtains can also be considered as a key fashion element. Their color, design, and shape all contribute to the room's overall aesthetics. Curtains are an important part of luxurious house as it can improve the appearance of a room using the right curtains. A hot climate is the ideal condition for a lot of insects, amongst them, the mosquitoes. This fact together with the climate change imply mosquitoes with the capacity of surviving for longer periods of time and so, the season of bites and diseases transmission is extended.

Doors and windows are considered to be one of the major sources for invading of dust particles, harmful rays, mosquitos, etc. into the room. Curtains can be a protective layer between the outside environment and the room so Curtains which can fulfill three main utilities – decoration, privacy and Protection can be developed in order to make homes a more safer place.

1.1 STATEMENT OF PROBLEM

Pollution is the introduction of substances (or energy) that cause adverse changes in the environment and living entities. Pollution need not always be caused by chemical substances such as particulates (like smoke and dust). Forms of energy such as sound, heat or light can also cause pollution. These substances that cause pollution are called pollutants. It is further categorized into many different types of pollutions. Increase in the levels of air pollution can cause a variety of adverse health outcomes. It increases the risk of respiratory infections; heart disease and lung cancer. Pollutant water are considered to be the breeding ground of mosquitoes as it prefers

stagnant or polluted water as their breeding sites. Resulting into the increase in transmission of mosquito borne diseases. Mosquito bites can give an unpleasant feeling and may transmit the vector disease such as dengue or malaria to humankind. Mosquitoes multiply easily in a span of a week, especially in places with warm weather or high humidity. Thus, hygiene must be taken care of to prevent these harmful pollutants and mosquitos invaded into houses through open doors and windows.

1.2 OBJECTIVES AS STATED IN THE PROJECT PROPOSAL:

To develop a protective curtain that minimizes the harmful dust particles from entering into the room as well as a mosquito-repelling

To serve the aesthetic purpose by embroidering the front portion of the curtain using photoluminescent yarns which will glow in dark.

2 RESEARCH METHODOLOGY:

Nature and source of data/information to be collected- quantitative data collection Sample and sampling technique –Prototype will be made by outsourcing, lab development and designing some materials. Assembling will be done In-house. Tools and Techniques to be used for data collection – lab development of mosquito repellent chemical coating, Machine embroidery of photoluminescent yarns on curtains, Creating the air filters

3 LITERATURE REVIEW

MOSQUITO REPELLENT FINISH ON TEXTILES

The author is Senior Lecturer in Department of Fashion Technology at Kumaraguru College of Technology, Coimbatore

The article talks about the method and chemicals used to develop mosquito repellent textiles. Apart from the industrial use, Mosquito repellent finish on textiles has become essential in our day today life to live in free diseases and hygienic atmosphere. The finished textiles can have excellent potential in various uses such as baby care products and. Night wears. Even though many products have come, but still there is very good scope for the textile researchers in this field.(Krishnaveni, 2009)

MOSQUITO REPELLENT FABRICS(Textil, 2014)

This application can be done by means of different textile technologies:

1. During the extrusion process of synthetic fibers.
2. During the finishing process of the fabric
3. On the final garment by means of a finishing step.

This kind of process, the **textile raw material**, the selected biocide (type and state – microcapsules, emulsion and etc.) as well as the care and maintenance conditions of the textile will be the determinant factor of the repellent effect durability.

ANTIMICROBIAL ACTIVITY OF AZADIRACHTA INDICA (NEEM) LEAF, BARK AND SEED EXTRACTS(Challa, 2013)

This study shows that the aqueous extracts of neem leaf exhibited highest antimicrobial activity compared with the bark and seed. Margolone, margolonone and isomargolonone are tricyclic diterpenoids isolated from stem bark are shown to exhibit antibacterial activity. Nimbidin and nimbolide from seed oil show antifungal, antimalarial and antibacterial activity including inhibition of Mycobacterium tuberculosis. Presence of high concentrations of azadirachtins, quercetin and β -sitosterol in A.Indica leaves might be responsible for strong antibacterial and antifungal activity compared with bark and seed.

