DEVELOPMENT OF NANO COATED COTTON FABRIC FOR FILTRATION OF CO_2 EMISSION FROM DIESEL ENGINE

A PROJECT REPORT

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ABSTRACT

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In the current scenario, due to the various applications of industrial motors, generators as well as increase in vehicle usage, the emission of carbon di oxide and carbon monoxide into the atmosphere is more.The study of " World Population Prospects 1950-2050 " says that world has polluted 380ppm of carbon di oxide over the past 100 years since industrial revolution.

Nano finish is recently applied for many functional purposes where the application of Nano particles on the fabric makes less change in the properties such as comfort, permeability, drapability, stiffness and thickness. The use of Nanoparticles may have advantage over conventional due to the much larger surface area and small size.

In this project an effort has been taken to coat the cotton fabric using Nanotechnology with TiO_2 to filter carbon di oxide and carbon monoxide emitted from the vehicles and motors. Nano TiO_2 is synthesized using Sol-gel method and coated on the cotton fabric by dispersion method via sonication. Then Nano coated and cotton fabrics are used as filters in the outlets of engine. The filters are tested to measure the rate of carbon adsorbed .Other properties such as air permeability, water vapour permeability, thermal conductivity, drapability, stiffness and thickness of Nano coated and cotton fabrics are compared.

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INTRODUCTION

CHAPTER – 1 INTRODUCTION:

Pollution, accumulation of hazardous and unwanted material into the earth by human activity and natural disaster has created a great impact in the modern era. World is moving towards eco-friendly and sustainable products. But the natural products itself are turning against the humans. Carbon Dioxide (CO_2) is a natural part of Earth's Atmosphere.

Due to human activities, the amount of CO_2 released into the atmosphere has been rising extensively during the last 150 years starting from the industrial revolution.Carbon Dioxide (CO_2) levels in the atmosphere have risen from 0.028% to 0.038% (380ppm) over the past 100 years. Increasing carbon dioxide emissions cause about 50-60% of the global warming.

Fossil fuel combustion for energy generation causes about 70-75% of the carbon dioxide emissions. The remaining 20-25% of the emissions is caused by land clearing and burning and by emission from motor vehicle exhausts Energy is used grossly inefficiently at present because it is largely used as heat, both in Carnot-limited engines and in thermal processing to manipulate matter via phase changes.

Environmental concerns regarding carbon-di-oxide emissions have stimulated considerable interest in the minds of people. The main contribution for the Carbon dioxide emission is vehicle. Technologies are also getting the fever, and are coming up with new innovations to reduce fuel consumption for passenger vehicle.

The latest Nanotechnology plays an important role in reduction and removal of Carbon dioxide from the atmosphere. Nanotechnology is the design, characterization, production and application of structures, devices and systems by controlling theshape and size at thenanometer scale; Environmental nanotechnology (E-Nano) products can be developed for a wide array ofurgently needed environmental remediation. The Nanoparticles / anostructures made by mechanical and /or microbial actionwith fundamental building blocks are among the smallest human made objects and exhibit novel physical, chemical andbiological properties; which has wider application for pollution prevention, detection, monitoring and remediation ofpollutants. Environmental nanotechnology would be the new innovation to remediate and treat the contaminants to acceptablelevels. Environmental scientists and engineers are already working with Nanoscale structure to manipulate matter of the atomicor molecular scale that has cut across discipline of chemistry, physics, biology, and even engineering.

Nano filtration is a relatively recent filtration process which holds promise to deliver cost effective method and air treatment solution. Nano filters are not only used to remove pollution from air and water, but also used for desalination of salt water.

Nanostructured materials are used as biosensors for monitoring and detection of different compounds. The use of Nanoparticles may have advantage over conventional due to the much larger surface area of Nano particles on a mass basis. The unique structure and electronic properties of some Nano particles are adsorbent of pollutant. Many Nano materials have properties of adsorbents,depend on size. Achemically modified Nano materials have also attracted a lot of attention especiallyNano porous material due to their exceptionally high surface area. The particle size of such materials is,however, not in the Nano range but normally 10-100um. Another option is to modify chemically the Nano particles itself.

As new material Nano sized TiO_2 is of great interest of many scientists in the recent years. Its small size and large specific surface area allow for certain unique and unusual physical and chemical properties more over due to its high chemical stability, non toxicity and good heat resistance. It is highly promising to be used in electronic photo catalysis as well as carbon adsorption. Nano TiO_2has three crystalline structures Anatase, Brookite and Rutile. There is many way to synthesis Nano particles, compared to all the method Sol-gel method is most economical and laboratory method to synthesis. Hence TiO_2 Nano is synthesised using Sol-gel method. The synthesised Nano particle is characterised by SEM and XRD to determine its phase and size of the particle. Among the various methods, Nano particle is coated on the fabric using dispersion method via sonication. The efficiency of the coated fabric is determined using carbon adsorption, water vapour permeability, air permeability, thermal conductivity, thickness, stiffness and SEM results. Comparing all the results Nano coated fabric is more efficient than cotton fabric and is used as filters in automobile exhaust and will be effective in reducing CO_2 and CO emission.

REVIEW OF LITERATURE

CHAPTER – 2 REVIEW OF LITERATURE

2.1 POLLUTION:

Pollution is the introduction of contaminants into a natural environment that causes instability, disorder, harm or discomfort to the ecosystem i.e. physical systems or living organisms. Pollution can take the form of chemical substances or energy, such as noise, heat or light. Pollution is often classed as point source ornonpoint pollution. It is created mostly by human actions, but can also be a result of natural disasters. Pollution has a detrimental effect on any living organism in an environment, making it virtually impossible to sustain life. Pollution harms the Earth's environment and its inhabitants in many ways. The three main types of pollution are air, land and water pollution. Pollutants, the components of pollution, can be either foreign substances/energies or naturally occurring contaminants.

2.1.1TYPES OF POLLUTION:

- Air pollution
- Water pollution
- Soil pollution (contamination) / Land pollution
- Agricultural pollution
- Industrial pollution
- Transport pollution
  - Car pollution / Heavy vehicle pollution
  - Ship pollution
  - Airplane pollution
- Commercial and domestic sector pollution
- Radioactive pollution (contamination)
- Chemical pollution
- Invasive species pollution
- Light pollution
- Noise pollution
- Visual pollution
- Volcanic eruptions
- Dust storms
- Smoke from forest and grass fires

2.1.2 TYPES OF POLLUTANT:

There are many different kinds of pollutants, but some of the larger problems result from:

2.1.2.1Petroleum:

Everyday people dig deeper to another aquafer in the ground. Oil/Gas stations keep leaking and do the minimum to clean, remediate the problem. Just light oversight. Soon, water will be even more costly than oil. It's only a matter of time. LA has the biggest water pollution in Southern California, in simple terms. Petroleum's and the effects is deeper fresh water drilling and more polluted groundwater.

2.1.2.2 Greenhouse Gases:

Carbon dioxide and methane are two of the most important of these gases, called greenhouse gases because they trap heat in the earth's atmosphere. This is already causing severe problems around the world and the situation will only get worse. The rising temperatures will likely lead to more severe weather events, cause shifts in natural communities, and probably lead to greater species extinction rates, among numerous other effects.

2.1.2.3 Pesticides:

Pesticides are poisons. A lot of these chemicals will wash into our rivers and streams and cause direct toxicity to fishes, and may work their way up the food chain to affect birds, bears, whales, and other predatory wildlife, including humans. Some of these pesticides will persist for long periods of time in the environment. DDT was a pesticide used for a long time in the US, but has been banned in the US since 1972. Yet we still find DDT in our environment, sometimes at very high levels.

2.1.2.4 Heavy Metals:

Most heavy metals, such as mercury, are a natural part of the earth's crust, and would be slowly released into the environment over time anyway, just from weathering of soils and rocks. However, our consumption of fossil fuels has greatly increased the introduction of heavy metals into our environment. It is estimated that half of the mercury introduced into the environment today is due to human sources. The problem is mercury, as well as other heavy metals, cannot be detoxified. Toxic effects of heavy metals vary. Mercury is a potent toxin in people targeting nervous tissue, but targets other tissues in other animals. The effects of heavy metals can also be quite severe, since plants and animals have no natural ability to deal with heavy metals specifically and heavy metals do not have any functio plastics. They can cause quite a lot of harm. There are many different kinds of hormones. Usually, our body produces the amount of hormones we need at any particular point in time. But EDs come in and pretend to be a hormone, making our body react in an inappropriate way. We have found some natural populations of fishes that are all or mostly female, or all male, for example. This is likely hormone mediated. Obviously, this is not a good situation, since a population that is all one sex cannot reproduce.

2.2 AIR POLLUTION:

Air pollution is the accumulation of hazardous substances into the atmosphere that danger human life and other living matter. Air Pollutants can be in the form of solid particles, liquid droplets, or gases. In addition, they may be natural or man-made.Air pollution has been aggravated by developments that typically occur as countries become industrialized: growing cities, increasing traffic, Automobile emissions, Tobacco smoke, Combustion of coal, Acid rain, Power plants, Manufacturing buildings, Large ships, Paint fumes, Aerosol sprays, Wildfires, Nuclear weapons, rapid economic development and higher levels of energy consumption. The high influx of population to urban areas, increase in consumption patterns and unplanned urban and industrial development has led to the problem of air pollution.

Air pollution is the major contributor of environment pollution in India that can cause more harm to humans and the environment.Currently, in India, air pollution is widespread in urban areas where vehicles are the major contributors and in a few other areas with a high concentration of industries and thermal power plants. Vehicular emissions are of particular concern since these are ground level sources and thus have the maximum impact on the general population. Also, vehicles contribute significantly to the total air pollution load in many urban areas.

Air pollutant emission factors are representative values that people attempt to relate the quantity of a pollutant released to the ambient air with an activity associated with the release of that pollutant. These factors are usually expressed as the weight of pollutant divided by a unit weight, volume, distance, or duration of the activity emitting the pollutant (e.g., kilograms of particulate emitted per mega gram of coal burned). Such factors facilitate estimation of emissions from various sources of air pollution. In most cases, these factors are simply averages of all available data of acceptable quality, and are generally assumed to be representative of long-term averages.

TABLE 1

Countries with the highest per capita CO_2 emissions

Country	Carbon dioxide emissions per year (Tons per person) (2006)
Qatar	56.2
United Arab Emirates	32.8
Kuwait	31.2
Bahrain	28.8
Trinidad and Tobago	25.3
Luxembourg	24.5
Netherlands Antilles	22.8
Aruba	22.3
United States	19
Australia	18.1

TABLE 2

Countries with the highest CO_2 emissions

Country	Carbon dioxide emissions per year (10^6 Tons) (2006)	Percentage of global total	Avg. emission per Km^2 of its land (Tons)
China	6,103	21.5%	636
United Status	5,752	20.2%	597
Russia	1,564	5.5%	91
India	1,510	5.3%	459
Japan	1,293	4.6%	3421
Germany	805	2.8%	2254
United Kingdom	568	2.0%	2338
Canada	544	1.9%	54

South Korea	475	1.7%	4758
Italy	474	1.7%	1573

2.3 ENVIRONMENTAL IMPACT OF GREENHOUSE GASES:

The greenhouse effect is a phenomenon whereby greenhouse gases create a condition in the upper atmosphere causing a trapping of heat and leading to increased surface and lower troposphere temperatures. Carbon dioxide emissions from combustion of fossil fuels are a source of greenhouse gas emissions.

Other greenhouse gases include methane, hydro fluorocarbons,per fluorocarbons, chlorofluorocarbons, nitrogen oxides, and ozone.

This effect has been understood by scientists for about a century, and technological advancements during this period have helped increase the breadth and depth of data relating to the phenomenon. Currently, scientists are studying the role of changes in composition of greenhouse gases from natural and anthropogenic sources for the effect on climate change.

A number of studies have also investigated the potential for long-term rising levels of atmospheric carbon dioxide to cause increases in the acidity of ocean waters and the possible effects of this on marine ecosystems.

Air pollution adversely affects humans by causing cardio-respiratory problems among other health problems. Read about the other effects of air pollution on health.

On the environmental front, air pollution results in problems such as global warming and climate change, acid rain, Earth's ozone depletion, etc. Read about air pollution effects on the environment.

Bearing in mind the main types of pollution effects, it is very important that everyone should do their bit to prevent air pollution.

There are simple ways to put a check on air pollution. In the area of air pollution solutions for cars, some simple strategies include car pooling, proper vehicle care and making use of public transport as much as possible.

