SYNOPSIS (SUMMARY) OF THE THESIS

A Study on Needle punched and Spun bonded Nonwoven and their Environmental Acceptability

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INTRODUCTION

An average person is unlikely to be familiar with the term *Nonwovens* and a few decades back there were no experts in this field. When the consumer hears the term Nonwovens it makes him think of something, which is not like traditional woven fabrics, something modern, advanced, hygienic. Nonwovens fabrics are different than the conventional textile fabrics and paper. Nonwovens are not based on yarns and (with frequent exceptions) do not contain yarns. They are based on webs of individual fibers. Nonwovens are different than paper in that nonwovens usually consist entirely or at least contain a sizeable proportion of long fibers and/or they are bonded intermittently along the length of the fibers. Although paper consists of fiber webs, the fibers are bonded to each other so completely that the entire sheet comprises one unit (**DAHIYA, KAMATH, HEGDE).**

Nonwovens are broadly defined as sheet or web structures bonded together by entangling fibre or filaments mechanically, thermally or chemically. Nonwoven fabrics are flat, flexible, porous sheet structures that are produced by interlocking layers or networks of fibres, filaments, or film-like filamentary structures **(Pal, 2009).**

1.5 FIBERS FOR NONWOVEN INDUSTRY:-

Raw materials used in nonwoven industry vary greatly, covering the entire spectrum from synthetic to natural fibres. Man-made fibres are completely dominate nonwovens production, accounting for over 90% of total output. Man-made fibres fall into three classes, those made from natural polymers, those made from synthetic polymers and those made from inorganic materials. The world usage of fibres in nonwoven production is:

Polypropylene 63%

Polyester 23%

Viscose rayon 8%

Acrylic 2%

Polyamide 1.5%

Other speciality fibres 3% **(Russell, 2007).**

Polypropylene (PP) is one of the most successful commodity fibres. PP fibres belong to the newest generation of manufactured chemical fibres after polyester, polyamides and acrylics. Poly-olefins [Low density polyethylene (LDPE), High density polyethylene (HDPE), Polypropylene (PP)] are a major type of thermoplastic used throughout the world for applications like bags, toys, containers, pipes (LDPE), house wares, industrial wrappings etc. Poly-olefins are high molecular weight polymers, unable to enter the body of micro organisms easily and hence are not easily biodegradable. Their basic structure comprises of carbon and hydrogen, due to which they are usually inert. Their hydrophobic nature prevents the growth of microorganisms on them thereby inhibiting the enzymatic action of microorganisms. The large accumulation of these thermoplastic materials in the environment is an issue of increasing concern from the point of view of environmental safety **(Vishvanath, 2010).**

1.5.1Polypropylene and its properties:-

Stereo regular polypropylene (PP) was discovered in the early 1950s by Giulio Natta. Polypropylene's repeating unit is-[CH2-CH (CH3)] n-. It is a thermoplastic polymer obtained by the polymerization of propylene in the presence of a catalyst under controlled heat and pressure. The molecular configuration of PP can be altered to give three types of PP depending on the catalyst and the polymerization method used namely atactic, isotactic, and syndiotactic configurations.

PP has attracted much attention because of the superior properties that it offers at low to moderate costs. These advantages include:

1) High toughness
2) High strength to weight ratio
3) Lighter weight
4) Corrosion resistance
5) Chemical resistance.

Due to easy process ability PP has replaced conventional materials like wood, metal and glass as an efficient as well as cost effective material for the manufacture of articles with various colours, complicated shapes, and designs (**Vishvanath, 2010**).

Thus there is an increasing need to develop degradation methods of the available samples.

1.6 NONWOVENS PRODUCTION:

Nonwovens production begins with the arrangement of fibres in a sheet or web. The fibres can be staple fibres, or filaments. A nonwoven product is essentially characterized by four influencing factors:

1. Fibre: the building block
2. Web formation: the fibre arrangement (Dry laid, Spun melt, Wet laid, Other technologies) (**Pal, 2009**).
3. Web bonding: the cohesion of fibres (Chemical, Thermal and Mechanical)
4. Web finishing: the additional chemical or mechanical treatments (**Waltz, 1994).**

1.7 CLASSIFICATION:

Generally nonwovens into three major areas- dry laid, wet laid, and polymer-laid (encompassing the spun melt technologies of spun bond, melt blown and flash spun), it can be said that dry laid materials have their origin in textiles, wet laid materials in papermaking and polymer-laid products in polymer extrusion and plastics.

1.7.1 DRYLAID NONWOVENS:

In dry laid web formation, fibres are carded or aerodynamically formed and then bonded by mechanical, chemical or thermal methods. These methods are needle punching, hydro entanglement, stitch bonding (mechanical), thermal bonding and chemical bonding.

1.7.2 WETLAID NONWOVENS:

Paper-like nonwovens fabrics are manufactured with machinery designed to manipulate short fibres suspended in liquid and are referred as 'wet laid'.

