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Prospects of Agrotextiles as Technical Textiles in the World Market

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Abstract

Agro-textile is a woven or knitted or non-woven technical textile which is extensively used for controlling environment for plants/animals in applications to agriculture, forestry, horticulture, etc. The applications include all activities concerned with the growth and harvesting of live products and foodstuffs. Agro-textiles contribute about 1.5% to total production of technical textiles in India. Agro-textiles help to keep sufficient soft humidity and increase the soil temperature. Unique fabrics are generally manufactured for agricultural appliance. Some of the main fields of agro-textiles are shade nets, mulch mats, crop covers, anti-hail nets, net for protection from birds and fishing nets. Tapping the potential of technical textiles, agro-textiles are driving the sector profitability by improving the productivity and reducing the need for chemicals. Man-made fibers are preferred for agricultural textiles than the natural fibers due to certain advantages. The essential physical properties of agro-textiles help with the growth and harvesting of crops and other foodstuffs.

Keywords*: - Agro-textile, or non-woven technical textile, agricultural textiles*

INTRODUCTION

Any technical textile is a textile product manufactured for non-aesthetic purposes, where function is the primary criterion and agro-textiles are one of such varieties of technical textiles. It is large and growing sector that supports a vast array of other industries **[01].** Agro-textiles is application of textile materials in the agricultural fields **[02}.** Agriculture has been amongst the most primal occupations of the humankind and is still a major industry

globally. Tapping the potential of technical textiles and putting their vital properties to an advantage; agriculture, horticulture, forestry, and fishing segments (all the four sectors combined together are popularly called as 'agro-tech' sector) are increasingly using them for equipment development and other applications **[03].** According to the author **[04],** increasing population pressure, limited resources such as land, water, energy, etc, increasing standard of living and ecological problems, etc, the importance of agro-textiles is justified from the view points to control climate, ecological degradation, efficient use of water, reduce herbicides, save energy and improve product quality, etc. The agro-textiles are used as managing surroundings for plants/animals in the applications like agriculture, horticulture, animal husbandry and forestry as explained **[05].**

Man-made (synthetic) fibers are preferred for agricultural products than natural fibers due to their high strength, durability and other suitable properties of agricultural applications. On the other hands, natural fibers based agro-textiles not only serve the specific purpose but also after some years degrade and act as natural fertilizers **[06].** Agro-textiles is one of the smaller categories of technical textiles, with consumption accounting for 8.2% by volume and 6.4% by value of the global technical textiles market in 2010 **[07].** Today, agro-textile plays a significant role to control environment for crop production, eliminate variations in climate, weather change and generate optimum condition for plant growth. Adopting the high-tech farming techniques, where textile structures are used, could enhance quality and over all yield of agro products **[08].** Unique manufacturing techniques and properties of this blend of agro-textiles sector products, whose cost is lesser than that of pesticides and chemical herbicides have been emphasized. Agro-textiles give multi-dimensional views and solutions to the problems being faced by agro-industry **[09].** Bonar Technical fabrics **[10],** offers creative and durable solutions for the agro and horticulture industry since more than 40 years.

The renowned group known as CTM Textile Group **[11],** located in the textile city Ahmadabad is producing agro-textiles in areas shed nets, garden nets, agro shed nets, etc and exporting their products. With a clear focus on technical textiles, they are involving themselves in the various agro-textiles areas and they have plan to set up state of art manufacturing facilities by establishing strategic alliance

with world class producers of agro-textiles materials. According to the authors **[12],** progressively eco-textiles are being used for industrial purposes as well as in components of composites, in medical implants and agro-textiles. The use and disposal of the textiles will be more of environmentally sustainable to minimize harm to the people and the environment. Agriculture textile for its excellent environmental resistance, mechanical properties, easy process ability and durability can improve quantity, quality and safety of agricultural products **[13].** Textile structures in various form are used in shade house/poly house, green house, and also in open fields to control environmental factors like, temperature, water and humidity **[14].** Agro-textiles help to keep sufficient soil, humidity and increase the soil temperature **[15].** Fibers used in agro-textiles are nylon, polyester, polyethylene, polyolefin, polypropylene, jute and wool as stated **[16].** Among these fibers, the polyolefin is extensively used, where as among natural fibers, jute and wool are used, which not only serve the purpose but also after some years, they degrade and act as natural fertilizers.