Other tips on reducing air pollution include saving energy, practicing energy efficiency tips, planting more trees, opting for green and renewable energy sources, carbon emission reduction.

2.4 CARBON CONTANT IN POLLUTION:

2.4.1 Carbon dioxide

Carbon dioxide is a naturally occurring chemical compound composed of two oxygen atoms covalently bonded to a single carbonatom. It is a gas at standard temperature and pressure and exists in Earth's atmosphere in this state, as a trace gas at a concentration of 0.039% by volume.CO_2 is toxic in higher concentrations: 1% (10,000 ppm) will make some people feel drowsy. Concentrations of 7% to 10% cause dizziness, headache, visual and hearing function, and unconsciousness within a few minutes to an hour.

2.4.2 Carbon monoxide:

Carbon monoxide CO is a colourless, odourless, non-irritating but very poisonous gas. It is a product by incomplete combustion of fuel such as natural gas, coal or wood. Vehicular exhaust is a major source of carbon monoxide

More than 70% of air pollution in India comes from vehicles. Idling a vehicle for more than 30 secondsuses more fuel than that required for restarting the engine. It was also found that air pollution around schools is much higher due to vehicles idling outside. This pollution has led to an increase in the number of cases of asthma in children.

Vehicle emissions control reduces emissions of nitrogen oxides from motor vehicles. According to the Society of Indian Automobile Manufacturers, India's auto production has doubled from 7 million units in fiscal year 2004 to over 14 million units in year 2010 in India. The daily pollution load generated due to automobiles in 12 metropolitan cities is shown in Table 10.1. Carbon monoxide (CO) and hydrocarbons (HC) account for 64% and 23%, respectively, of the total emission load due to vehicles in all these cities considered together (CPCB 1995).

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2.5INCREASES IN NUMBER OF VEHICLES:

The number of motor vehicles has increasedfrom 0.3 million in 1951 to 37.2 million in1997 (Most 2000). Out of these, 32% areconcentrated in 23 metropolitan cities. Delhi itself accounts for about 8% of the total registeredvehicles and has more registered vehiclesthan those in the other three metros (Mumbai,Calcutta, and Chennai) taken together. Figure10.1 shows the steep growth in the number ofvehicles in India (Photo 10.1).At the all-India level, the percentage oftwo-wheeled vehicles in the total number ofmotor vehicles increased from 9% in 1951 to69% in 1997, and the share of buses declinedfrom 11% to 1.3% during the same period(Most 2000). This clearly points to a tremendousincrease in the share of personaltransport vehicles. In 1997, personal transportvehicles (two-wheeled vehicles and cars only)constituted 78.5% of the total number ofregistered vehicles.

Road-based passenger transport has recordedvery high growth in recent yearsespecially since 1980-81. It is estimated thatthe roads accounted for 44.8 billion passengerkilometer (PKM) in 1951 which has sincegrown to 2,515 billion PKM in 1996. Thefreight traffic handled by road in 1996 was about 720 billion tone kilometer (TKM)which has increased from 12.1 TKM in 1951(Most 1996). In contrast, the total roadnetwork has increased only 8 times from 0.4million kms in 1950-51 to 3.3 million kms in1995-96. The slow growth of road infrastructureand high growth of transportperformance and number of vehicles all implythat Indian roads are reaching a saturationpoint in utilizing the existing capacities. Theconsumption of gasoline and HSD has grownmore than 3 times during the period 1980-1997. While the consumption of gasoline andHSD were 1,522 and 9,050 thousand tones in 1980-81, it increased to 4,955 and 30,357thousand tones in 1996-97, respectively(CMIE 2000).

2.6CARBON EMISSION FROM VEHICLES:

The combination of low vehicle ownership and robust economies has led to very rapid growth in the vehicle fleets in India in recent years. The number of vehicles in India has been growing at an annual rate of almost 13 percent for 30 years, nearly doubling every 5 years. India's fleet has been expanding at more than 7 percent per year, this percentage can be expected to grow in the years to come.

The growing use of internal combustion vehicles, especially in urban areas, will increase congestion, raise the demand for oil, worsen air pollution, and increase emissions of a variety of greenhouse gases, including methane, ozone, carbon monoxide nitrous oxide, and, most important, CO2.

Worldwide, Almost 232 million different types of vehicles are driven by citizens every day, adding greenhouse gases into the air.Motor vehicles currently emit well over 900 million metric tons of CO2 each year. These emissions account for more than 15 percent of global fossil fuel CO2 releases [7]. Because of their large vehicle fleets, developed countries are responsible for a commensurately large share of emissions. in 1993, the countries of the Organisation for Economic Co-Operation and Development (OECD) accounted for about two thirds of total world CO2 emissions from motor vehicles, although these countries represented only 16 percent of the world's population. If the linear growth in emissions characterizing the past 20 years were to continue into the next century, OECD countries would still account for fully 60 percent of global motor vehicle emissions by the year 2050.

TABLE 3

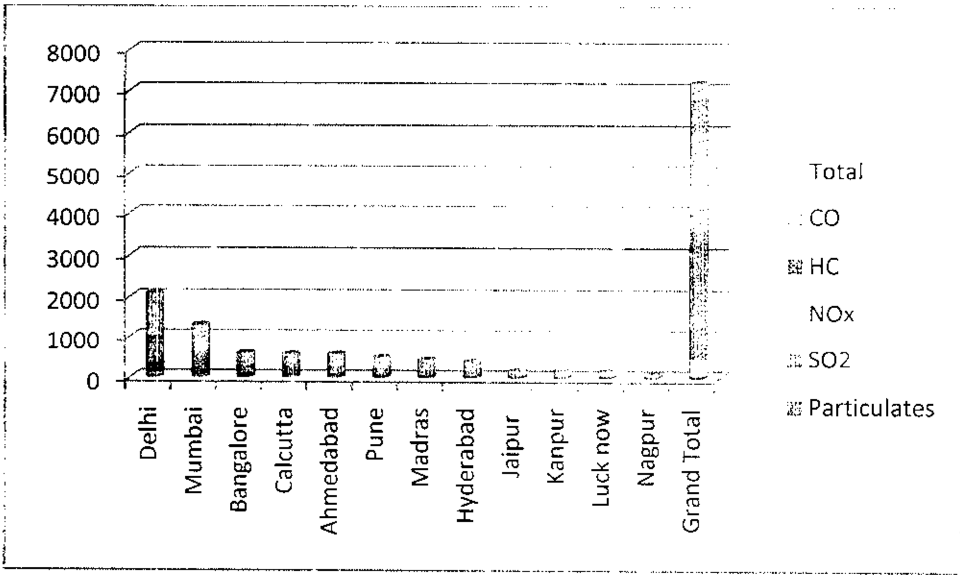
Vehicular pollution load (tonne per day)

Name of the city	Particulates	SO_2	NO_x	HC	CO	Total
Delhi	10.30	8.96	126.46	249.57	651.01	1046.30
Mumbai	5.59	4.03	70.82	108.21	469.92	659.57
Bangalore	2.62	1.76	26.22	78.51	195.36	304.47
Calcutta	3.25	3.65	54.69	43.88	188.24	293.71
Ahmedabad	2.95	2.89	40.00	67.95	179.14	292.73
Pune	2.39	1.28	16.20	73.20	162.24	255.31
Madras	2.34	2.02	28.21	50.56	143.22	226.25
Hyderabad	1.94	1.56	16.84	56.33	126.17	202.84
Jaipur	1.98	1.25	15.29	20.99	51.28	88.99
Kanpur	1.06	1.08	13.37	22.24	48.42	86.17
Luck now	1.14	0.95	9.68	22.50	49.22	83.49
Nagpur	0.55	0.41	5.10	16.32	34.99	57.37
Grand Total	35.31	29.84	422.88	809.96	2299.21	3597.20

Given the likely growth of the world vehicle fleet, the problems of global warming and urban air pollution will almost certainly need to be addressed by making a long-term shift away from oil as the universal energy source for transportation. But designing a new generation of resource-efficient, environmentally friendly vehicles is one of the most challenging technological problems facing the industrialized world. Most of the major automakers around the world are responding to this challenge and are actively developing more efficient conventionally fuel vehicles as well as so-called alternatively fuel vehicles. The latter are variously powered by fossil fuels (called hybrid vehicles), electric batteries, or hydrogen. In all cases, the vehicles have electric drives, meaning they are ultimately driven by electric motors.

FIGURE 1

Vehicular pollution load (tonne per day)



In a typical hybrid configuration, a small, clean, internal combustion engine or gas turbine generates electricity that can power the car directly through its motors or charge on-board batteries. In some designs, the gasoline (or other liquid hydrocarbon, such as methanol) is broken down into hydrogen and CO2 and the hydrogen is then used to power a fuel cell that produces electricity, which in turn powers the vehicle. Hybrid vehicles powered by fossil fuels are much more efficient than today's standard vehicle designs but still emit CO2. In this sense, they are not a long-term solution.

2.7 DIESEL ENGINE EMISSIONS:

The main concern with diesel engine emissions has always been smoke because it is clearly visible, particularly at high engine loads. In the past this smoke was considered to be undesirable because of aesthetics and odour but now there is growing concern about the health effects of this particulate matter when it is breathed into the lungs. The term particulates are used to describe the collection of small particles that make up smoke.

2.7.1The Source Of Emissions:

Exhaust emissions as they are known are just the by-products of combustion of a fuel. For every 1kg of fuel burnt, there is about 1.1kg of water (as vapour/steam) and 3.2kg of carbon dioxide produced. Unfortunately we don't have 100% combustion and so there is also a small amount of products of incomplete combustion and these are carbon monoxide (denoted CO), hydrocarbons (vaporised fuel) and soot or smoke (actually hydrocarbons in a different form). In addition, the high temperatures that occur in the combustion chamber promote an unwanted reaction between nitrogen and oxygen from the air. This result in various oxides of nitrogen, commonly called NO.

There are also several minor contributors to exhaust emissions which are burnt crankcase oil and sulphur from the fuel. Both of these components will show up mostly as particulates. Oil consumption is obviously a function of engine design and amount of wear but sulphur dioxide is formed from the sulphur in the fuel.

2.7.2 Measurement of Exhaust Emission:

The gaseous emissions are generally measured using electronic instruments but for field use Dragger tubes are used. These contain a chemical which changes colour by varying degrees when a particular gas is present. This is most commonly used in underground mines to ensure that engine emissions meet the Mines Department regulations. Any of the non gaseous emissions from a diesel exhaust are measured as smoke or particulates. This includes smoke, soot and sulphur dioxide. Smoke may be filtered out of the exhaust and weighed or the exhaust passed through an instrument such as a Bosch Smoke Meter that measures opacity ie the percentage of light transmittance. The units of measurement of emissions vary with the application and test procedure. Typical units are ppm, % volume, gm/kw hr, gm/km or gm/test.

Currently on road diesel emissions are not measured in Australia but in the future we may adopt regulations from overseas. While it is difficult to quantify the typical emissions from a diesel engine, using the current USA regulations for an approximation, 1kg of fuel would produce around 30gm of carbon monoxide, 3.5gm of hydrocarbons, and 1.7gm of particulates and 8gm of NOx. Total unwanted emissions which could be attributed to 'inefficient' combustion accounts for something less than 4% of fuel used. Note that this does not necessarily relate to wasted fuel because these components are the product of incomplete combustion and so have still released much of their energy content. As an aside, this shows that there is not much scope to improve fuel consumption through improved combustion alone.

2.8 NANO TECHNOLOGY:

Nanotechnology is an emerging field which is producing much attractive and long desired result. It exploitsdistinctive properties of tiny matter, whose size is less than 100 nm. Application of Nano materials in variousfields is a solid proof of its acceptance. Nanotechnology was first used to classify integrated manufacturingtechnologies and machine systems which provide ultraprecision machiningcapabilities in the order of 1 nm. Since then ultraprecision technologies have grownrapidly over recent years and have tremendous impact on the development of newproducts and materials. Nanotechnology is the target of ultraprecision machiningbecause the theoretical limit of accuracy in machining of substance must be the size ofan atom or molecule of the substance. With the advent of new materials,manufacturing is facing challenges in machining them to meet their functionalrequirements. As the demand moves from the micro technology (1μm accuracydemands rapid increase in stringency and complexity .Technical textile is one of the areas which is highly relying on Nanotechnologies.Textile is one of the most aggressive areas where Nanomaterials are applied and there is an increasingtrend in the consumption.