1.7.3 POLYMER-LAID NONWOVENS:

Polymer-laid or 'spun melt' nonwovens including spun bond (spun laid), melt blown, flash-spun, aperture films as well as layered composites of these materials, are manufactured with machinery developed from polymer extrusion. In a basic spun bonding system, sheets of synthetic filaments are extruded from molten polymer onto a moving conveyor as a randomly oriented web in the closest approximation to a continuous polymer-to-fabric operation.

1.8 WEB FORMATION:

In all web formation processes, fibres or filaments are either deposited onto a forming surface to form a web or are condensed into a web and fed to a conveyor surface. The condition at this stage can be dry, wet or molten-dry laid, wet laid or polymer-laid. Web formation involves converting staple fibres or filaments into a two- dimensional web or three dimensional web assembly, which is the precursor for the final fabric. Their structure and composition strongly influences the dimension, structure and properties of the final fabric.

1.9 WEB BONDING:

Nonwoven bonding processes can be mechanical, chemical or thermal. The degree of bonding is a primary factor in determining fabric mechanical properties, porosity, flexibility, softness and density. Mechanical consolidation methods include needle punching, stitch bonding and hydro entangling. Chemical bonding methods involving applying adhesive binders to webs by saturating, spraying, printing or foaming techniques. Thermal bonding involves the use of heat and often pressure to soften and then fuse or weld fibres together without inducing melting (**Russell, 2007**).

1.10 SPUNBONDED

Spun bonded fabrics are produced by depositing extruded, spun filaments onto a collecting belt in a uniform random manner followed by bonding the fibres. The fibres are separated during the web laying process by air jets or electrostatic charges. The collecting surface is usually perforated to prevent the air stream from deflecting and carrying the fibres in an uncontrolled manner (**PAL, 2009).**

The spun bonding process includes five operations as listed below:

a) Filament extrusion

b) Drawing

c) Quenching

d) Lay down

e) Bonding

Diagram of the open spun bond process with belt collector **(Vishvanath, 2010).**

1.11 NEEDLEPUNCHED

Needle-punched nonwovens are created by mechanically oriented and interlocking the fibres. This mechanical interlocking is achieved with thousands of barbed felting needles repeatedly passing into and out of the web (**PAL, 2009).**

Needle punching process (**Kamath, Dahiya, and Hegde)**

Process Description-

(A)Opening & Mixing- To process different type of fibres' from bale stage, blended in the correct proportions by means of openers. The fibres' are opened and dispersed for the preparation of carding process.

(B)Feeding -The fibres' are blown from the opening machine which supplies a predetermined Quantity to Cards by electric auto scale controlled system.

(C)Carding-The fibres' fed into the carding machine are snared by the wire of rotating cylinder and fibres' are aligned in an essential parallel direction. A web or net is formed on card and removed from the card by doffer to the cross lapper.

(D) Cross lapping- Fibres webs layered to increase the fabric's cross directional strength, thickness. Weight, width and improve uniformity

(E) Web Feeding - Layered web can be adjusted to meet the standards of any specifications and delivered to needle punching by means of Web Feeder . The Web Feeder is to avoid the layered web to be deforming and tactility.

(F) Preneedle Punching-The layered web are fed through a series of needle punching machines, the Preneedle Punching is to interlace the various layers each other with lower needle density. It is a preliminary 3D interleaving to entangle the fibres'.

(G) First Double Side Finish Needle Punching- The layered web are delivered by means of conveyor and rollers to first double side finish needle punching loom. The operation will make the web becomes the middle high density nonwoven fabric.

(H) Second Double Side Finish Needle Punching-The applications of geotextile and filtration need high tensile and high entanglement nonwoven fabric. Special fibres have developed that permit them to be converted into soft, fine finish fabric to be high density structure.

(I) Calendar - After the fabric has been sufficiently interlaced by two times double side needle punching, the fabric can be fed through calenders to further compress.

(J) Slitting, Winding and Edge cutting- Nonwoven roll goods are converted in a variety ways, such as slitting to the widths required for end product converting , edge cutting for end product packing, and rewinding to prepare rolls of appropriate for product converting.

1.12 Applications of nonwovens:

Nonwovens find numerous applications ranging from baby diapers to industrial high performance textiles. Some of the important areas where nonwovens are treated as primary alternative for traditional textiles as Geo textiles, materials for building, thermal and sound insulating materials, hygienic and health care textiles and automotive industries. Nonwovens are also used in cover stocks, agriculture, aerospace, home furnishings etc. Although it is not possible to list all the applications of nonwovens, some of the important applications are listed below:

	Table 1 - Products That Use Nonwovens	
Agriculture and	**Home Furnishings**	**Industrial/Military**