In the era of modernization, agriculture for higher production, boost to agriculture will not be possible not be possible without increasing involvement of agro-textiles **[17].** Several techniques of fabric production can be used to produce agro-textiles; with each method offering specific advantages for particular product. The essential properties for agro-textiles are strength, elongation, stiffness, porosity, bio-degradation, resistance to toxic environment **[18].** The applications include, all activities concerned with the growth and harvesting of live products and food stuffs, such as gardening, and landscaping, agriculture, animal husbandry and in fences **[19].** Present market opportunities and in free quota region, the prospects for the technical textiles are increasing to cater the needs of requirements. According to requirements of technical textile materials in the world during 2005, agriculture and forestry occupy 7% of world's consumption **[20].** Usage of agro-textiles products reduced the usage of weed killers and pesticides which also help to prevent environmental pollution **[21].** Agro-textiles product includes diverse items such as crop covers, nursery over wintering, forest protection, weed control fabrics, root bags, mulching, containers, landscaping, turf protection products, gardening, green-house shading, seed blanket, fishing nets and fish-lines, ropes, shade fabrics, mulch mats, bird protection nets, etc **[22].** Natural fibers

agro-textiles are also used where bio-degradability of products are essential **[23].** Agro-textiles transmit light, prevent infestation by pests, protect against storm, cold spells and hail damage.

2.0 AGRO TEXTILES: A textile fabric has a long history of application in agriculture and textiles can be regarded as the backbone of agriculture. The practice textiles is now widen to safeguard the agro-products like plants, vegetables and fruits from weather, weed and birds, etc. agriculture can play a duo by contemplating the strengths of each other to produce a new evolution of agro-textiles revolution. Textiles always keep up its style of uniqueness by creating vast technological strides in all the fields slowly since evolution. It is the need of the hour to emphasis more on agriculture textiles for all the technologists. Although the volume of technical textiles manufactured for agricultural applications are small compared to other areas of technical textiles, it does not mean the use of textiles in agriculture ins not significant. Today, agriculture and horticulture has realized the need of tomorrow and opting for various technologies to get higher overall yield, quality and tasty agro-products.

Tapping the potential of technical textiles and putting their vital properties to an advantage; agriculture, horticulture, forestry and fishing segments (called agro-textiles) are increasing using them for equipment development and other applications. This textile sector comprises of all textiles that are used in growing, harvesting, protection and storage of either crops or animals. These textiles are driving the sector profitably by improving the productivity and reducing the need for chemicals. Some of the purposes for which these textiles are being increasingly used are as follows:-

a) Preventing erosion and paving way for a forestation
b) In green house cover and fishing nets
c) For layer separation in fields
d) In nets for plants, rootless plants & protecting grassy areas
e) As sun screens and wind shields
f) As packing materials and in bags for strong grass
g) Controlling stretch in knitted nets
h) shades for basins
i) Anti-birds nets, etc.

FIBERS USED IN AGRO-TEXTILES: Agro-textiles are now a days' extensively used in horticulture, farming and other agricultural activities. The usage of agro-

textiles will be benefited in terms of products with enhanced quality, higher yields, less damage and bearable loses. Agriculture has been the most basic occupations of humankind and is still a major industry globally accepted. In this era of modernization and high technological advancements, it has spread its horizons and started using man-made, non-conventional textiles, called technical textiles.