2.9 NANO FINISH:

The concept of Nano finish is not new it was started over 40 years ago. According to the National Nano Technology Institute, NNI, Nano technology is defined as the utilization of structures with at least one dimension at Nano mater size for the construction of materials, devices or systems with significantly improving properties due to their Nano size. Nano technology not only produces small structure, but also an anticipated manufacturing technology which can give through inexpensive control of the small structure of matter.Nano finish can best be described and activities at the level of atoms and that have applications in the real world. Nano particles in commercial products are in the range of 1-100nm.

Nano finish also has real commercial potential for the textile industry. This is mainly due to the facts that conventional methods used to import different properties to fabrics often don't lead to permanent effects, and will lose their functions after few laundering or wearing. Nano finished fabrics has greater durability because Nano particles have a surface area-to-volume ratio and high surface energy, thus presenting better affinity for fabrics and leading to an increase in durability of the function. In addition a coating if Nano particles on fabric will not affect their breathability or hand feel or harmful to skin.

The first work Nano technology in textiles was undertaken by Nano-Tex a subsidiary of the US based Wellington Industries, later more and more textile companies began to investing in the development of Nano technology

2.9.1 Titanium Di Oxide Nano Particle:

NanocrystallineTiO_2particles are of interest due to their unique capability) to the nanotechnology region (1 nm accuracy) the systems engineeringproperties and several potential technological applications. TiO_2exists in three polymorphic phases: rutile (tetragonal density = 4.25 g/cm^3), anatase (tetragonal, 3.894 g/cm^3) and brookite(orthorhombic, 4.12 g/cm^3). Both anatase and rutile have tetragonal crystal structures but belong to different space groups. Anatase has the space group $I4_1/amd$ with four formula units in one unit cell and rutile has the space group $P4_2/mnm$ with two TiO_2formula units in one unit cell. The low-density solid phases are less stable and undergo transition rutile in the solid state. The transformation is accelerated by heat treatment and occurs at temperatures between 450 and 1200^{0}C . This transformation is dependent on several parameters such as initial particle size, initial phase, dopant concentration, reaction atmosphere and annealing temperature, etc.

2.9.2 Methods To Synthesis Nano Particle:

There are 2 ways in synthesis of Nano phase materials they are Top down approach and Bottom up approach. Top down approach involving breaking down the bulk materials to Nano sizes (Eg. Mechanical alloying).Bottom up approach the Nano particles also made by building atom by atom (E.g. Inert gas condensation) .One of the trends in synthesis process is to pursue Nano scale emulsification through which finishes can be applied to textile materials in more through, even and precise manner. Finishes can be emulsified into nano-miciellesmade into Nano sols (or) wrapped in nano capsules, that can be adhere to textile substrates more evenly.

TiO_2Nanoparticles can be produced by a variety of techniques ranging from simple chemical to mechanical to vacuum methods, including many variants of physical and chemical vapor deposition techniques. Nanoparticles can be synthesized using various methods such as sulfate process, chloride process, impregnation, co precipitation, hydrothermal method, direct oxidation of $TiCl_4$, metal organic chemical vapor deposition method, etc. Sol-gel method is one of the most convenient ways to synthesize various metal oxides due to low cost, ease of fabrication and low processing temperatures. It is widely used to prepare $TiO_2$for films, particles or monoliths. In general, the sol gel process involves the transition of a system from

METHODLOGY

one of the most convenient ways to synthesize various metal oxides due to low cost, ease of fabrication and low processing temperatures. It is widely used to prepare $TiO_2$for films, particles or monoliths. In general, the sol gel process involves the transition of a system from a liquid "sol" (mostly colloidal) into a solid "gel" phase. The homogeneity of the gels depends on the solubility of reagents in the solvent, the sequence of addition of reactants, the temperature and the pH. The precursors normally used for the synthesis and doping of Nanoparticles are organic alkoxides, acetates or acetylacetonates as well as inorganic salts such as chlorides. Among the classes of solvents, alcohols are largely used but other solvents such as benzene may also be used for some alkoxides.

2.10 COTTON:

Cotton fiber is amazingly versatile, whether alone or blended, it outsells all other fibers combined. Cotton is a natural fiber that comes from the seedpod of the cotton plant and is used to make many fabric types at every price point. The fiber is hollow in the center and, under the microscope, resembles a twisted ribbon.The varies property of cotton are

- Absorbs up to 27 times its own weightin water
- Has a comfortable, soft hand
- Is easy to launder
- Takes dye easily, good colour retention
- Is durable and strong
- Conducts heat well
- Resists abrasion
- Resists pilling and moths
- Has little resiliency; prone to wrinkling
- Weakens from extended exposure tosunlight
- Is easy to handle and sew

CHAPTER – 3 METHODOLOGY

3.1 FABRIC PARTICULARS:

Fabric material: 100% cotton

Type of fabric: Light weight fabric

Fabric GSM: 104 GSM

Fabric colour: Grey

3.1.1 CONSTRUCTION DETAILS:

Weave: Plain weave

Ends/inch:100

Picks/inch:90

Warp count: 80^s

Weft count: 80^s

3.2 CHEMICAL PROCESS:

3.2.1 Desizing:

Desizing is the process of removing the size material from the warp yarns in woven fabrics.Desizing agents are selected on the basis of type of fabric,environmental friendliness, ease of removal, costconsiderations, effluent treatment, etc.Since enzymaticdesizing is economical and laboratory method,it is selected for the further process.

Procedure:

Chemical to water ratio: 2:100

Enzyme: Amylase

Chemicals used: Sodium Hydroxide, Sodium Carbonate

Temperature: 50^0C

Time: 20 minutes

The bath is prepared by mixing the chemicals and water in the above ratio.The beaker in placed on the heat bath. The sample to be desized in then dipped into the solution. The whole process is allowed to take place for 20minutes. Then the sample is taken out and subjected to water wash.

3.2.2 Preparation of Tio_2 Nano Particles:

3.2.2.1 Properties of $TiCl_4$:

Titanium tetrachloride or titanium (IV) chloride is the chemical compound with the formula TiCl4.Pure-Titanium Tetrachloride (TiCl4) is transparency & no-colored liquid, although Crude-TiCl4 before refining is slightly red-brown liquid. TiCl4 itself is not dangerous in inflammability& explosion, if, however, TiCl4 reacts with water, white smoke is generated, which is one of the special feature. TiCl4 is active against water, and generates hydrochloric acid (HCl).

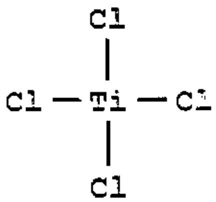


FIGURE-2 Space Full model of titanium tetrachloride

Molecular formula : TiCl4

Molar mass: 189.71g/mole

Appearance:Colourless fuming liquid

Density: 1.726gms/cm3

Melting point : 24.8^0C

Boiling point: 136.4^0C

Flash Point:46 °F

Solubility: Soluble in ethanol

Viscosity: 8.27*10^-4 Pascal

Brand name: Spectra 99.99%

3.2.2.2 Sol-Gel Method:

Chemicals used:Titanium tetrachloride, Glacial acetic acid, Ethanol

Temperature: Room temperature

Instruments used: Burette, Conical flask, Magnetic stirrer, Muffle furnace, Crucible

The titanium Nanoparticles were synthesized by drop wise addition of titanium tetrachloride: $TiCl_4$ (Fluka 98%) in ethanol (Pharmco 200 proof).50ml ml of glacial acetic acid was taken in the burette.30ml of TiCl4 was added to 60ml ethanol in conical flask.The conical flask is placed within ice cubes.Then glacial acetic acid is added in drops into ethanol for 6 hours. The chemical solution is stirrer for 6 hours using magnetic stirrer.The reaction was performed at room temperature. The large amount of chlorine and hydro chloride gases evolved in this reaction. The resulting yellow solution was allowed to rest and cool back to room temperature as the gas evolution ceased. The suspensions obtained were dried in an oven for several hours at 100^{o}C until amorphous and dried TiO_2 particles were obtained. The obtained powder samples were calcined for one hour in a muffle furnace of Volts 440, maximum temperature 1000^0Cand power 6KW at temperature ranging from 300 to 550 ^{o}C in an ambient atmosphere.

SOL-GEL PROCESS FLOW CHART:

500 ml beaker surrounded with ice cubes is placed on magnetic stirrer

⇓

60 ml of ethanol is taken in beaker

⇓

Add 30 ml of $TiCl_4$

⇓

60 ml of glacial acetic acid is added at regular intervals with the help of burette for 6 hours

⇓

The process is stirrer and continued for 6 hours at room temperature

⇓

Yellow solution obtained and heated at 100^0C for 1 hour

⇓

Heat the powder at 500^0C to obtain the Nano TiO_2

3.2.3 Fabric Coating Technique With Nano Titanium Di Oxide Particles:

There are various technique to coat Nano particle on the fabric. They are as follows:

- Thermal evaporation
- Hydrothermal
- Magnetron spattering
- Photovoltaic
- Galvanic cell
- Spin-coating
- CVD
- Foil titanium anoxide
- Electro deposition
- Electrophoresis
- Sol-gel
- Laser assisted aerosol
- Cold spray
- NPDS
- Flame spray pyrolysis(SnO_2& In_2O_3& TiO_2-WO_3)
- Microwave
- Electrostatic precipitation
- Scattering
- Plasma spray
- LBL Technology
- CDC Method
- Dip-coating

Above all, Sol-gel process is conventional and time efficient hence this process is carried out.

3.2.3.1 Coating TiO_2 Nano particles on cotton fabric:

The synthesized TiO_2 Nano particle is coated on cotton fabric using dispersion method via sonication. The bath is prepared in the ratio 1:100 of TiO_2 Nano particle to water. The prepared bath is kept inside the sonicator for sonication process for 10 Minutes.

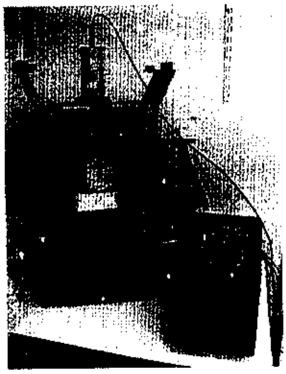
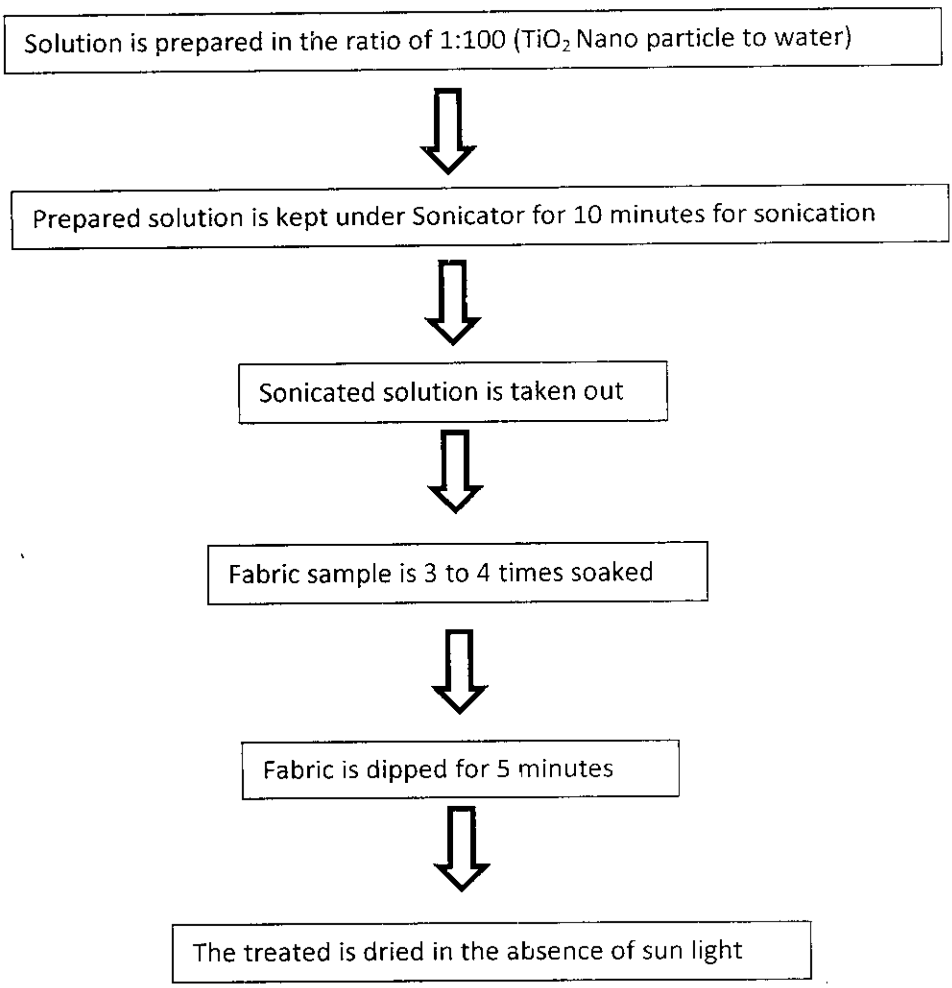


FIGURE-3 SONICATOR

FABRIC COATING FLOW PROCESS:



prepared sample is held in front of exhaust of the machine .The experiment is carried out at time interval of 5, 10 and 15 minutes. Weight of the sample before and after experiment is noted .Through the weight different of Nano finished and cotton fabric, efficiency of the Nano finished fabric is found out.