Landscaping		
Crop Covers	Furniture construction sheeting	Coated fabrics
Turf protection products	Insulators, arms and back	Filters
Nursery overwintering	Cushion ticking	Semiconductor polishing pads
Weed control fabrics	Dust covers	Wipers
Root bags	Decking	Clean room apparel
Containers	Skirt linings	Air conditioning filters
Capillary matting	Pull strips	Military clothing
	Bedding construction sheeting	Abrasives
Automotive	Quilt backing	Cable insulation
Trunk applications	Dust covers	Reinforced plastics
Floor covers	Flanging	Tapes
Side liners	Spring wrap	Protective clothing, lab coats
Front and back liners	Insulators	Sorbents
Wheelhouse covers	Quilt backings	Lubricating pads
Rear shelf trim panel covers	Blankets	Flame barriers
Seat applications	Wall covering backings	Packaging
Listings	Acoustical wall coverings	Conveyor belts
Cover slip sheets	Upholstery backings	Display felts
Foam reinforcements	Pillows, pillow cases	Papermaker felts
Transmission oil filters	Window treatments	Noise absorbent felt
Door trim panel carpets	Drapery components	
Door trim panel padding	Carpet backings, carpets, and	Leisure, Travel
Vinyl, landau cover backings	Pads	Sleeping bags
Moulded headliner substrates	Mattress pad components	Tarpaulins, tents
Hood silencer pads		Artificial leather, luggage

Dash insulators	Health Care	Airline headrests, pillow cases
Carpet tufting fabric and under	Surgical: caps, gowns, masks,	
Padding	Shoe covers	Personal Care and Hygiene
	Sponges, dressings, wipes	Diapers
Clothing	Orthopaedic padding	Sanitary napkins, tampons
Interlinings	Bandages, tapes	Training pants
Clothing and glove insulation	Dental bibs	Incontinence products
Bra and shoulder padding	Drapes, wraps, packs	Dry and wet wipes
Handbag components	Sterile packaging	Cosmetic applicators, removers
Shoe components	Bed linen, under pads	Lens tissue
	Contamination control gowns	Hand warmers
Construction	Electrodes	Vacuum cleaner bags
Roofing and tile underlayment	Examination gowns	Tea, coffee bags
Acoustical ceilings	Filters for IV solutions, blood	Buff pads
Insulation	Oxygenators and kidney	
House wrap	Dialyzers	School, Office
Pipe wrap	Transdermal drug delivery	Book covers
		Mailing envelopes, labels
Geo textiles	Household	Maps, signs, pennants
Asphalt overlay	Wipes, wet, dry polishing	Floppy disk liners
Road and railroad beds	Aprons	Towels
Soil stabilization	Scouring pads	Promotional items
Drainage	Fabric softener sheets	Pen nibs
Dam and stream embankments	Dust cloths, mops	

Golf and tennis courts	Tea and coffee bags	
Artificial turf	Placemats, napkins	
Sedimentation and erosion	Ironing board pads	
Control	Washcloths	
Pond liners	Tablecloths	
Source: The Nonwoven Fabrics Handbook, Association for the Nonwoven Fabrics Industry, Cary, North Carolina		

A bag is a good source of carrying things from one place to other like buying garments or grocery etc. Shopping bag is a medium used by grocery shoppers. Plastic carry bag is a very well known name to carry things. The versatility of plastic has led to its use in everything we use today. The benefits it has to offer are lightness, flexibility, durability and water-resistance.

1.1 IMPORTANCE OF PLASTIC CARRY BAGS-

Plastic bags are light and at the same time strong enough that they can carry normal weight, are cheap and are used in all types of shops in our daily life. For example: bakeries, medical shops, grocery stores, hotels, etc. People are so accustomed to them, that they find it very difficult to part with them. Plastic bags have made it possible for people to go without bags to market or work place as these bags are easily available and can be thrown without a second thought **(Moorthy).**

1.2 PLASTIC CARRY BAGS HAZARDS-

Worldwide a staggering four to five trillion plastic carry bags are used every year. Most are discarded after a single use. Shopping bags are being perceived as a symbol of throw- away society. They have some characteristics which makes them a problem **(Iyer, 2009).**

The biggest current problem with the conventional plastics is associated with the environmental concern, including non-biodegradability, release of toxic pollutants, litter, impacts on landfill etc. Indiscriminate disposal of plastic waste, mostly containing plastic carry bags are the prime cause for concern.

1.3 PLASTIC CREATES PROBLEMS:-

Polybags served us well as they are light, cheap, and waterproof. Poly bags can harm us more. Millions and millions of poly bags are thrown away to clog drains and choke soil. Pollution in manufacture and disposal are added attributes. Some problems are discussed here-

1.3.1 Choked Drains: Light poly bags settle in down the drains. They cause backflow and water logging. They get into storm water pumps and damage them. Polybag induce water logging which triggers off landslides in the mountains.

1.3.2 Choked Soil: Millions of poly bags settle in the soil. They are non-porous and non-biodegradable. They obstruct free flow of water and air. Thus they choke the soil and suffocate plant roots. Toxic chemical additives leach into the soil thus degrading the soil quality.