Thus, *the tests performed in the above study, compared the antimicrobial efficacy of aqueous extracts of neem leaf, bark and seed which showed high, moderate and low antimicrobial activities respectively.*

ANTIBACTERIAL FINISHING OF POLYESTER/COTTON BLEND FABRICS USING NEEM (AZADIRACHTA INDICA): A NATURAL BIOACTIVE AGENT(M. Joshi, Ali, & S., 2007)

The study focused on the development of biofunctional polyester/cotton blend fabric using a natural product. An antimicrobial agent extracted from the seeds of Neem tree (Azadirachta indica) was used for imparting antibacterial property to the blend fabric. Resin and catalyst concentrations were optimized to get the maximum crosslinking in the fabric blends using glyoxal/glycol as a crosslinking agent. The results showed that the treated fabrics inhibited the growth of Gram-positive bacteria (Bacillus subtilis) by more than 90% as compared to the control sample.

DYEING OF COTTON FABRIC FOR IMPROVED MOSQUITO REPELLENCY(Teli & Chavan, 2017)

Mosquito repellent-treated textile material initially shows good repellency against mosquitoes but upon repeated washing cycles this effect gets washed off considerably. In the present work, 4-Amino-N, N-diethyl-3-methyl benzamide (MD) is synthesized from N, N-diethyl-m-toluamide (DEET) and it is used as base material for synthesis of azo group. The dyed cotton fabric using naphthols and MD showed very good and durable mosquito-repellent activity.

FABRIC INFUSED WITH A BOTANICAL REPELLENT FOR PROTECTION AGAINST MOSQUITOES(Halbkat, et al., 2019)

Fabric swatches consisting of 80% nylon and 20% elastane were separately treated with an organic repellent using a patented nonwoven vessel. The fabrics were then tested for effectiveness in repelling the mosquito Aedes aegypti using an arm-in-cage assay, the most commonly used method for mosquito repellents. The infused fabrics showed to be effective at repelling mosquitoes for up to 8 h after repellent infusion.

DEVELOPMENT OF MOSQUITO REPELLENT, ANTIBACTERIAL, ANTIOXIDANT AND UV PROTECTIVE COTTON USING A NOVEL METHOD OF AZOIC DYEING WITH TERMINALIA CHEBULA(Singh & Sheikh, 2021)

Preparation of azoic dyes was performed using ethyl anthranilate (EA), a safe mosquito-repellent, and Terminalia chebula natural dye as the coupling component. The novel method resulted in mosquito-repellent cotton with 100% mosquito repellency, which was found durable until at least 20 washes. Additional functional properties such as antibacterial activity (more than 94%), antioxidant activity (>87%) and UV protection (UPF >50) were also confirmed.

AIR PERMEABILITY OF MULTILAYER WOVEN FABRIC SYSTEMS

(Sundaramoorthy, Nallampalayam, & Jayaraman, 2011)

The performance of the proposed model has been successfully validated by using it to predict the air permeability of other multilayer woven fabric systems and comparing it to experimentally determined values. The model can thus be used as a valuable tool in the engineering design of multilayer woven structures with desired air permeability performance requirements.

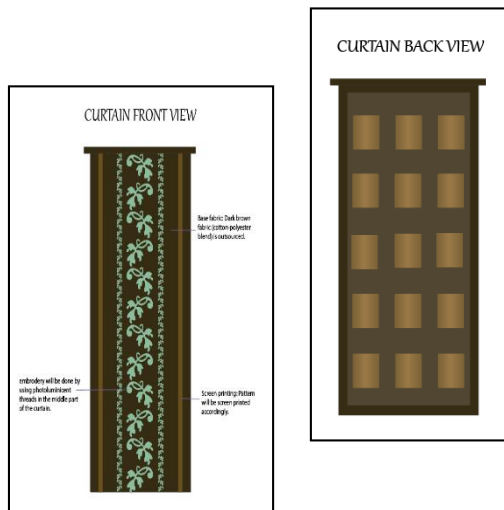
TOTAL POROSITY, THEORETICAL ANALYSIS, AND PREDICTION OF THE AIR PERMEABILITY OF WOVEN FABRICS(Tugrul & (Mavruz) Mezarcioz, 2011)

Air permeability is one of the most important properties of textile materials that ensure their comfort. For many materials for technical applications (filters, sails, vacuum cleaners, parachutes, etc.), this is one of the main properties that determine their quality. Since the amount of air passing through both the pores between yarns and the interstices in the fibers constituting the yarn structure was calculated, theoretical values of air permeability were obtained very close to the experimental values.