3.3.1.1 Type 1: Diesel Engine

Type:Vertical Engine

Make: Field Marshall

Number of Cylinder: Single

Number of Stroke: 4

Bore diameter of cylinder: 114.3mm

Stroke of Piston: 130mm

Rated RPM: 850

Rated BHP: 8

Type of loading: Rope brake dynamometer

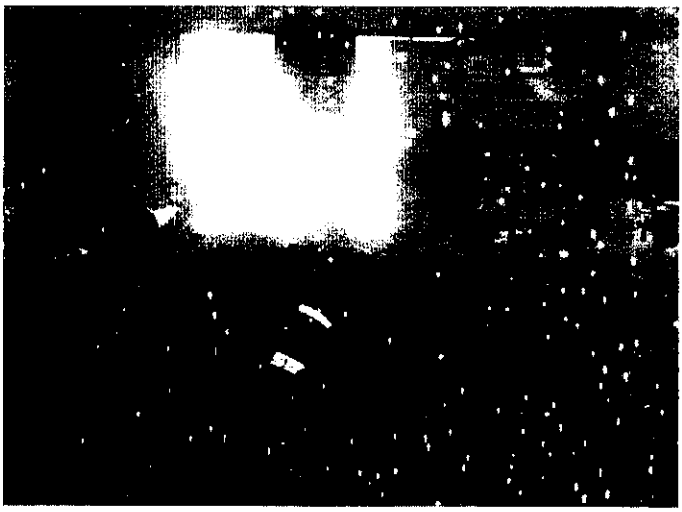


FIGURE – 4 DIESEL ENGINE

3.3.1.2 Type 2:Bio-Diesel Engine

Type	: Power Mag
Cooling	: Air
Load Measurement Method	: Strain Gauge
Max Speed	: 3000 Rev/M
Hp	: 5 Hp
Coupling Type	: Direct
Loading	: Auto Loading System
Make	: Kirloskar

No Of Cylinder	: Single
Cooling	: Water
Fuel	: Diesel
Speed	: 1450 – 1550 Rpm
Starting	: Crank
Lubrication	: Forced

3.3.2 Water VapourPermeability Test:

The water vapour permeability is an important property in the clothing systems. The human body cools itself by sweat production and evaporation during periods of high activity. The clothing must be able to remove this moisture in order to maintain comfort and reduce the degradation of thermal insulation caused by moisture build up.

Sample Preparation:

Eight samples of 11cm * 11cm are prepared from four each in Nano coated and pure cotton fabric.

Water vapor permeable cup (Method A-1)

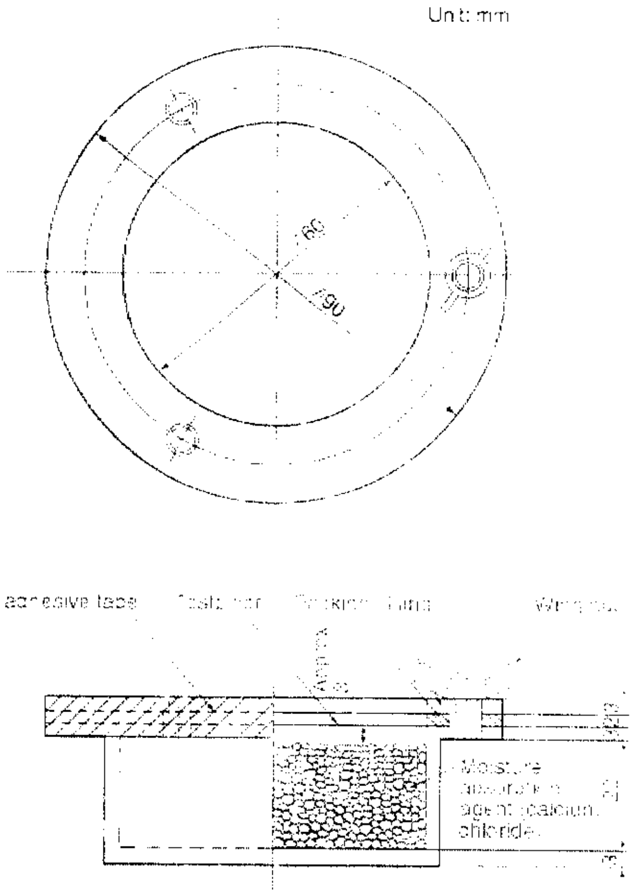


FIGURE-5 WATER PERMIABILITY

Procedure:

Take three circular testpieces, each measuring approximately 7cm in diameter, from the sample fabric to be tested. Pre-warm the water vapor permeable cup to approximately 40°c and fill with the moisture absorption agent until it is approximately 3mm from the top of the cup. Next place a testpiece with its front surface facing the moisture absorption agent and direct it so as to form a concentric circle with the water vapor permeable cup. Attach the packing and ring to the testpiece and fix with the wing nut. Then seal the packing/ring side with vinyl adhesive tape to prepare a test body. Put this test body in the thermo hygrostat in which air at 40±2°c. 90±5% RH circulates. After 1 hour, remove the test body and immediately measure its mass a1 (mg). Again put this test body in the thermo hygrostat, remove it after 1 hour, and measure the mass a2 (mg) immediately.

Calculate the water vapor permeability using the following formula.

$$P = \frac{10 \times (a1 - a2)}{S}$$

Where P = water vapor permeability (g/㎡ hr.)

S = water vapor permeable area (㎠)

Repeat the above procedure three times and take the average (up to the integer place) of the calculated values.

3.3.3 Air Permeability Test:

Air Permeability is the ability of a fabric to allow air to pass through it. While Air Permeable fabrics tend to have relatively high moisture vapor transmission, it is not necessary to be Air Permeable to be breathable.

APPARATUS REQUIRED:

- Air permeability tester,
- Vacuum cleaner,
- Fabric sample.

Test Procedures:

- The pilot test must be performed long enough to evacuate a minimum of 1.5 - 2 pore volume of air in order to gather sufficient and representative data. This typically can be accomplished within 8 to 12 hours of test operation. The tests need to be conducted for along enough period of time for the measured vacuums and extracted VOC concentrations to reach equilibrium conditions.
- Document the first representative sample of the extracted VOC vapours only after air in the vicinity of the extraction well(s), monitoring wells or probes has been purged. Initial extracted VOC concentrations observed are not indicative of equilibrium conditions (i.e., especially with the presence of free product) and tend to be higher than during system operation.
- Extraction well vacuum should be stepped (i.e., more than one vacuum should be applied at the test well). Sufficient steps should be performed in order to adequately establish the relationship between vacuum, air flow rates and the VOC mass removal rate. The highest vacuum step applied should be at the maximum capabilities of the air pump or blower used (without submerging the screened interval). Lower vacuum step tests should also be performed, because results from operating at the vacuum extremes helps to determine the vacuum required to obtain optimum mass removal rates.

- Changes in barometric pressure should be monitored at the beginning and end of each vacuum step (especially on windy days), in order to determine baseline shifts in apparent vacuum.
- Extraction well vacuum must be held constant at each step until vacuum measurements in all monitoring points have stabilized and reached equilibrium.
- Vacuum monitoring readings should be taken at wells and/or probes at nominal 15 minute intervals through each vacuum step. Air flow rates should be measured at the extraction well frequently throughout each vacuum step in order to document any increase or decrease in flow.
- Blowers/vacuum pumps need to have explosion proof motors, starters, and electrical systems.

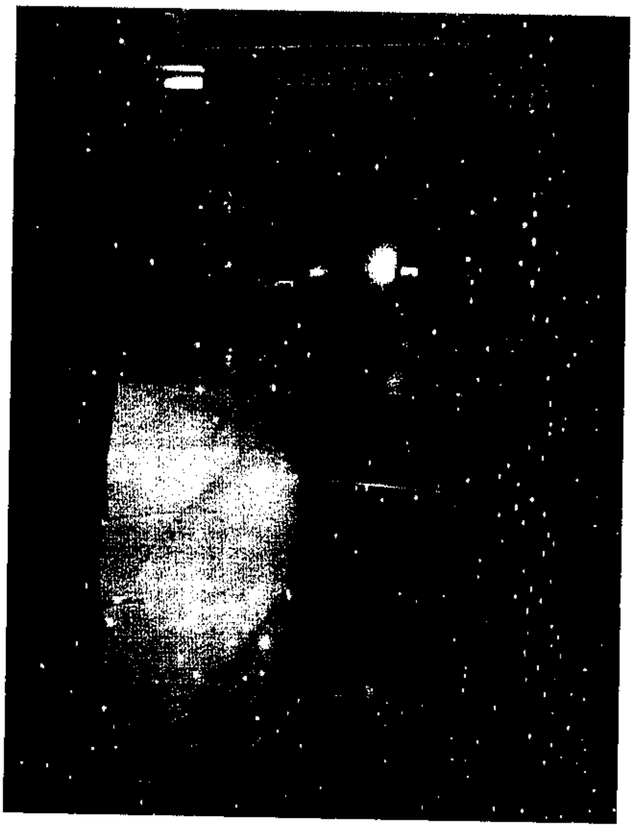


FIGURE-6 AIR PERMEABILITY

3.3.4STIFFNESS:

Stiffness is the resistance offered by a material to a face tending to bent it. Cantilever principle of working is used to determine the stiffness of fabrics stiffness is related with handle and drape of the fabric.

Sample Preparation:

A sample size of 6" X 1" is cut 10 samples in warp way and weft way direction.

Procedure:

- The tester is cut on a table, so that the horizontal platform and the index lines are at eye level.
- The specimen is placed in between the platform and the template so that the fabric and the zero mark of the template coincides with the datum line.
- Both template and fabric are slowly pushed forward.
- The fabric will tend to drop are the edge on its own weight.
- Both are moved forward until the tip of the fabrics cuts the index lines when viewed in the mirror.
- The bending length is measured from the scale. The bending rigidity, flexural rigidity and bending modules are calculated.

Flexural rigidity= w2xc^3x10^3 mg.cm

Where,

C= Bending length in cm

W1= Cloth weight in ounces per square yard

W2= cloth weight in grams per square cm

Overall flexural rigidity (G) = (G1+G2) ^1\2

Where,

G1 = flexural rigidity of warp

G2= flexural rigidity of weft

Bending modulus (Q) =(12Gx10^-6)\g2^3 kg\sq.cm

Where,

g1= Fabric thickness in thousands of an inch

g2 = Fabric thickness in cm

Drape is the ability of a fabric to assume a graceful appearance in use.Drapability of a fabric can be determined using the instrument.Drape meter and is expressed in terms of drape co-efficient.

SAMLE PREPARATION:

The sample is be prepared by cutting the specimen fabric to the desired size of 30 cm diameter to facilitate the fixing in the supporting disc by using a template designed as an accessory for the drape tester.