1.3.3 Animal Deaths: Cows foraging dustbins eat poly bags and die. Ingested poly bags block their intestines. Toxins released from poly bags also harm animals that eat them. Poly bag also harms marine animals through ingestion.

1.3.4 Food Hazards: Chemicals used to manufacture poly bags can leach out into food products stored in them and thereby reach our systems. The two commonly used dyes in plastics are lead - a known neurotoxin and cadmium - a nephro-toxin. Other additives used are toxic as well.

1.3.5 Mosquito Breeding: Stray poly bags act as receptacles of water, sufficient enough for mosquito breeding.

1.3.6 Limited Recyclability: Plastic recycling is linear, not cyclic - i.e. plastics degrade on recycling. Thus more and more fresh plastic is required creating more and more waste at the end of the line. Besides, stray poly bags, (thin and dirty as they are) are not lucrative enough for the rag pickers to collect.

1.3.7 Polluting Industry: Manufacture of poly bags, mainly done in small moulding shops, with no environmental standard involve hazardous materials and emit obnoxious gases posing serious problems first for the workers and then for the neighbourhood.

1.3.8 Disposal Hazards: If disposed through landfills, poly bags continue to pollute soil for many years. If burnt they emit hazardous gases that pollute the air **(DISHA-Society for Direct Initiative for Health and Action).**

1.4 ENVIRONMENTAL CONCERN-

The "GREEN MOVEMENT" has gained popularity in both consumer and business sectors. Due to public awareness, demands of biodegradable or environmentally friendly textiles increases, especially disposable nonwoven products such as diapers, incontinence products, surgical gowns has attracted special attention in an effort to solve the solid waste crisis (**Chiprus,2004**).

The recent and best solution of this plastic bag problem has come from nonwovens. They are the best solution to cater the shopping needs of people. Eco-friendly and reusable bags made from nonwoven polypropylene (NWPP) are indeed a perfect alternative to plastic bags. Nonwoven bags can be used a number of times before they get worn out. They are flexible enough to carry a variety of items. NWPP carry bags, on the other hand, are known to be environment friendly. They are 100% reusable and recyclable **(Lee, 2005).**

2. REVIEW OF LITERATURE

Muthu et al. carried a study on different shopping bags that were of plastic, paper, nonwoven, and woven. A comparative life cycle assessment was accomplished of these bags by the eco-indicator'99. The main impact categories to be investigated were carcinogens, respiratory organic and inorganic, climate change, radiation, ozone layer, eco-toxicity, acidification, land use, minerals and fossil fuels. From the result it was found that reusable shopping bags-nonwoven bags followed by woven bags were found to create lower environmental impacts compared to single use plastic bags.

__Tensile Properties :-__ **Scaff and Ogale** (1991) studied the tensile elastic and viscoelastics properties of a nonwoven polypropylene backing. Viscoelastic tests showed that the stress relaxation modulus for the tufted nonwoven substrate was insensitive to temperature over the range of 72-100*C.

Ghosh et al. (1995) found effect of number of passes on tensile and tear properties of nonwoven needle punched fabrics. If the study nonwoven needle-punched polypropylene fabrics have been prepared by varying the number of passes, keeping all machine parameters constant except strokes/ min, and the effect of number of passes on tensile and tear properties has been studied. With higher number of passes, thus is very little effect on tensile strength and work of rupture. On the contrary, higher number of passes increases tensile strength initial modules and work of rupture in cross direction. Tear strength, tear elongation and work of rupture decrease with higher number of passes.

Talukdar et. al (1998) reported that needle-punched nonwoven fabrics have been prepared with polyester fibers of normal and triobal cross-sections using the processing parameters selected on the basis of central rotable composite design and the influence of processing parameters and cross-sectional shape of fiber on bending length of fabric studied. It is observed that bending length initially increases, reaches a peak and then decreased with the increase in needle depth. Less needle depth means less fiber intermingling thus lower stiffness i.e. lower bonding length is obtained. But when needle depth is higher it restricts mobility during bending and this result in higher bending length.

Patel and Kothari (2001) studied the stress strain behavior of spun bonded needle punched fabric. The stress strain behavior of constituent fibers of these fabrics has also been studied and the structural parameters of nonwoven fabrics evaluated. It was observed that in the case of needle punched fabrics, the stress strain curve of the staple fiber fabric showed major deviation. The slippage of fiber is a dominating factor in the deformation of needle punched nonwoven fabrics in general and staple fiber fabric. The structure of nonwoven fabrics is the most important factor affecting the tensile behavior of these fabrics.

Sengupta et al. (2005) studied the effect of dynamic loading on jute and jute polypropylene blended needle punched nonwoven fabrics. It was observed that with the increase in cycles of dynamic loading, the thickness loss increase with diminished rate. Thickness loss decrease with the increase in punch density, depth of needle penetration and area density. As the proportion of polypropylene fiber increased in the blend with jute, the thickness loss as well as relaxation from compression decreased.

