

*Aditi Dhama*

## **New Innovation in Textiles: Corn Fibre**

**Aditi Dhama\***

\*Research Scholar, CCS University, Meerut

### **Abstract**

*Corn fiber is a new innovation in the textile industry. Corn Fiber is also called Ingeo fiber. It is a man-made fiber derived entirely from annually renewable resources. It is made using fermentation of simple plant sugar to create a range of textile products. It has emerged as an alternative to synthetic fibers. The fabric made from corn fiber is easy to care for, cheap, and very comfortable to wear. Moreover, it is stain-resistant and UV resistant. This fabric can be used for several applications such as readymade apparel, diapers, bedding, carpets, and upholstery. The production of this fabric requires the use of less fuel, and is hence environment-friendly as well.*

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## **Introduction**

Corn fibre is a comparatively new innovation in the textile industry. Cargill Inc. and The Dow Chemicals joined together to form Cargill Dow Polymers LLC, which developed corn fibre. Corn Fibre is also called Ingeo fibre. Corn is an agricultural product with large quantities of starch, which manufacturers extract from the plant fibres and break down into sugars that are then fermented and separated into polymers. At this point in the process, the corn fibres are paste-like substances which are then extruded into delicate strands that are cut, carded, combed, and spun into yarn. Aside from the chemical processes, the rest of the process is similar to what is done with wool.

**Abstract**



**Fig: Corn**

Corn fibre is a manmade fibre derived entirely from annually renewable resources. These fibres have the performance advantages often associated with synthetic materials, and complementing properties of natural products such as cotton and wool. Corn fibre is composed of lactic acid, which is produced by converting corn starch into sugar & then fermenting it to get lactic acid. Lactic acid can be considered a commodity chemical sleeping giant, with advantages including:

- a. It can be made from biomass.
- b. It has both a hydroxyl group and a carboxylic acid group.
- c. It is optically active.

The fabric made from corn fibre is easy to care for, cheap and very comfortable to wear. Moreover, it is stain-resistant and UV resistant. This fabric can be used for several applications such as readymade apparel, diapers, bedding, carpets and upholstery. Moreover, the production of this fabric requires the use of

less fuel, and is hence environment-friendly as well.



Fig: Corn fibre

The process for manufacturing the polymer used to make corn fibre on an industrial scale centers on the fermentation, distillation and polymerization of a simple plant sugar, maize dextrose.

The production and use of corn fibre means less greenhouse gases are added to the atmosphere. Greenhouse gases are the chief contributor to global climate change. Composability and chemical recyclability mean that under the right conditions and with the right handling, the complete life cycle of production, consumption, disposal and re-use is neatly closed.

#### **Manufacturing Process of Corn Fibre**

First step is the process of separating starch from the bio-mass basically wet milling is the process adopted. The starch is processed into dextrose that is then converted to lactic acid using a fermentation process using bacteria e.g. HomolacticLactobacteriaceae family. Monomer lactide collected through condensation and then purified through vacuum distillation. Using a solvent free process like Ultrafiltration, Nanofiltration and Ion-exchange process we obtain PLA resin from the lactide.

The lactic acid exists in two optical isomers L-isomer & D-L isomer. The polymer produced from D-L isomer by using direct condensation requires solvent under high pressure & high vacuum. Hence L isomer is used. Lactic acid firstly condensed to transform it into short chain PLA. It is then converted into lactic acid by using vacuum distillation. No solvent is required during distillation. The final stage is ring-opening polymerization.

**Flow of Manufacturing:**

Corn → Starch → Undefined Dextrose → Fermentation → Lactic acid → Direct polymerization → PLA → Melt spinning → PLA fibre

Corn fibre production sequence is:

Seeds, Soil, Water, Carbon dioxide, Sunlight

Grow-months

Biomass, ideally corn

Harvest/Wet Mill

Starch

Acid/Enzyme Hydrolysis

Dextrose ?

Fermentation

Lactic Acid

Polymerise

Crude Polylactic Acid Pre-polymer

Depolymerise

Crude Lactide monomer

Fractional Distillation

Pure lactide monomers

Blend/Polymerise

Polylactic Acids

Modification for end-use

Granules for extrusion etc.

Melt Spinning

“Crop-Based” Fibres

Producing the lactide with the right purity and stereochemistry to make decent fibres is not trivial. In a recent Cargill patent, the refining process, intended to be able to cope with crude lactic acid feedstock, was illustrated as follows:

Feed Crude Lactic Acid to Evaporator continuously

Remove water or solvent discard or recycle water, solvent or by-products

Feed concentrated lactic acid to a pre-polymer reactor

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Polymerize to form pre-polymer by removing water discard or recycle water, solvent or by-products contaminated with lactic acid

Feed in catalyst Feed pre-polymer to lactidereactor' !Remove high-boiling unreacted polymer

Remove crude lactide as vapour

Partially condense crude lactide Remove lactide impurity as a vapour

Purify crude lactide in a distillation column ' !Remove lactide impurities

Remove purified lactide as high-boiling bottoms from the column

#### Polymerisation

Yarns, fabrics and garments made from corn fibres can be processed on conventional machinery through all of the manufacturing stages; there is no need for any capital investment in plant. In many of the downstream sectors fibre spinning, yarn spinning, fabric production and dyeing and finishing- corn fibre is comparable with polyester. Both are available in filament and staple form; they are melt spun ;weaving and knitting set up conditions are similar; fabrics can be heat treated to give dimensional stability and they are both dyed with disperse dyes.

#### **Properties of Corn Fibre:**

Corn fibre combines the quality of natural and synthetic fibres in a new way.

Strength and resilience are balanced with comfort, softness and drape in textiles.

Corn fibre is naturally flame retardant and good moisture management characteristics.

It has good stain resistance properties.