PROCEDURE:

- The transparent lid of drape tester is opened and the supporting disc is presses down to the platform and locked at the position is taken out by unsewing rushed net.
- The conditional specimen is then carefully transferred and placed over the bottom supporting disc.
- The top supporting discis then placed over the fabric and it made tight by securing on the knurled nut over the threaded stem of the supporting disc.
- Carefully Press the supporting disc by un-twisting anticlockwise.
- The supporting disc unit is released and allowed to rise by means of a compressed spring.
- This allows the edge of the fabric to drape freely under its own weight.
- The top level is now closed and sheet of paper size 30 cm x 35 cm is placed over it.
- The light is switched on .Draw the outline of the projected and area of the specimen.
- Drapability is calculated using the formula

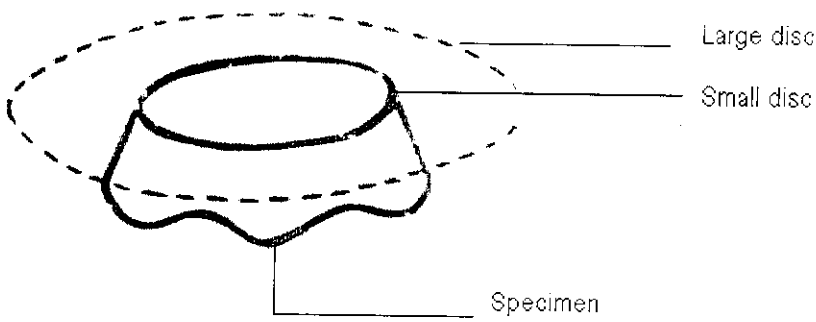


FIGURE-7 DRAPABILITY TEST

Drape co-efficient% = $(W_s - W_d) / (W_D - W_d) \times 100$

Where,

Ws- Weight of the paper whose area is equal to the projected area of the specimen

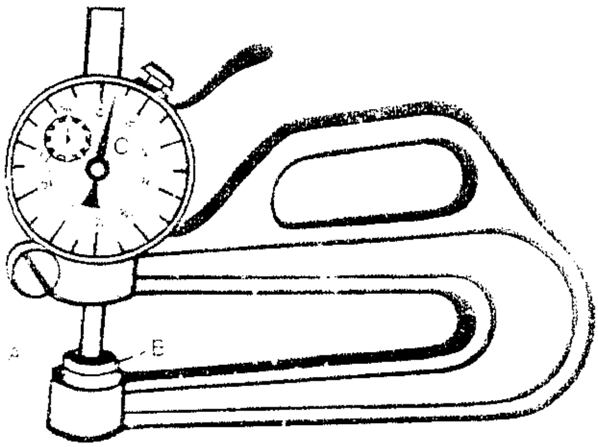
Wd-Weight of the paper whose area is equal to the area of the specimen.

W_D - Weight of the specimen or large disc.

3.3.6 FABRIC THICKNESS TEST:

Sample Preparation:

Take a sample of fabric measuring 6" x 6" avoiding the selvedge of the fabric.



A- Anvil B Presser C – Pointer

FIGURE-8 THICKNESS METER

Procedure:

1. Clean the circular pressure foot and the anvil (base plate)
2. Set the gauge dial to zero
3. Keep the sample below the presser foot without wrinkles.
4. The presser foot is lowered on to the sample slowly at a uniform rate.
5. The thickness of the fabric is noted from the dial then the movement of the pointer has stopped.
6. Repeat the process taking 5 readings at different points of the sample and find out the average thickness of the fabric.

3.3.7THERMAL CONDUCTIVITY TESTS:

Thermal conductivity is the quantity of heat conducted per second normally across unit area of cross section of the material per unit temperature difference. It denotes the heat conducting power. Its unit is Watts/meter/Kelvin

Sample Preparation:

Four samples of Nano coated and pure cotton of 11cm*11cm is prepared for testing.

Procedure:

The Lees disc set up is arranged as shown in fig. Steam is passed through the chamber. As heat gets conducted into the brass disc through the bad conductor, it gets heated up. The temperature is noted from time to time. At one stage the temperature becomes steady. When the temperature becomes steady for at least 10 minutes the steady temperature is noted ($\theta_2{}^0$C)

The temperature of steam is noted ($\theta_1{}^0$C). Now the cardboard is removed and the brass disc is heated in direct contact with the steam chamber until the temperature rises by about 5^0C above the steady temperature.

The disc is now separately suspended from the ring after removing from the steam chamber. Temperatures are noted in steps of 30secs from $(\theta_2+5)^0$C to $(\theta_2-5)\ ^0$C and the values are tabulated (Table) . A graph is drawn with temperature on the Y axis and the time on the X axis.

A horizontal line is drawn corresponding to steady temperature $\theta_2{}^0$C . The time dt for a fall of temperature of $\theta_2{}^0$C is found by taking two points one degree above 2 and the other one degree below.

Note down the mass (M) of the brass disc B as noted over it or determine its mass using balance. Its diameter is found and hence the radius (r) is determined using verniercalipers.The thickness (l) of the brass disc is found using verniercalipers and thickness of the bad conductor (d) with a screw gauge.

3.3.8 SEM (SCANING ELECTRO MICROSCOPE):

A type of electron microscope, designed for directly studying the surfaces of solid objects that utilizes a beam of focused electrons of relatively low energy as an electron probe that is scanned in a regular manner over the specimen. The electron source adelectromagnetic lenses that generate and focus the beam are similar to those described for the transmission (TEM). The action of the electron beam stimulates emission of high-energy backscattered electrons and low-energy secondary electrons from the surface of the specimen.

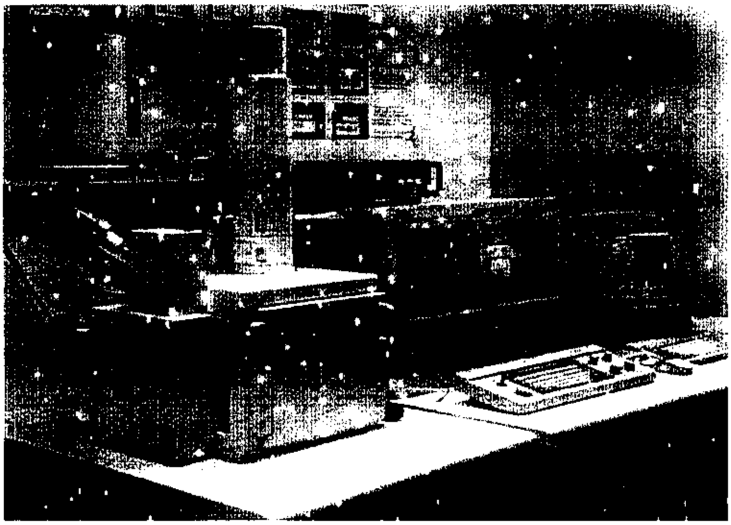


FIGURE- 9 SEM TEST

No elaborate specimen-preparation techniques are required for examination in the SEM, and large and bulky specimens may be accommodated. It is desirable that the specimen be rendered electrically conducting; otherwise, a sharp picture will not be obtained. Conductivity is usually achieved by evaporating a film of metal, such as gold, 50–100 angstroms thick onto the specimen in a vacuum (such a thickness does not materially affect the resolution of the surface details). If, however, the SEM can be operated at 1–3 kilovolts of energy, then even nonconducting specimens may be examined without the need for a metallic coating.

Scanning instruments have been combined with TEMs to create scanning transmission electron microscopes. These have the advantages that very thick sections may be studied without chromatic aberration limitation and electronic methods may be used to enhance the contrast and brightness of the image.

3.3.9 X-Ray Powder Difraction:

X-ray powder diffraction (XRD) is a rapid analytical technique primarily used for phase identification of a crystalline material and can provide information on unit cell dimensions. The analyzed material is finely ground, homogenized, and average bulk composition is determined.

X-ray diffraction is based on constructive interference of monochromatic X-rays and a crystalline sample. These X-rays are generated by a cathode ray tube, filtered to produce monochromatic radiation, collimated to concentrate, and directed toward the sample. The interaction of the incident rays with the sample produces constructive interference (and a wavelength of electromagnetic radiation to the diffraction angle and the lattice spacing in a crystalline sample. These diffracted X-rays are then detected, processed and counted. By scanning the sample through a range of 2θangles, all possible diffraction directions of the lattice should be attained due to the random orientation of the powdered material. Conversion of the diffraction peaks to d-spacing allows identification of the mineral because each mineral has a set of unique d-spacing. Typically, this is achieved by comparison of d-spacing with standard reference patterns.

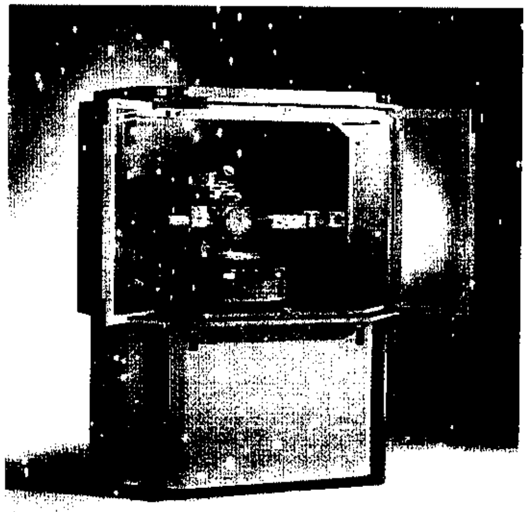


FIGURE-10 XRD TEST

All diffraction methods are based on generation of X-rays in an X-ray tube. These X-rays are directed at the sample, and the diffracted rays are collected. A key component of all diffraction is the angle between the incident and diffracted rays. Powder and single crystal diffraction vary in instrumentation beyond this.

RESULTS AND DISCUSSION

CHAPTER – 4RESULTS AND DISCUSSION

4.1 FABRIC PARTICULARS:

Ends/ inch =100

Picks/inch =90

Warp count =80^s

Weft count =80^s

Warp cover factor = 10.062

Weft cover factor =11.180

4.2 CARBON ADSORBTION TEST

4.2.1CARBON ADSORBTION TEST FROM DIESEL ENGINE:

The table shows the weight difference of the cotton fabric before and after the test for the duration of 5, 10 and 15 minutes.

TABLE-5

WEIGHT OF THE COTTON FABRIC

SAMPLE NO	TIME DURATION (Mins)	BEFORE TESTING (g)	AFTER TESTING (g)
1.	5	0.63	0.64
2.	10	0.61	0.62
3.	15	0.62	0.63

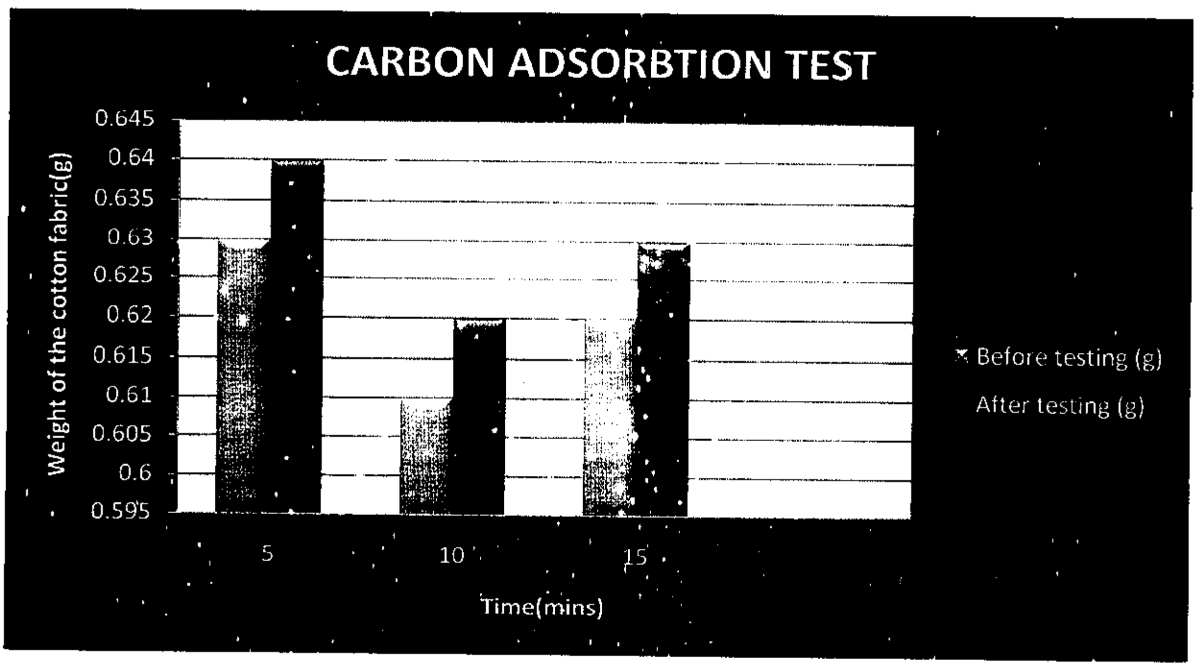


FIGURE-11CARBON ADSORBTION TEST –COTTON FABRIC

The table shows the weight difference of Nano coated cotton fabric before and after the test for the duration of 5, 10 and 15 minutes.