Anandjiwala et al. (2007) revealed the nonwoven wipes for household application using the hydro entanglement bonding technique with the blends of polyester, viscose and flax were compared in terms of tensile strength and elongation properties. It was concluded that flax fibers can be successfully utilized for developing household or individual wipes, having higher tensile strength in wet state compared to polyester fiber blended fabrics.

Sengupta et al. (2008) found the effect of compressive load on tensile behaviour of jute needle-punched reference to crack or void generation. A test box is designed to apply compressive load on the fabric. The tensile behaviour of single, 2ply, 3ply, fabric was been studied with different compressive pressures. It is observed that fibre orientation and wetting of fabric play a role in determining the tensile behaviour under compressive load. The performance of cross laid nonwoven with respect to tensile behaviour during crack or void generation is better than parallel-laid nonwoven.

Sengupta et al. (2008) found the effect of punch density, depth of needle penetration, fiber orientation and density of jute needle-punched nonwoven fabric, for use as reinforcing material in jute reinforced plastic composite, has been studied and the composite properties, such as tensile strength and modules, flexural strength and modules, and impact strength optimized. The fabric made with optimized parameters has been chemically treated and the mechanical properties of its composite evaluated. It is observed that the cross-laid nonwovens produces better composite, compared to parallel-laid nonwoven.

Air permeability:- **Chatterjee** et al. (1993) found air permeability of nonwoven filter fabrics. The study showed that with the increase of pressure drop, the air permeability increased. Fabrics of higher weight per sq. meter show lower air permeability with the increase of depth of needle penetrations the air permeability decreases.

Bhattacharjee et al. (2002) investigated experimental investigation on air & water permeability of spun heated Typar fabrics and found that the porosity of the fabrics plays a very important role in deciding the air permeability of the fabrics. Excellent linear correlation was observed between air and water permeability.

_**Midha** et al. (2004) revealed the individual and interactive effects of needling parameters and web parameters on air permeability, compressibility; compression recovery and bending length properties of hollow polyester needle-punched nonwoven fabrics have been studied using Box-Behnkan experimental design. Needle-punched fabrics have been made from cross-laid as well as parallel-laid webs. It is observed that as the web gets more consolidated, the compressibility decreases, recovery and stiffness generally increases. The air permeability decreases as the fabric weight increases.

Midha and Mukhopadyay (2005) studied the physical properties of needle punched nonwoven fabrics. According to the study the air permeability decreases with the increase in needling density of manufacturing of needle punched nonwovens.

Water absorbency:- **Enomae** et al.(2006) studied a nonwoven fabric made from a paper like cellulosic material made of rayon and hemp, which was investigated and it was found that rayon fibers gave relatively high water absorbency to the nonwoven fabric.

Anandjiwala et al. (2007) studied the liquid absorption characteristics of household wipes made from polyester, viscose and flax fibers blends using hydro entanglement bonding technique. The study concluded that flax fibers can be successfully utilized for developing household wipes due to their good absorption characteristics.

Filtration characteristics:- **Das** et al. (2009) studied the filtration behavior of two types of spun-laid nonwoven fabrics, namely thermo bonded and needle-punched. They studied the air filtration characteristics of different types of filter fabrics studied. The results of needle-punched nonwoven showed good filtration efficiency then the corresponding thermo bonded nonwovens. Overall, the needle-punched fabrics perform better as a filter fabric in comparison to thermo bonded nonwovens.

Biodegradability:- **Chiparus** (2004) revealed the degradation of Bagasse and Easter bio-copolymer (bonding polymer). The EBC polyester is designed to perform required lifetime reliability and then fully degrade within a composting environment. In a time frame comparable to cellulose (Paper), this aliphatic – aromatic polyester fully degrades to carbon dioxide, water and biomass. Within 12 weeks in an active composting site, on article made from this copolymer typically becomes invisible to the naked eye and completely biodegrades within 6 months.

Mohee and Unmar (2006), undertook an experiment to observe any physical change of Rigid plastic (plastic-A) and eco-safe plastic (plastic B) as compared to a reference plastic, namely, compostable plastic (plastic C) when exposed to a natural composting environment. Theremophilic temperatures were obtained for about 3-5 days of composting and the moisture content was in the range of 60-80% throughout the degradation process. It was concluded that naturally based plastic made of starch would degrade completely in a time frame of 60 days, whereas plastic with biodegradable additive would require a longer time.

Vishwanath (2010), worked on degradation studies of polypropylene fibers and nonwoven with Pro-degrant additives. According to the study the effects of photo-oxidation, soil burial and vermi-composting on Totally Degradable Plastic Additive and ECM additive containing polypropylene nonwoven have been studied. The samples were observed after 180 hours through xenon arc lamp exposure. SEM studies clearly indicated the breakdown of fibers and nonwovens on Xenon arc exposure. The samples were subjected to vermi-composting time period of 4 weeks and the results indicate a significant drop in peak load after vermi-composting. FIIR analysis showed a drastic reduction of the samples after 8 weeks of soil burial.