Man-made fibers are preferred for agricultural products than the natural fibers due to their high strength, durability and other suitable properties of agricultural applications. On the other hand natural fibers based agro-textiles not only serve the specific purpose but also they act as natural fertilizers after some years as bio-degradable materials. Different variations in fiber types and their uses in the manufacturing of agro-textiles have enriched the options of selecting fibers in the manufacturing processes of agro-textiles. Fibers normally being used are nylon, polyester, polypropylene, Polyolefin, polyethylene, jute, wool, coir, sisal, flax, hemp, etc. Though man-made fibers are preferred for agro-textiles than natural fibers, mainly because of their favorable price performance ratio, light weight with high strength and long service life, but natural fibers can be used in agro-textiles in specific areas where characteristics like high moisture retention, wet strength and bio-degradability are effectively exploited.

RECOMMENDED PROPERTIES OF AGRO-TEXTILES: man-made fibers are preferred than natural fibers due their certain advantages over the natural fibers, which have already been explained earlier. However, some more important properties like ease of transport, space saving and long service life as well as their important physical and chemical properties are discussed below;-

Tensile strength-The tensile strength of shade nets can be the deciding factor for its long term durability and service life. Therefore, tensile strength is a necessary parameter for shade nets.

Abrasion Resistance:-The abrasion to which a shade net is subjected may be of the material itself or stray animals. Abrasion of the shade net would result in holes though animals and pests could enter the structure and harm the crops. Good abrasion resistance is required for shade nets.

Light Weight: **-** The weight of the fabric should be such that it will bare by the plant.

Bio-degradability: **-** natural fibers like wool, jute, and cotton are also used where the bio-degradability of the products is essential. Natural polymer gives the advantage of the biodegradability but has low service life when compared to the synthetic fibers.

Protection Property:-It must have the properties of protection from wind, and creation of micro-climate between the ground and the fabric, which results in temperature and humidity being balanced out.

Resistance to Micro-organisms:-It must be resistant to micro-organisms to protect the living being.

Resistance to Solar radiation:-Agro-textiles are laid over the cultivated areas immediately after sowing or planting. For such applications, agro-textiles have to withstand solar radiations with varying surrounding temperatures.

Stable Construction:-The construction must be such that it must be stable for any type of applications.

High Potential To Rain Water: **-** This is achieved by means of fiber materials, which allow taking in much water and by filling in super absorbers.

Withstand Ultra Violet Radiations:- Polypropylene and polyester are more resistant to UV radiations when used as outdoor materials. Polypropylene is treated with the appropriated UV stabilizers.

TYPES OF AGRO-TEXTILES PRODUCTS:-*Examples with application and features of some of the agro-textiles are discussed below-*

Hail Nets; this fabric is tough, rib resistance and highly UV stabilized, light weight net made of UV stabilized polypropylene mono-filament in woven and knitted structures. Hail nets are used to protect fruit, herb and vegetable crops. A typical quad crossover hail nets are made light weight, high density polypropylene yarns, knitted into rascal warp diamond design to reduce hail damage and to increase crop yield.

Hail Guard; Typical hail guard fabrics are knitted into a rocker-arm design and made of high density polyethylene yarns. Close hole helps protect crops from small rice hail and it is built-in eye lets which allows easier cable and cord insertion.

Orchard Hail Protection: Typical hail nets are made of polyethylene netting, UV resistant and tear resistant which prevent hail damage to fruits and deforestation.

Vineyard Hail Protection; This net has small holes which traps hail while allowing plenty of sun light. It is tough, rip resistant and highly UV stabilized.

Wind Control Fabric; The wind break fabrics block the wind, which reduce the wind speed and may increase the orchard temperature. Wind control fabrics give protection for crop from wind and are abrasion and UV resistant. These are made up of woven and knitted polyethylene mono-filament.

Orchard Wind Control; These fabrics protect the orchard from damaging effects of wind, evaporation, fruit bruising, blossom and leaf damage.

Field Crop Wind Breaks; Field crop wind break protects field crops from damaging effects of wind and improve crop irrigation efficiency, lower evaporation rates and lower soil loss. They are made of rugged polyethylene with UV resistant and reinforced seams.