TABLE-6

WEIGHT OF THE NANO FINISHED COTTON FABRIC

SAMPLE NO	TIME DURATION (Mins)	BEFORE TESTING (g)	AFTER TESTING (g)
1.	5	0.70	0.72
2.	10	0.72	0.75
3.	15	0.71	0.75

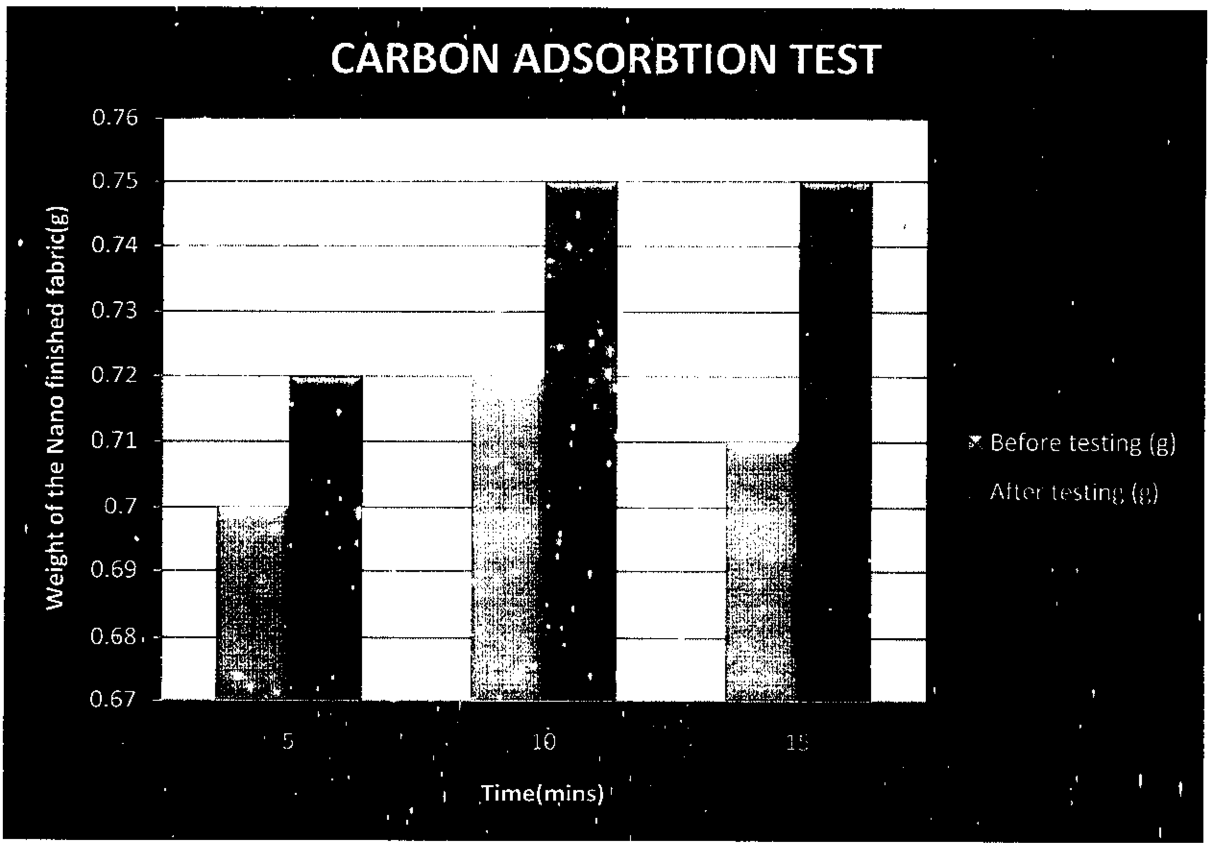


FIGURE 12CARBON ADSORBTION TEST – NANO FINISHED COTTON FABRIC

4.2.2 CARBON ADSORBTION TEST FROM BIO-DIESEL ENGINE:

The table shows the weight difference of the cotton fabric before and after the test for the duration of 5, 10 and 15 minutes

TABLE-7

WEIGHT OF THE COTTON FABRIC

SAMPLE NO	TIME DURATION (mins)	BEFORE TESTING (g)	AFTER TESTING (g)
1.	5	0.62	0.64
2.	10	0.60	0.62
3.	15	0.63	0.65

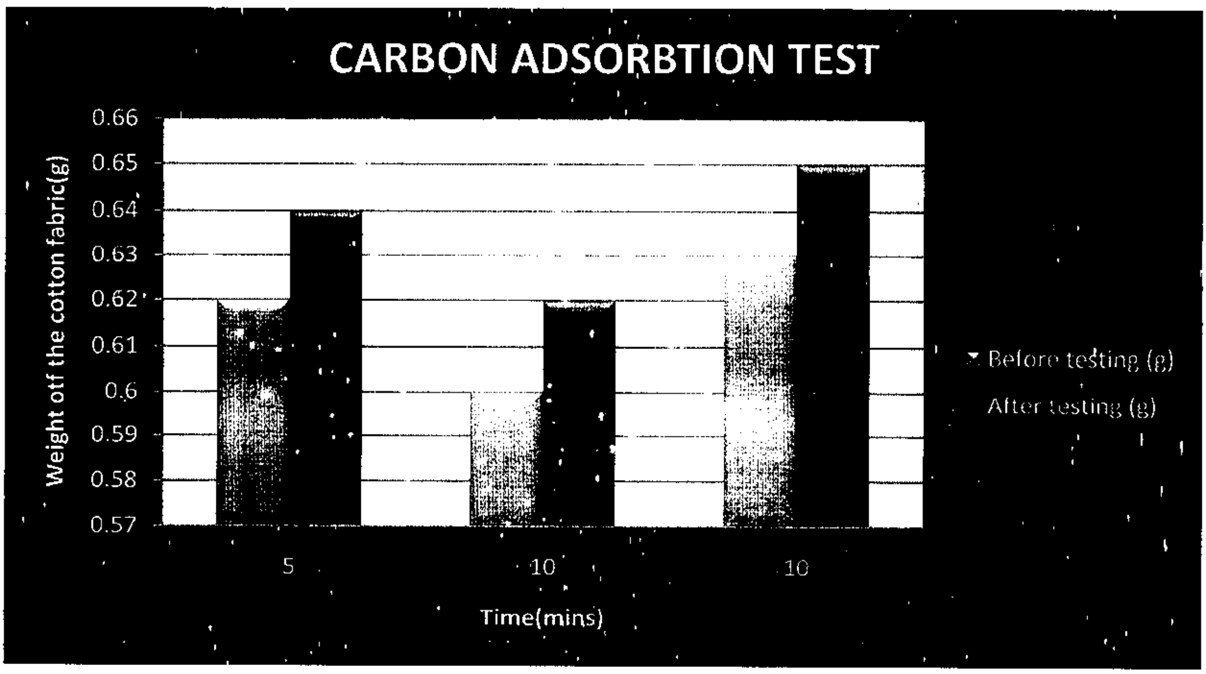


FIGURE-13CARBON ADSORBTION TEST- COTTON FABRIC

The table shows the weight difference of Nano coated cotton fabric before and after the test for the duration of 5, 10 and 15 minutes.

TABLE-8

WEIGHT OF THE NANO FINISHED COTTON FABRIC

SAMPLE NO	TIME DURATION (mins)	BEFORE TESTING (g)	AFTER TESTING (g)
1.	5	0.64	0.68
2.	10	0.64	0.70
3.	15	0.65	0.72

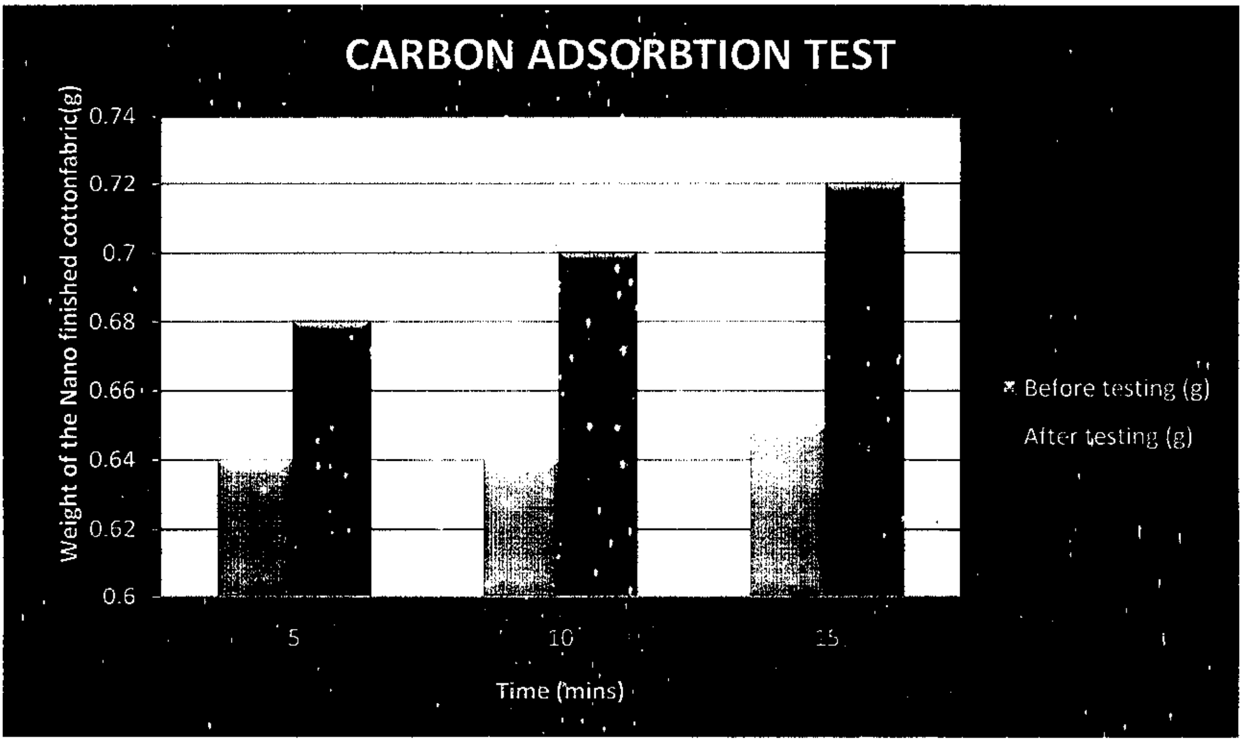


FIGURE-14CARBON ADSORBTION TEST-NANO FINISHED COTTON FABRIC

From the above abservation it is clear that weight difference of Nano coated fabric before and after the test is greater when compaired to the pure cotton fabric.

4.3WATERVAPOUR PERMIABILITY TEST:

TABLE 9

SAMPLE NO	UNTREATED COTTTON (gm/m^2/day)	NANO FINISHED COTTON (gm/m^2/day)
1.	3156.36	3089.83
2.	3178.53	3193.32
3.	3185.93	3089.83
4.	3156.36	3333.76
Avg	3156.29	3176.69

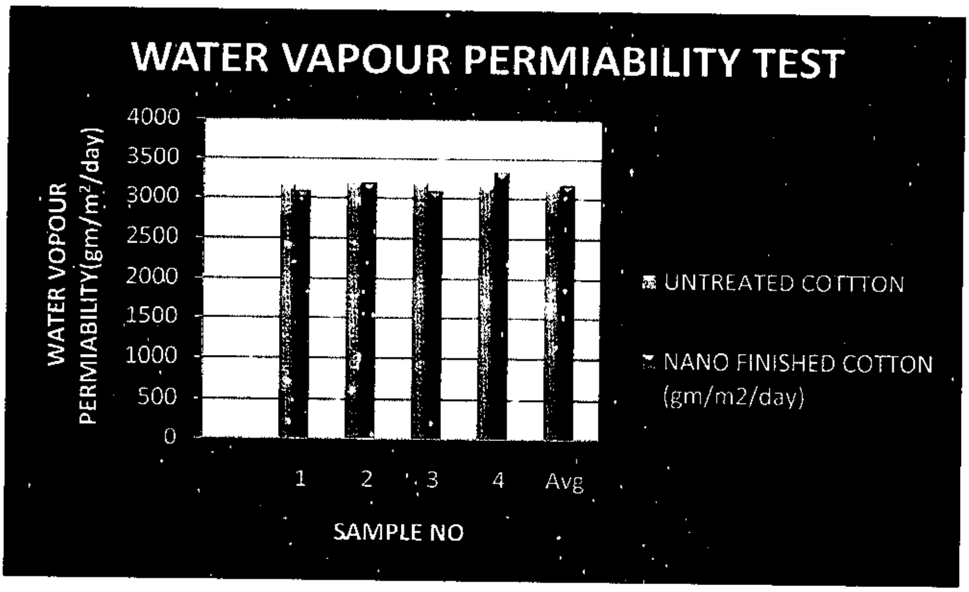


FIGURE 15 WATER VWPOUR PERMIABILITY TEST FOR UNTREATED COTTON AND NANO FINISHED COTTON

4.4AIR PERMIABILITY TEST

The table shows the air permeability of untreated and Nano coated fabric.