Zhang et al. (2010) studied the biodegradation of a series of chemically modified thermally processed Wheat gluten (WG) - based natural polymers which were examined according to Australian Standard (AS ISO14855). Most of these materials reached 93-100% biodegradation within 22 days of composting, and the growth of fungi and significant phase deformation were observed during the process.

Kumar et al. (2010) found in their study that biodegradability of flax fiber reinforced polylactic acid based composition in presence of ampiphilic additives, which was investigated by soil burial test, the results indicated that in the presence of mandelic acid, the composites showed accelerated biodegradation with 20-25% loss in weight in 50-60 days. Depending on the end use, different ampiphilic additives can be added for delayed or accelerated biodegradability.

Zhou and Zhao reported that 1% wt. Cu+ doped anatase nanoparticals were added into polypropylene as a photo sensitizer. The blend was melt spun and heat bonded to prepare spun bonded polypropylene nonwovens, which contain 1.2% wt. doped nano_TiO_2.Having been irradiated with 340mm UV light at

70 degree C for different, the samples were studied by mechanical property analyses. It can be concluded that the Cu+ doped anatase nanoparticals is an effective photo sensitizer to the photo degradation of polypropylene spun bonded nonwovens.

Ultra violet photo-oxidation:- **Li** et al.(2001) demonstrated Fourier infrared photo caustic spectrum which was used for the studies of UV photo-oxidation in polypropylene. The attribution of oxidation products and changes of crystillanity during exposure were studied. It was found that the dominant oxidation products were ketone, carboxylic acid and ester. Spectra at different depths indicated that the fractional crystillanity decreased from surface to subsurface.

Wang et al. (2006) studied the aging mechanism of polypropylene fibers by accelerated aging test and natural aging test. They gave the contrast of sample structure and tensile strength, before and after ageing. Results showed that ultra-violet accelerated ageing made tensile strength of polypropylene fiber decrease markedly and the molecular weight dropped. The sample surface became crude and appeared spotty. The chemical reaction was of the molecular weight's dropping and production of carbonyl compound.

3. RATIONALE OF THE STUDY:

Plastics are synthetic substances produced by chemical reactions. Plastic has many properties which have made it a raw material of choice for manufacturers of plastic bags and packing materials. Cost of production, light weight, strength, easy process of manufacture and availability are few of the properties (**Moorthy**).

3.1 SHOPPING CULTURE IN EARLIER DAYS (Pre Plastic age 1970+)

Before the advent of poly-bags, people did shop, buy things, bring eatables from the market, and did the same marketing as is done now. The raw material for the bag was decided by its usage. Cloth bags for lighter items, Gunny bags/Jute bags for voluminous and heavier goods. The cost did not justify use and discard attitude. These bags were washable and reusable lasting for six months to a year (**Moorthy).**

3.2PLASTIC-HAZARDS-

The hazards plastics pose are numerous. The land gets littered by plastic bag garbage presenting an ugly and unhygienic scene. The "Throw away culture" results in these bags finding their way in to the city drainage system, the resulting blockage causes inconvenience, difficulty in maintaining the drainage with increased cost, creates unhygienic environment resulting in health hazard and spreading of water borne diseases (**Moorthy)**.

As a substitute of cloth, paper etc. there are nonwoven bags which are also available, made up of poly-olefins. Their high molecular weight makes them non-biodegradable.

Thus the primary objective of the research is to find out the degradation methods of the available samples. The present work has its ultimate goal to create plastic carry bag free environment and to contribute towards the clean and green society. Plastic free world would be a better place to live for every living being on earth, as it is duty of every sane person on earth to pass on every possible opportunity for a better future of our next generations.

4. OBJECTIVES- The main objectives of the study are as follows:-

1. To find out trends used in use of non-woven carry bags.
2. To determine the physical properties such as thickness, weight, bursting strength, flexibility and chemical properties- as solubility, fiber identification, color fastness and biological properties such as degradability.
3. To identify the fiber content of the available carry bag samples by conducting solubility tests.

4. To find out degradation time of the samples (needle-punched and spun bonded) available in the market. The degradation methods will be photo-degradation, soil burial and vermi composting.

5. After carrying out an assessment of currently used carry bags made with non-wovens- a prototype of ideal carry bag-using materials and techniques which would give optimum performance, at the same time being eco-friendly will be identified.

5. METHODOLOGY-

Phase 1- Study the Trend

Phase 2- Testing

Phase 3- Degradation Process

The research process will include following phases for accomplishing the objective of the research. An attempt will be made to study and analyse the market trend and to determine degradation methods of the available samples to suggest healthy environmental practices in the context of cleanliness.