Corn fibre also uses no chemical additives or surface treatments, and is naturally flame retardant.

Corn fibre stain resistance properties make it an ideal carpet fibre for the home, and the transportation.

The melting point is 170 deg C.

The heat setting is done at 125-130 deg C for 30 second.

Hydrolysis degradation of the polymer will occur, particularly under combined aqueous high-temperature and alkaline conditions.

PLA has excellent physical and mechanical properties, forced it to become a good challenger candidate for substitution for petrochemical thermoplastics. The high price for PLA was hurdle which made its use to medical and specialty applications only, but recent breakthroughs in lactic acid fermentation technology have opened up possibilities for the production of PLA in bulk volumes also.

### **Yarn Made from Corn**

Yarns made from corn, such as Kollage yarn's Corntastic or Bernat'sCot'n Corn (a blend of corn and cotton fibres). To turn corn into yarn, manufacturers extract a plant sugar called dextrose from the plant fibres. (The image shown in figure11 is of a model of dextrose) .Next, they ferment the corn sugar and distil it, using the same process used to make beer, and then extract the lactic acid that is produced. The lactic acid forms a long chain, or polymer, called Polylactic Acid (PLA) .Once it is spun into yarn, PLA has a texture similar to cotton or even silk, depending on how it is spun, and it is less dense than cotton or wool, so it can be used for lighter weight garments.

### **Characteristics of Corn Fibre**

- a. Corn fibre is a kind of yogurt polymer. It is tested that Corn knitted fabric will not stimulate skin, and it is beneficial and comfortable to wear. Corn fibre has excellent drape, slippery, moisture regain and air permeability and it has full luster and elasticity.
- b. This fibre has living creature and can decline a solution.
- c. Corn fibre is light and soft to slip to follow.
- d. The strength is big, absorbing wet well ventilated.
- e. The product processed has the sheen and comfortable skin touch
- f. Good heat-proof and anti- ultraviolet ray function.
- g. Fibre doesn't use petroleum to equalize work raw material completely.
- h. The wastes can decline a solution under the aquatic microorganism function of the soil and the sea will not pollute environment.

### **Benefits of Corn Fabric**

- a. It has good strength and resiliency.
- b. It has natural comfort and drape.
- c. It is naturally insulating.
- d. It have moisture wicking.
- e. It is more breathable than polyester.
- f. It provides odor control.

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- g. It is stain resistant and color fast.
- h. It has low pilling.
- i. It does not shrink dries quickly.
- j. It is hypoallergenic.
- k. It is natural UV resistance.
- l. It is ideal for all climates.
- m. It has Low flammability and less smoke generation.
- n. It has Low index of refraction, which provides excellent color characteristics, with the shiny luster as silk.

### **Application of Corn Fibre**

Corn fibre has a natural feel that provides true innovation from yarns to garments. This fibre can replace many various textile materials, it is most fit for clothing, can be made into yarn, fabric, knitting, nonwoven, staple fibre, multifilament and single filament. It can be spun into pure yarn, at the same time it can be spun with cotton, wool, viscose and other chemical fibres. The natural source and inherent performance attributes of corn fibre make it ideal for use in a wide range of fibre applications.

### **Apparel**

Characteristics like strength, resilience, comfort and drape combined with loft, natural insulating warmth and moisture management make corn fibre the perfect solution for both outer and inner fabric performance needs. Moreover, because of its easy-care properties, corn fibre-based fabrics are an easy choice for clothing manufacturers. Corn fibre is used in many different apparel applications such as contemporary sports and casual wear t-shirts, fleece and jeans. Functional fashion separates like shirting's, trousers, duvet jackets, jersey dressing and essential next- to-skin items such as underwear and hosiery. Corn fibre can also be used in new fibrefill blends for thermal wadding that offers unique natural insulation properties. The use of corn fibre in clothing fabrics translates into garments that are both easy care and easy wear.



Fig: Clothes made from corn

### **Home Textiles**

The natural versatility of corn fibre allows it to be created as furnishing and home textile also. Corn fibre is used in different home textile product categories and it is suitable for bedding fibrefill (such as pillows, duvets and quilts), ticking fabrics, mattresses, blankets, carpets, draperies, upholstery fibrefill and in office wall paneling.

### **Nonwoven**

Corn fibre is already in use in two non-woven applications: wipes and feminine hygiene products. With its unique end-of-life options, it is well suited for use in cosmetics and diapers.

### **Industrial Applications**

Corn fibres can be used for geotextiles, agro textiles and specialist filtration media. Corn in form of biopolymer can also be used, in its plastic form, for packaging.

***For construction/civil engg.Material:*** Curing sheet, slope vegetation nets, etc.

***For food packaging:*** Trays, fast- food containers, etc. For daily sundry products: Garbage pail bags, strainer bags, etc.

### **Medical field**



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Such as seam after operations, non-woven fabric, bandage, gauze, absorbent cotton. Its composite material is used as fixup in bone joint.

### **Conclusion**

Corn fibre is a manmade fibre derived entirely from annually renewable resources. These fibres have the performance advantages often associated with synthetic materials, and complementing properties of natural products such as cotton and wool. Also, with global warming concerns, corn fabrics can help you say bye-bye to heat and sweat. Corn clothes can fight off humidity by diffusing perspiration into the air, providing your body with wearable air conditioning (minus the hassle of electricity bills). With their remarkable permeability and moisture absorbency, corn fabric can keep you dry in even the dampest conditions. And, like other eco-friendly fabrics, corn fibres provide the equivalent of SPF60 sun protection due to their high UV ray resistance. More and more environmentalists and clothing manufacturers are claiming that corn is well situated to take root in the fashion industry. Since corn leads all the other crops in both value and volume, many also believe that it will become the number one textile product in the 21st century.

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