TABLE 10

SAMPLE NO	UNTREATED COTTON (cm^3/sec)	NANO FINISHED COTTON (cm^3/sec)
1.	0.0077	0.0073
2.	0.0077	0.0077
3.	0.0074	0.0073
Avg	0.0076	0.0074

FORMULA:

Air permeability= (Knob1+Knob2+Knob3)*10/(1000*3600) cm^3/Sec

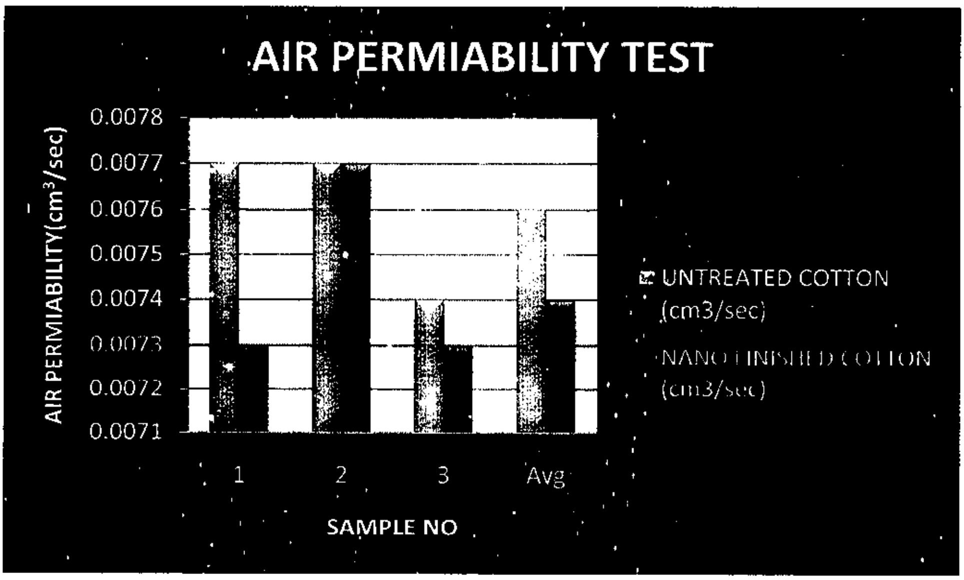


FIGURE 16 AIR PERMIABILITY TEST FOR UNTREATED COTTON AND NANOFINISHED COTTON

The difference of air permeability of untreated and Nano coated fabric is minute; hence the Nano finish does not alter the property of air permeability.

4.5 FABRIC STIFFNESS TEST:

The table shows the stiffness of the pure cotton and Nano finished cotton fabric.

TABLE-11

SAMPLE NO	UNTREATED COTTON FABRIC		NANO FINISHED COTTON FABRIC	
	Warp (cm)	Weft(cm)	Warp(cm)	Weft(cm)
1	1.95	1.75	2.10	1.80
2	1.95	1.80	2.15	1.75
3	2.05	1.85	2.00	1.85
4	2.05	1.85	2.15	1.80
Avg	2.015	1.82	2.10	1.80

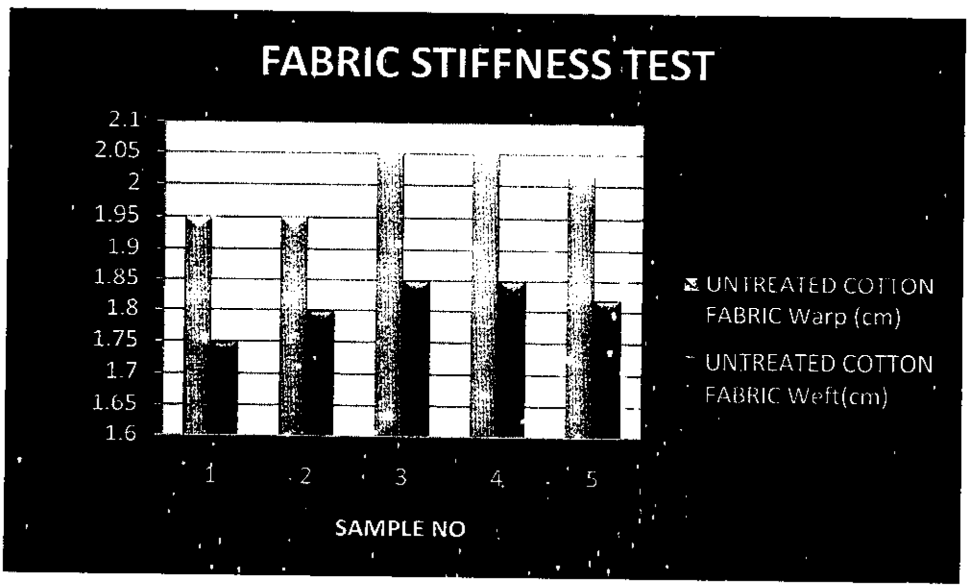


FIGURE 17 FABRIC STIFFNES TEST FOR UNTREATED COTTON FABRIC

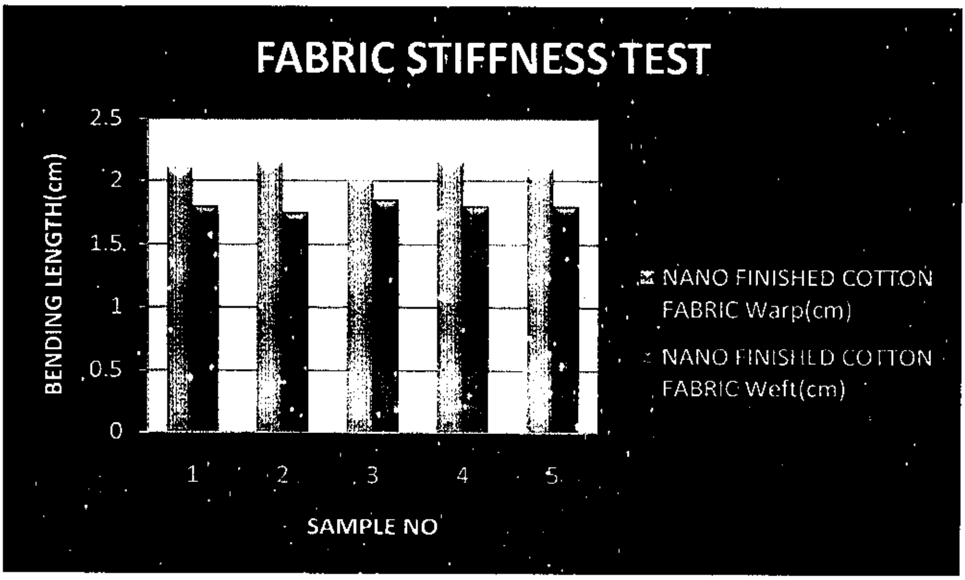


FIGURE 18 FABRIC STIFFNESS TEST FOR NANO FINISHED COTTON FABRIC

The stiffness of the Nano finished cotton fabric is more when compared to the untreated cotton fabric in warp way .The stiffness of the untreated and Nano finished cotton fabric in weft way is same.

4.6FABRIC DRAPABILITY:

The table shows the drapability of Nano finished and pure cotton fabric.

Small disc weight=2.158g

Large disc weight=5.914g

TABLE 12

SAMPLE NO	PURE COTTON (g)	NANO FINISHED COTTON (g)
1	5.064	5.250
2	5.154	5.750
3	5.125	5.512
Avg	5.114	5.504

Drape=W_s-W_d/W_D-Wd

W_s=Weight of projected area of specimen on drape meter.

W_d=Weight of small supporting disc.

W_D=Weight of specimen or large disc.

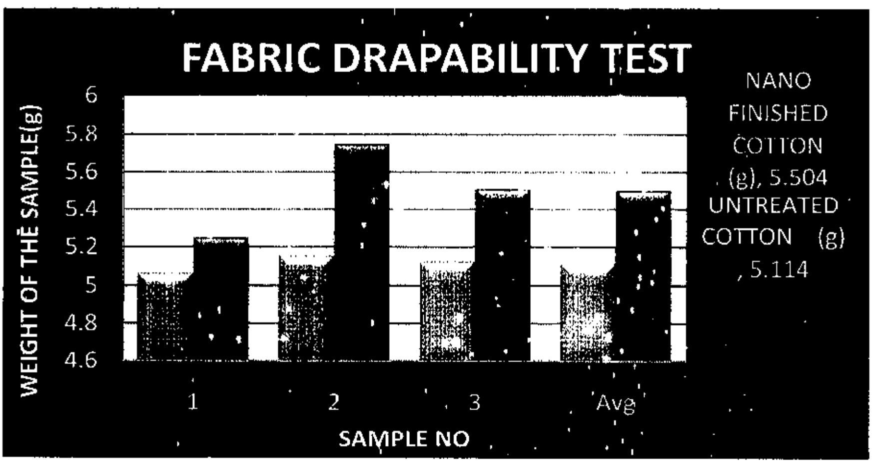


FIGURE 19 FABRIC DRAPABILITY TEST FOR UNTREATED COTTON AND NANO FINISHED COTTON

The drape test results indicate a slight decrement in the drapability of the Nano finished cotton.

4.7THICKNESS OF THE FABRIC:

The table shows the thickness of cotton and Nano finished fabric

TABLE – 13

Sl.No	Sample 1(Cotton fabric) cm	Sample 2(Nano finished) cm
1.	0.026	0.027
2.	0.027	0.026
3.	0.025	0.028
4.	0.026	0.026
5.	0.027	0.025
Avg	0.0262	0.0264

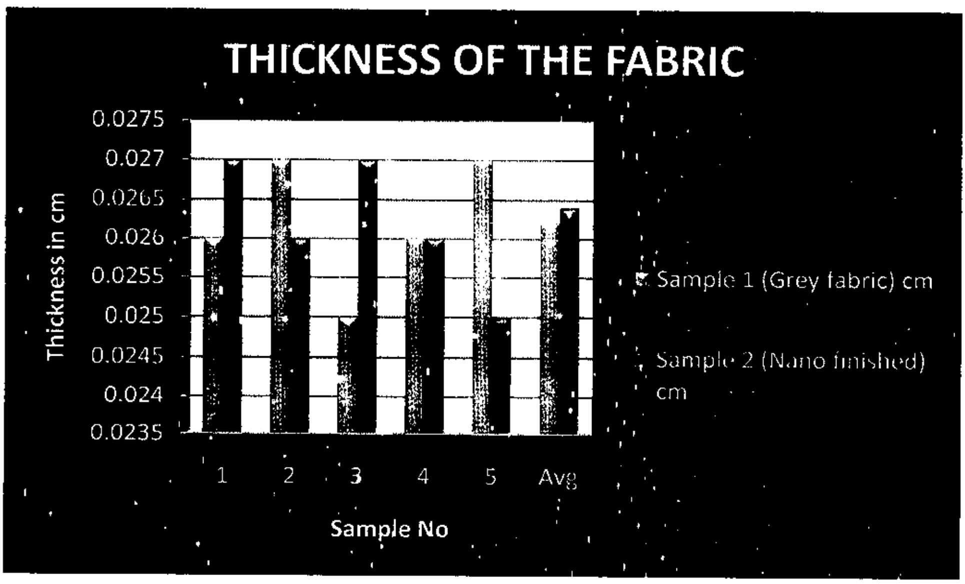


FIGURE 20 THICKNESS OF COTTON AND NANO FINISHED COTTON FABRIC

From the above observation it is clear that difference in the thickness of the cotton and Nano finished fabric is not varied greatly.

4.8THERMAL CONDUCTIVITY TEST:

The table shows the thermal conductivity of untreated and Nano coated fabric.

TABLE 14

Sl.No	Temperature ^0C		Time in Secs	
	Cotton	Nano finished	Cotton	Nano finished
1	96	93	0	0
2	95	92	25	20
3	94	91	55	50
4	93	90	82	76
5	92	89	110	102
6	91	88	140	130
7	90	87	170	162
8	89	86	200	184
9	88	85	232	220
10	87	84	256	252
11	86	83	283	280

Thermal conductivity of untreated fabric = 0.0254Watt/Meter/Kelvin

Thermal conductivity of nano coated fabric = 0.0146Watt/Meter/Kelvin

Thermal conductivity of Nano coated fabric is less when compared to untreated fabric, hence Nano coated fabric has good thermal resistance.