5.1 PHASE-1 STUDY THE TREND

This phase will emphasize on trend which is in for the use of nonwovens manufacturing. What type of fibers and techniques are used in manufacturing process? A questionnaire will be filled by 100 respondents (at least graduate) to know the awareness about plastic carry bags and non woven bags. Another questionnaire will be filled by 10 (manufacturers and wholesalers) to know about the blend, fiber type and manufacturing technique of the nonwoven bags.

5.2 PHASE-2 TESTING

In the next phase the testing procedure will be carried out to determine the physical, chemical and biological properties of the available samples like thickness, weight, bursting strength, fiber identification etc. The deliverable result at the end will be a document to identify the material's characteristics.

5.3 PHASE-3 DEGRADATION PROCESS

This phase will include various experiments that will help to discover potential errors and limitations of the proposed frame work. Photo-degradation, soil burial and vermi-composting will be the methods of degradation process for the testing processes we will use 06 samples each of needle punch and spun bonded carry bags.

5.3.1 PHOTODEGRADATION:

Oxo-biodegradation process uses two methods to start the biodegradation. The methods are photo degradation (UV) and oxidation. The UV degradation uses UV light to degrade the end product. The oxidation process uses time and heat to break down the plastic. Both methods reduce the molecular weight of the plastic and allow it to biodegrade. Photo-degradation refers to the degradation of polymer by the action of ultraviolet light (UV) from the sun with a wavelength of 290–400 nm. (ASTM D 5338) (Vishvanath, 2010).

5.3.2 VEMICOMPOSTING:

Vermi composting is also a bio-oxidation and stabilization process of organic material that, in contrast to composting, involves the joint action of earthworms and microorganisms and does not involve a thermo philic stage. The process of turning, fragmentation and aeration is carried out by earthworms. Certain species of earthworms can consume organic residuals very rapidly and fragment them into much finer particles by passing them through a grinding gizzard, an organ that all earthworms possess. The earthworms derive their nourishment from the microorganisms that grow upon the organic materials.

5.3.3 SOIL-BURIAL:

ASTM D6002-96 provides the standard guide for assessing the compost ability of environmentally degradable plastics. In soil burial method the samples are buried in rich soil. The samples will be buried in soil for some time for the degradation process. The length of the experiment will depend upon the fibre content present in the samples. Data will be recorded for each week and will compare against the next week's results.

6. INSTRUMENTS:

Gray scale of ISO AO3 will used for assessing the colour fastness to light and washing.

MITUTOYO Dial thickness gauge will used for determining the thickness of the samples.

PARAM SLY-S1 tearing tester will applicable in the tearing test of the available samples.

SASMIRA Launderometer will used for checking colourfastness to washing.

Weight will be taken on electronic balance of ADAIR DUTT AD 180.

7. SAMPLING TECHNIQUE:

Samples (respondent) for the study will be selected by simple random technique. The respondents will be selected randomly. While filling the schedule it will be kept in mind that all the respondents should be at least graduate so it would be easy to know that they are aware of Nonwoven bags.

8. PLACE OF WORK:

The work will be carved in Jaipur . The schedule will be filled at Jaipur. The samples will be collected from Delhi and Jaipur.

9. WORK PLAN:

- Identification of the sample both of the consumers and manufacturers- two months
- Developing of the questionnaire and conducting a pilot study- two months
- Filling of Schedule (questionnaire) and analysis of the data- three months

- Fiber content testing: - two months
- Soil burial test: - six month to one year
- Vermi-composting: - at least six months
- Compiling the data – three months

10. RESULT:

The data for the will be statically analyzed (in %) after filling of the schedule.

11. REFERENCES AND WEBLIOGRAPHY:

1. Ananjiwala, R., Soukupova, V. & Bouslavsky, L. (2007) .Studies on the properties of biodegradable wipes made by the hydro entanglement bonding technique. *Textile Research Journal*, Vol.77, No.5, 301-311.

2. Bhattacharjee,D., Ray, A. & Kothari, V.K. (2004). Air and water permeability characteristics of nonwoven fabrics. *Indian Journal of Fiber and Textile Research*, vol. 29, June ,122-128.

3. Chatterjee, K., Das, A. & Jhalani ,S.(1993). Air permeability of nonwoven filter fabrics (part 3).*The Indian Textile Journal*, January, Vol. 103, No. 4.

4. Chiparus, O.I. (2004). Bagasse fiber for production of Nonwoven Materials. B.S. Technical University. Gh. Asachi, Iari, Romani (Unpublished report).

5. Das, A., Alagriusamy, R. & Nagendra, R. (2009). Filteration characteristics of spun-laid nonwoven fabrics. *Indian Journal of Fiber and Textile Research*,September,Vol. 34.

6. Enomae, T., & Kurata, T. (2006). Development of nursing care sheets of cellulosic nonwoven fabric for ageing society. *Textile Research Journal*, Vol.76, No.1, .41-48.