THERAPEUTICS ROLE OF AZADIRACHTIN INDICA (NEEM) AND THEIR ACTIVE CONSTITUENTS IN DISEASES PREVENTION AND TREATMENT(Alzohairy, 2016)

The article concluded that neem leaf and stem bark extracts reduced the level of parasitemia in infected mice by about 51–80% and 56–87%, respectively, and other studies showed that azadirachtin and other limonoids available in neem extracts are active on malaria vectors.

4 DIGITAL VIEW OF PROTOTYPE



4.1 FRONT VIEW

Curtain length is 67" and width is 28". Embroidery is done using photoluminescent threads.

4.2 BACK VIEW

Pockets of 6x7 inches are placed on the back panel of the curtain. Total no of pockets: 15. coated fabric pieces will be placed inside these pockets.. Size of coated fabric: 5x5". samples made for testing. test sample size: 6x8". Pocket size: 5x5". coated fabric size: 4x4"

5 CONSTRUCTION OF PROTOTYPE

5.1 LAYER 1: MAIN FABRIC

Polyester fabric is used as the main fabric: Polyester fabric (polyethylene terephthalate) is a synthetic woven material known for being durable and relatively inexpensive to produce

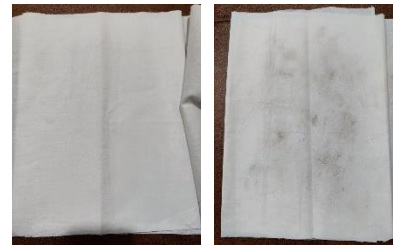
General properties of polyester:

It is durable as Polyester fibers don't tear, stretch, or pill easily like cotton and other natural fibers. It can easily handle abrasion from machine-washing and doesn't require special care. It's moisture-resistant. It is wrinkle-resistant and will better hold its shape, drape, and rigidity.

Fabric Details:

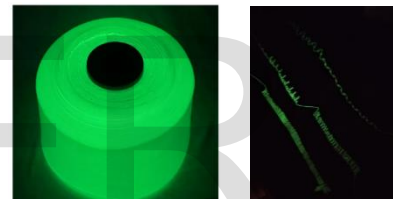
- Ends per inch: 74
- Picks per inch: 82.2
- Warp: 36 Ne
- Weft: 36 Ne
- Warp yarn: multifilament yarn
- Weft yarn: multi filament yarn
- Testing: Burning test

5.2 LAYER 2: POPLIN AS FILTER FABRIC



As per the research paper by Cukurova university engineering and architecture Faculty, experimental research was done to check the air permeability of the woven fabric, it is stated that the woven fabric can be used as air filters. here in this project, multiple layers of poplin fabric are used as an air filter which is often found in filter for its lightest weight, good resistances against alkali and acid. Poplin filter cloth is popular among filtration for its excellent abrasion-proof, water and air permeability.

5.3 PHOTOLUMINESCENT THREADS FOR EMBROIDERY



5.3.1 GENERAL PROPERTIES

Glow in the dark thread can be used to produce glow cloth or to sew glow designs on cloth. Can also be used for quilting and embroidery. Thread is made of super thin photoluminescent pigment with the combination of terylene thread by special technics. It can be used for all kinds of embroidery. When absorb visible light for about 10 minutes, it can glow in the dark for more than 5 hours, and can be used recurrently. It is luminescent and has fine chemical stability. It is nontoxic, harmless, and doesn't contain any radioactive element.

5.4 NEEM EXTRACT USED AS MOSQUITO REPELLENT AGENT IN COATING

5.4.1 ACTIVE COMPONENTS OF NEEM

Nimbolinin, nimbin, nimbidin, nimbidol, sodium nimbinat, gedunin, nsalannin

5.4.2 GENERAL DETAILS

Neem is considered as a natural mosquitos and insect repellent. In this research, neem bark and leaves extracts is used as a mosquito repellent solution which is mixed with polyester resin (cross linking agent) to make the coating more effective and the molecules of the extract are firmly coated on the fabric. Some of the studies showed that azadirachtin and other limonoids available in neem extracts are active on malaria vectors

6 METHODS AND PROCEDURE OF TESTING

6.1 SAMPLE 1



layer placement	L2-L3
Neem bark extract	15ml
water	100 ml
Cross linking agent	0.5 ml

6.2 SAMPLE 2

layer placement	L2-L3
Neem bark extract	30ml
water	100 ml
Cross linking agent	0.5 ml

6.3 SAMPLE 3



layer placement	L2-L3
Neem bark extract	45ml
water	100 ml
Cross linking agent	0.5 ml

Similarly, all the tests were done by using different concentrations of NLE, NBE, and CLA for other 12 samples.