4.9SEM RESULT

4.9.1SEM RESULT OF COTTON FABRIC:

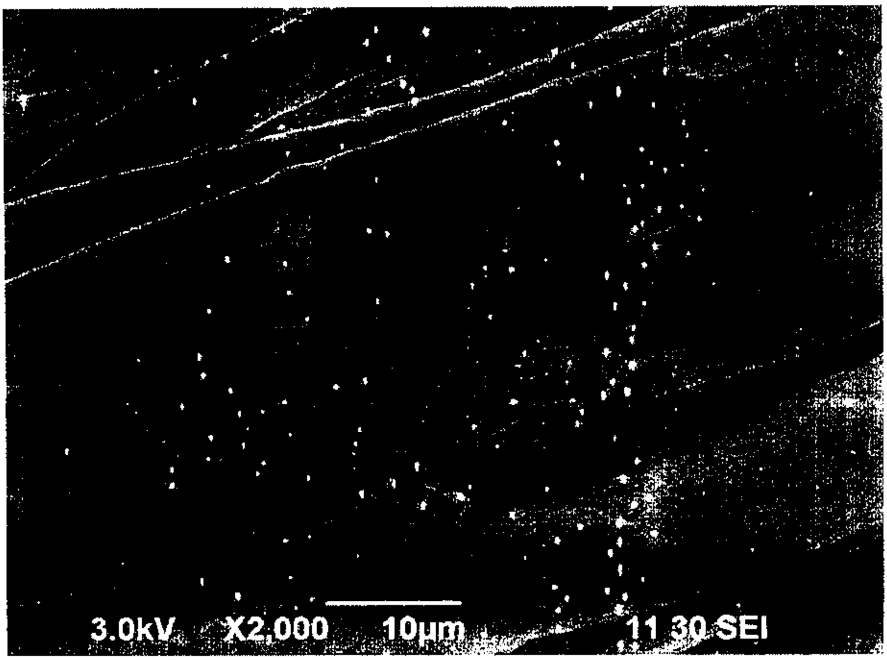


FIGURE – 21 SEM RESULT FOR UNTREATED COTTON FABRIC YARN

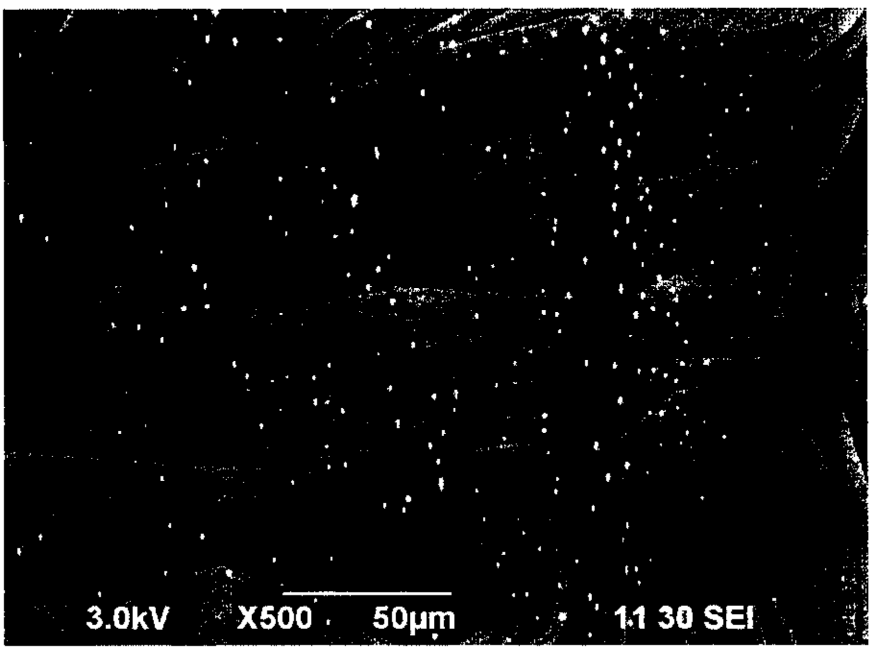


FIGURE – 22 SEM RESULTSHOWING YARN TWIST

4.9.2SEM RESULT NANO COATED FABRIC:

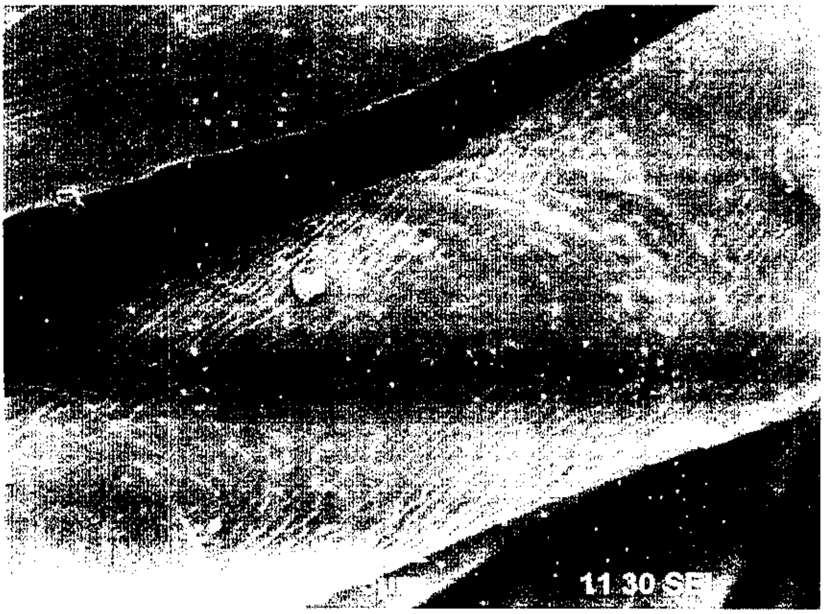


FIGURE-23 SEM RESULT OF NANO COATED FABRIC FIBRE

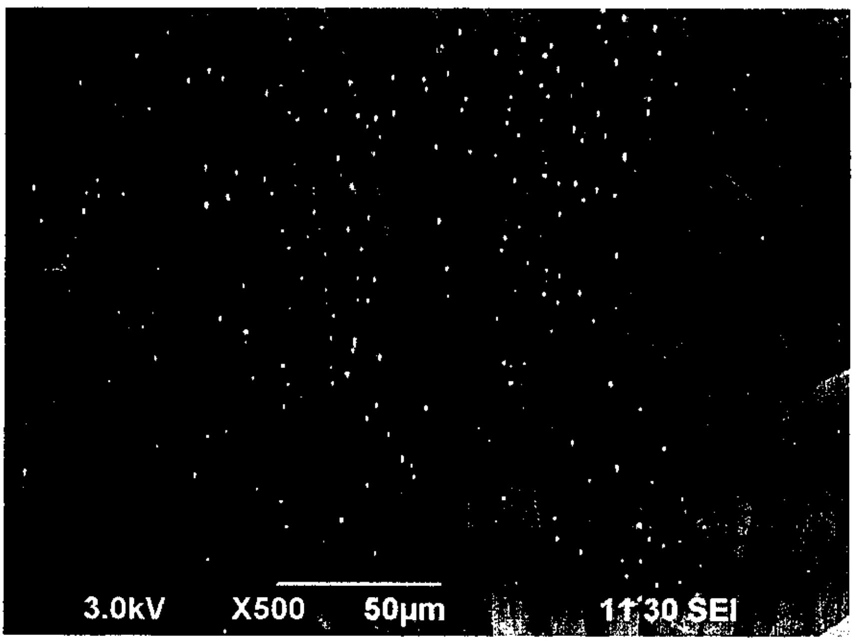


FIGURE – 24 SEM RESULT SHOWING OF NANO COATED YARN TWIST

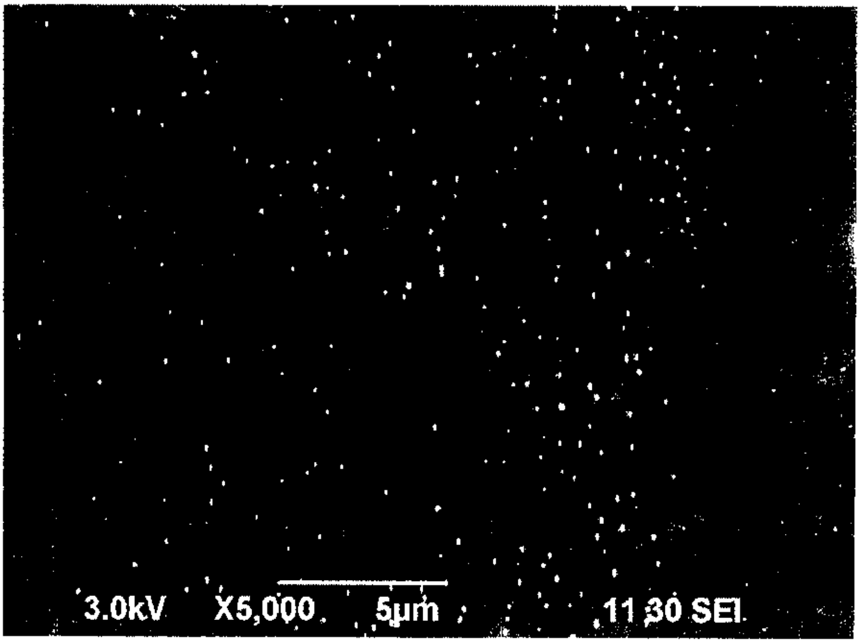


FIGURE- 25 SEM RESULT OF NANO COATED FABRIC YARN

4.10 OVERALL FABRIC TEST RESULTS:

TABLE-15

Sl.No	PARTICULARS	UNTREATED COTTON FABRIC	NANO FINISHED COTTON FABRIC
1.	ENDS PER INCH	90	90
2.	PICKS PER INCH	100	100
3.	WARP COVER FACTOR	10.062	10.062
4.	WEFT COVER FACTOR	11.180	11.180
5.	CLOTH COVER FACTOR	17.225	17.225
6.	DRAPE	77.36%	88.96%
7.	FABRIC STIFFNESS (over all flexural rigidity)	63.40mg/cm	65.50mg/cm
8.	AIR PERMIABILITY TEST	0.0076cm^3/sec	0.0074cm^3/sec
9.	WATER VAPOUR PERMIABILITY TEST	3156.29gm/m^2/day	3176.6929gm/m^2/day
10.	THERMAL CONDUCTIVITY TEST	0.0254watts/m/k	0.0146 watts/m/k

CONCLUSION

CHAPTER -5 CONCLUSION

The developed Nano coated cotton fabric has been tested for the carbon adsorption as a fiter medium. When compared to unfinished fabric, Nano coated cotton fabric shows good result, hence Nano coated cotton fabric can be used as a filters in the vehicle exhaust, carbon di oxide and carbon monoxide will be adsorbed on the surface hence reduces the carbon emission into atmosphere and filters can be cleaned and reused. The filter can also be used in air filters of vehicles. It will filtercarbon di oxide from the atmosphere of inlet air which in need leads to pure air entering into the vehicle. Thus performance of fuel is improved hence fuel utilization is reduce which leads to reduced carbon emission from the exhaust. Use of filters in the inlet and exhaust will greatly help to reduce the carbon emission into atmosphere and also effective utilization of fuel. Nano coated fabric shows good thermal resistant property when compared to unfinished cotton fabric, hence Nano finished fabric can also be used in related application. Nano finish on the fabric doesn't alter the thickness, stiffness, air permeability and water vapor permeability properties. The further study has to be carried out to make effective use of the Nano coated fabric

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CHAPTER – 6 REFERENCE

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    a.Fabrics for UV-Protection

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4. 2Department of Chemistry, SüleymanDemirel University, Isparta 32260, Turkey
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KCT/TiFAC/SSO/12 Date: 09.04.12

To

C. Pushpa (08BFT23),
B. Tech - Fashion Technology,
Kumaraguru College of Technology,
Coimbatore - 641 049

Ref: Your Letter dated 03.04.12

With reference to the above, we have tested your sample for Water Vapour Permeability and the report is as follows,

Sample No.	Water Vapour Permeability (gm/m^2/day)	Average
1.	3156.36	3156.29
	3178.53	
	3185.93	
	3156.36	
2.	3089.83	3176.69
	3193.32	
	3089.83	
	3333.76	

SAMPLE 1 - UNTREATED COTTON
SAMPLE 2 - TREATED COTTON

K. Gopinath
Senior Scientific Officer
KCT - TIFAC CORE

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