7. Ghosh, S., Talukdar, M. & Day, P. (1995). Effect of number of passes on textile and tear properties of nonwoven needle-punched fabrics. *Indian Journal of Fiber & Textile Research*, Vol. 20, September , 145-149.

8. Kumar, R., Yakubu,M. & Anandjiwala, R. (2010). Biodegradation of Flax fiber reinforced poly lactic acid. *Express Polymer Letters*, Vol. 4, No. 4,423-430.

9. Li, X. , Hu, I., Huang, I., Chang, T. & Zhou, G. (2001). Fourier infrared photocaustic spectroscopic analysis of polypropylene U.V. photo-oxidation. *Polymeric Material Science and Engineering*.(www.cnki.com.cn)

10. Midha, V. & Mukhopadyay, A. (2005). Bulk and physical properties of needle punched nonwoven fabrics. *Indian Journal of Fiber and Textile Research*, Vol.30, June, 218-229.

11. Midha, V., Alagirusamy, R. & Kothari, V.K. (2004). Studies on properties of hollow polyester needle-punched fabrics. *Indian Journal of Fiber & Textile Research*, Vol. 29, December, 391-399.

12. Mohee,R. & Unmar, G. (2007). Determining biodegradability of plastic materials under controlled and natural composting environments. *Waste Management,* Vol. 27, Issue No. 11, 1486- 1493.

13. Muthu, S., Li, Y., Hu, J., Mok, P. & Liao, X.. An exploratory comparative life cycle assessment study of grocery bags-Plastic, Paper, Nonwoven and Woven shopping bags. Institute of Textile and Clothing. The Hongkong Polytechnic University, Kowloon, Hongkong, China.

14. Pal, S., (2009). Nonwovens: Hygiene, geotextile, automotive applications. *The Indian Textile Journal*, August, Vol.119, No.11, 63-76.

15. Pal, S.(2009). Nonwovens web formation techniques. *Asian Textile Journal,* October, Vol.18, No.10, 33-39.

16. Patel, P. & Kothari, V.K.(2001). Relationship between tensile properties of fibers and nonwoven fabrics. *Indian Journal of Fiber and Textile Research,* vol. 26, December, 398-402.

17. Russell, S.J. A Handbook of Nonwovens (2007). *Woodhead Publications.*

18. Scaff, A. & Ogale, A. (1991). Tensile viscoelastic properties of spun bonded nonwovens polypropylene backing. *Textile research journal*, Vol. 61, No. 7, 386-392.

19. Sengupta, S., Chattopadhyay, S., Samajpati, S. & Day, A., (2008) . Use of jute needle-punched nonwoven fabric as reinforcement in composite. *Indian Journal of Fiber and Textile Research*, Vol. 33, March, 37-44.

20. Sengupta, S., Majumdar, P. & Ray, P., (2008).Tensile deformation of jute needle-punched nonwoven geo-textiles under compressive load. *Indian Journal of Fiber and Textile Research*, Vol 33, June ,139-145.

21. Sengupta, S., Ray, P. & Majumdar, P.(2005). Effect of dynamic loading on jute based needle punched nonwoven fabrics. *Indian Journal of Fiber and Textile Research*, Vol 30, December, 389-395.

22. Talukdar, M., Ray, M., Ghosh, S. & Mhadgut, R. (1998). Influence of fiber cross-section and processing parameters on bending length of nonwoven needle-punched fabrics. *Indian Journal of Fiber and Textile Research*, Vol. 23, September, 147-152.

23. Vishwanath, V. (2010). Degradation studies of Polypropylene and Fibers and nonwovens with prodegradent Additives. North Carolina State University, Raligh, North Corolina (Unpublished Paper).

24.Wang, Q., Fu, Z. & Zhu, T. (2006) . Effect of ultraviolet on the structure and tensile strength of polypropylene fibers. (www. cnki.com.cn)

25.Waltz, A., *Melliand*, October, E 217-233

26. Zhang, X., Gozukara, Y., Sangwan, P., Gao, D. & Batemen, S. (2010). Biodegradation of chemically modified wheat gluten based natural polymer

materials. *Polymer Degradation and Stability,* Vol. 95, Issue 12, December, 2309-2317.

27. Zhou, L. & Zhau, S. Study on photo degradable polypropylene spun bonded nonwovens. *Technical Textiles*.

WEBLIOGRAPHY:

1. DISHA (Society for Direct Initiative for Social Health and Action).www.google.com
2. Iyer, M.,(2009) "Yes or No to plastic carry bags?" http://bangalore.citizenmatters.in/articles/view/818-biodegradable-shopping-bags
3. Kamath, M.G., Dahiya, A. & Hegde, R. "Introduction To Nonwovens" and "Needle punched Nonwovens" http://www.engr.utk.edu/mse/Textiles/Needle%20Punched%20Nonwovens.htm
4. Lee, D. (2005) www.articlesnatch.com (2-4-2011)
5. Moorthy, K. www.vigyannprasar.gov.in (30-3-2011)