Samples	NLE ml	NBE ml	CLA ml	Water ml
Sample 1		15	0.5	100
Sample 2		30	0.5	100
Sample 3		45	0.5	100
Sample 4	15		0.5	100
Sample 5	30		0.5	100
Sample 6	45		0.5	100

Samples	NLE ml	NBE ml	CLA ml	Water ml
Sample 7	15		1	100
Sample 8	30		1	100
Sample 9	45		1	100
Sample 10		15	1	100
Sample 11		30	1	100
Sample 12		45	1	100

NLE: NEEM LEAVES EXTRACT

NBE: NEEM BARK EXTRACT

CLA: CROSS-LINKING AGENT

6.3.1 PROCESS

Different concentration (15,30,45) of neem bark extract is mixed with 0.5 ml of cross-linking agent and 100 ml water (40 degree C). The fabric piece is placed into this solution and is kept for 20 minutes.

6.3.2RESULTS

repellency was very low as the molecules of neem bark extract were not properly coated. So, the concentration of Cross-linking agent was increased to 1 ml. Similarly, the test was performed using different concentrations of extracts and cross-linking agent to check the efficiency of the natural repellent.

Samples made using neem leaves and bark extract,



7 MOSQUITO REPELLENT TEST

mosquito repellency test can be performed in two ways:

7.1 FIELD TEST:



this test is considered the most meaningful evidence for the efficiency of a treated fabric. The test is performed where there is high level of mosquitos. Treated and untreated fabric are place in such areas and observation is done. This method is used for the ultimate verification of the performance of the treated fabric. The most realistic conditions deliver he most meaningful results.

7.2 CAGE TEST:

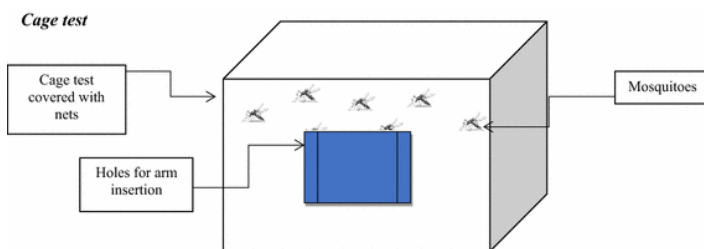


Figure 1 Cage test

The cage test might assess the viability of repelling substance against mosquitoes for lotions, cream including impregnated material done fast and effective approach. It is designed to observe the mosquito landing on the untreated and treated fabric in the cage. The advantages of this method are it provided the real situation of the probing and biting of the mosquito to the human besides it can directly provide the observation of the mosquitoes behaviour towards the treated materials. The drawbacks of cage test involve the human participation, it takes a lot of preparation either in term of paper works such as needed to apply ethical approval, the human and mosquito preparation. This test is performed in the cubical structure

made of glass. Treated fabric is placed into the cage and mosquitos are being released into the cage. repellency is checked and noted by this method. The cage concealed with transparent mosquito nets for easy observation and also to keep mosquito remain inside the cage. It has holes which also covered with nets for arm accessing purpose. According to WHO (WHO, 1996) conventional standards, the cage needs to be filled with 200 mosquitoes that have been starved overnight and only were supplied with sucrose solution.

8 FUTURE SCOPE

Gas sensors can be integrated into textiles which are helpful in monitoring leakage of dangerous gases in the room so that user can take preventive steps to minimize the hazards. Motion detecting sensors and micro camera can be integrated which can captures images beyond your property boundary, such as your neighbours' property or public streets and footpaths, then your use of the system is subject to the data protection laws.

9 CONCLUSION

The tests performed in the current study, compared the mosquito repellent efficacy of aqueous extracts of neem leaf and bark which showed high, moderate and low mosquito repellency respectively. It is concluded that both Neem leaves extract is more repellent compared to the Bark extract. Leaf extract are efficient and mosquito repellent which was observed at 30ml per while bark extract was repellent at more than 45ml. This type of curtains can be developed for the protective purpose and also the further modification and integration of different types of sensors and actuators so that it could have a versatile use in different fields.

We inspired for development of such curtains by natural Neam leafs because precautionary treatments available for human usages like – All Out Electric device with chemical, mosquito Coils with Smoke, Odomos (Direct touch with Skin) etc doesn't appear very safe for human health.

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