Tree Shelters; These are used to protect young trees from animal damage, drying wind, defoliation and scorching. It can improve water retention of the trees with reduce evaporation.

Shading Screens; These are made of polyethylene mono-filament yarns for plantation of flowers, ornamental plants, and fruits and are in the form of woven or knitted fabrics.

Green House Covers; These covers are highly resistant to ripping, water proof and UV resistant and are very useful in nursery, cultivation of vegetable and shade loving plants to protect them from hails.

Green House Sidewall Curtains; These fabrics improve the green house micro climate and heating costs, shield crops from cold winds and rains. They are durable, sun resistant finish and UV resistant fabrics.

Weed Control Fabrics; The weed control fabrics promote rapid plant growth and maintain higher soil temperatures. Landscape weed control fabrics are extensively used to control the weeds, which prevent growth while allowing air, water and nutrients to pass through to the plants, preserve soil moisture.

Ground Cover; The dense weave of ground covers effectively suppress the weed growth and conserves ground moisture. This fabric is highly UV resistant and protects harmful effects of exposure to sun light and offers long-term weed control.

Bird Nets; These are knitted mono-filament nets protect the seeds, crops and fruits against damage caused by birds and a variety of pests. The open mesh nets can be laid over the plants easily which repels birds.

Seed Cage Covers; These are typically made of rugged and UV resistant polypropylene fabrics which are very effective in covering the seed cage. It protects the seed and flowering crops from insects and birds.

Rain Covers;

The rain cover fabric is highly UV resistant and breathable fabric that protects the flowers and berries from damage on rainfall. It serves the purpose of saving the plant from rain and hail protection against cracking.

Temperature Controlled Fabric; This fabric is a spun bonded non-woven polyester fabric, which protects the crops from cold, frost, insects, wind and rain and a variety of adverse environmental factors while letting them breathe. The temperature controlled fabrics capture heat on sunny days, retain heat radiation from ground at night and also block night time winds.

MANUFACTURING PROCESSES AND SPECIFICATIONS:-India has tremendous potential for production, consumption, and export of technical textiles. Agro-textiles contribute about 1.5% of the total production of technical textiles in India, while the globally growing demand for agricultural products is expected to boost the need for agro-textiles products. There is use of synthetics as well as natural fibers in agro-textiles and the various fibers used for their production have discussed earlier. Several techniques of fabric production can be used to produce agro-textiles, with each method offering specific advantages for particular product.

Woven-Woven products are produced by using Sultzer projectile weaving machines. The machines with weaving width of 540cm to 846cm are available for production of agro-textiles. The nets with a mesh width of 1.8mm to 40mm can be produced.

Knitting-warp knitting is the most widely used technique compared to weft knitting. Warp knitted protective nets are used in different sectors, which are produced on Rascal machines. Agro-nets are produced in various constructions or lapping.

Non-woven-There are many techniques to produce non-woven fabrics. Spun bonding and Needle punch techniques are mainly used for the production of non-woven agro-textiles. The spun bonded fabrics have high and constant tensile strength in all directions. It has also good tearing strength. Needle punch fabric plant bags provide advantages over conventional fire clay products. All natural fibers offer an added advantage of that the container decomposes after being planted in the ground.

Product Specifications;-

Bird Protection Net- Polyolefin mono-filament/tape yarns; warp knitted; 2-3 cm mesh size; 40-80gms/m.

Shade Net- Polyethylene tape yarns; warp knitted; mesh size varies as per requirement of shade net%; 60-90gms/m; woven structure of lighter weight are also used.

Wind shield Fabric- Polyethylene mono-filament/tape yarns; warp knitted; mesh size as per required wind blockage%; 40-80gms/m; woven structures of lighter weight are also used.

Plant Nets- Polyethylene mono-filament/polyethylene tape yarns; warp knitted; strips of nets with large opening; 30-40gms/m.

Harvesting Nets- Polypropylene mono-filament/polyethylene tape yarns; warp knitted; flat nets of square or triangular construction; mesh size 8-12cm; 40-90gms/m; woven structure of lighter weight are also used.

Ground Covers- Polyethylene; spun bonded; 100gms/m & above; woven/non-woven bio-degradable structures of jute and coir are also used.

Packing Materials- Polyethylene tape yarns; warp knitted; 50-60gms/m; woven jute sacks are also used.

STANDARDS ON AGRO-TEXTILES: - BIS initiative through TXD35, the sectional technical committees for Technical Textiles for Agro-textiles applications, some standards have already been approved and some more are in the

process of approval. Moreover, the Government of India, have taken initiatives through the steering Committee for growth and development of technical textiles under the chairmanship of textile Commissioner, Mumbai, and also the involvement of Centre of Excellence with the SASMIRA, Mumbai as lead partner with MANTRA, Surat and NAU, Navsari as partners. But, it is a long way to go for the full proof Standardization on agro-textiles. However, the requirements for qualifying as standards for agro-textiles use are discussed in short as follows;-

(i)Sunscreen- Quality of nets required will depend on the amount of sun light required for the crop as compared to that available in a given area.

(ii)Bird Protection Nets- These are made from sufficiently strong materials, open structure with minimal shading and sufficiently small opening not to allow birds damaging the crops and also be able to withstand sun, wind and rain.

(iii)Plant Nets- The structure should restrict the moisture reaching fruits and have maximum allowable level of moisture transmission through the fabric to be decided on the behavior of the fruits under protection.

(iv)Ground Cover- Fabrics must have moisture and heat transportation ability and it must not allow ant and weeds to get light for development.

(v)Wind Shield- fabric structure depends on the maximum wind speed attainable in the region and size of the fabric is determined on the basis of plantation size. Air permeability is very important.

(vi)Root Ball Net- these fabrics should have sufficiently open structure to allow roots to grow and are bio-degradable over a period of time.

(vii)Meshes for Insects- Mesh materials to be strong enough for insects to be not able to destroy it and must have adjustable character.

(viii)Tuft Protection-It should allow the grass to grow but give sufficient strength to ground so that earth is not removed with the movement of animals.

(ix)Crop Covers- These fabrics should be tough with a high degree of UV stabilization and suppleness for ease of handling. They must offer protection from frost, rain, hail and wind.

CONCLUSIONS

Textile structures in various forms are used in shade houses/poly houses, green houses, and also in open fields to control environmental factors like temperature, water and humidity. The need of **textile goods** in the field of **agriculture** has been stressed and their role in the reduced usage of harmful pesticides and herbicides to render a health farming culture underlined. Textiles proved to be **flexible** in their suitability for specific **geographical locations**. All the essential properties of **agro-textiles** help with the **growth and harvesting of crops** and other food stuffs. The volume of special textiles that are manufactured for agricultural applications is small compared to other areas of technical textiles and this does not mean that the use of textiles in agriculture is not significant. Tapping the potential of technical textiles and putting their vital properties to an advantage, agriculture, horticulture, forestry and fishing segments are increasing in agriculture, forestry and fishing segments using them for **equipment development** and other applications. The essential properties required for agro-textiles are strength, elongation, stiffness, porosity, bio-degradability, resistance sun light and resistance to toxic environment. The best known agro-textiles products are shade netting, and thermal screens, the use of which can **save up to 40%** on energy in heating of green-houses and their use prevents staining and improves uniformity of color. Natural as well as synthetic fibers are used in agro-textiles. Agro-textiles as technical textiles are becoming very popular all over the world due to several functional requirements, user friendliness, eco-friendliness, health and safety, cost effectiveness, and durability. Agro-textiles form about 1.5% of the technical textiles' market. Man-made/synthetic fibers are mainly used in technical textiles due to their important advantages. For standardization of these products some have already been approved and some are in the process.

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