Natural, artificial and synthetic fibres: because there are differences...there are many...and it is important to know them.

Natural fibres are those obtained through simple mechanical processes that do not modify the structure. They differ between natural fibres of **animal origin** (wool, angora fur, camel fur, cashmere fur, mohair fur, alpaca fur, llama fur, vicuna fur, bison fur, qiviut fur, sea silk, down) and **vegetable** (cotton, linen, hemp, jute, ramie or nettle, sisal, coconut, broom, hibiscus, manila, straw, bamboo, soy, kapok).

- **Silk**

Chemically:

- **Fibroin** – highly biocompatible and biodegradable natural polymer protein (carbon 47.6% Hydrogen 6.39% Nitrogen 18.33% Oxygen 27.68%)
- **Sericin** – natural protein with a unique affinity to other human proteins (carbon 46.50% Hydrogen 6.04% Nitrogen 16.50% Oxygen 30.96%)

Amino acid components:

GLYCINE (Helps to trigger the oxygen release process) - **ALANINE** (Important source of energy for muscle tissue) - **SERINE** (Source of glucose storage in the liver and muscles) - **ASPARTIC ACID** (Helps the expulsion of harmful ammonia from the body) - **GLUTAMIC ACID** (Considered as a natural "food for the mind") - **VALINE** (Stimulates mental vigour and muscle coordination) - **PROLINE** (Important for the correct functioning of joints and tendons) - **THREONINE** (Important constituent of collagen) - **LYSINE** (Ensures adequate calcium absorption) - **ARGININE** (Improves the immune response to bacteria, viruses and cancer cells) - **THYROSINE** (Transmits nerve impulses to

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the brain) - **PHENYLALALINE** (Used by the brain to produce noradrenaline) - **LEUCINE** and **ISOLEUCINE** (Provide the ingredients for the manufacture of essential biochemical components in the body) - **METHIONINE** (Principle supplier of sulphur) - **CISTINE** (Antioxidant, aid for the body in protecting against radiation and pollution) - **TRYPTOPHAN** (Natural relaxant, helps relieve insomnia) - **TAURINE** (Helps stabilise the excitability of membranes) - **HISTIDINE** (Found abundantly in haemoglobin. **Artificial fibres** are fibres that have natural products such as cellulose, animal or vegetable proteins as their starting point but which are **subjected to chemical processes** with the aim of making them soluble and, once properly filtered and broken down, coagulated and recomposed under filament form (acetate, cupro, lyocell, Tencel, modal, Triacetate, Viscose or Rayon)

- **Viscose**

  Designed in 1883 by the French chemist Hilaire Bernigaud de Chardonet. He immediately tried to legitimise it with denominations that would make the way it was produced less evident. It was called Artificial Silk, a brand that was subsequently abolished due to the obvious cases of counterfeiting with respect to natural silk. It is produced by processing wood pulp or other cellulose-based vegetable matrices and preliminarily treated with **caustic soda**. The resulting fragments are left to mature for 40/60 hours at 18/22°C and then macerated in a chemical solution, generally in **carbon disulphide**. The product obtained is macerated again in alkaline solvents (**caustic soda**), obtaining a yellowish substance that will be

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subjected to extrusion. Then it is dried and placed in sulphuric acidbased coagulating baths to obtain chemical solidification.

- **Carbon disulphide is an organic sulphide**, a colourless liquid with a characteristic and unpleasant odour. Very **flammable**, irritating, **toxic** due to its interaction with the central nervous system and **harmful to reproduction.**
- **Sulphuric acid** is a very strong, liquid, oily, colourless and odourless mineral acid. Highly **corrosive**, the vapours cause severe irritation to the eyes, respiratory tract and mucous membranes with possible **risks of pulmonary oedema** with damage to the respiratory tract • **Sodium hydroxide** or improperly sodium hydrate, commercially known as **caustic soda**. It is a strong, extremely **corrosive** mineral base, especially if combined with water with very high levels of **pollution** both during use and during its production.

Commonly produced from the cellulose of trees, including beech, pine and eucalyptus. More than **120,000,000 trees** are **deforested** every year, with irreparable damage to the ecosystem and fauna. During the production phases, there is considerable **environmental damage** from industrial wastewater discharge and from atmospheric pollution.

- **Cupro** was created in Germany at the end of the nineteenth century. It is obtained from filaments situated near the seed of the cotton plant (cellulose), dissolved in a **cuprammonium solution of copper and ammonia**, and then extruded. The solution is **greatly hazardous to health**, **highly polluting** to the air and wastewater.

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- **Lyocell or Tencel**

  fibre produced from cellulose on the viscose protocol; it is first fragmented and then dissolved in a **powerful oxidant**, NMMOmonohydrate. It is subsequently extruded for the production of fibre.

Synthetic fibres are fibres that derive directly from a **chemical transformation** (polymerisation) of as many chemical substances deriving in most cases from **petroleum** or petroleum compounds (acrylic, aramid, modal acrylic, chlorovinyl, neoprene, polyamide or nylon, polyester, polythene, polytetrafluoroethylene or Goretex, polyurethane, nylon)

- **Polyester**

  Introduced as a textile material in 1948 under the Terylene brand, among the various types, that textile is defined as PET (polythene terephthalate). The initial monomers are 1,4-benzenedicarboxylic acid (**terephthalic acid**) and 1,2-ethanediol (**ethylene glycol**). During the first stage, an ester is formed; then, there will be the polymerisation stage (temperature of 260°C, at low pressure) with a catalyst (antimony oxide). Its production uses **enormous quantities of water** which, together with the lubricants used, represents a great source of contamination. To produce **1 kg of PET**, **2 kg of oil** are required. The worldwide production of Polyester is 53,000,000 tonnes. A polyester sweatshirt deposits up to **1,000,000** dangerous and polluting **microfibres** in the washing water. **Biodegradable in 450/600 years**, **PET** is advertised as the safest plastic, which is most

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commonly subject to recycling-related projects, and a constituent part of countless other artificial fibres (e.g. Celiant) highlights countless very critical areas:

- Subject to variations in temperature and/or high temperatures, PET tends to deteriorate by spreading a toxin called **DEHA**, which is suspected of being carcinogenic and toxic to reproduction and the liver.
- PET can release **antimony**, a toxic metalloid,
- PET can release well-known brominated compounds, including **PBDEs**, which are powerful environmental pollutants with potential effects of high toxicity at the endocrine and neurological level.
- As per its name, **PET contains phthalates**, which represent plasticisers used to provide plastics with flexibility. They are generally believed to be harmless. A recent German study (Johann Wolfgang Goethe University in Frankfurt - 2009) confirming countless scientific publications highlighted the release of substances (**hormone-mimic phthalates**) which confirm the danger of direct human exposure to endocrine disruptors.

- **Nylon**

  Its discovery, or rather its synthesis, can be traced back to 1935 (Dupont laboratory by Wallace Carothers): the two most common variants (Nylon-6 and Nylon-6.6) are obtained respectively from **caprolactam** (a ring-shaped molecule of 7 atoms) and **adipic acid** and hexamethylenediamine. In addition to its production being **extremely polluting**, if degraded in an incinerator, it creates **nitrogen oxide**, a

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greenhouse gas 310 times more powerful than carbon dioxide. **Biodegradable in 450/600 years**

- **Polypropylene**
  Considered a plastic that is as safe as PET, its use and production, in addition to contamination and pollutants from petroleum products, is very dangerous from the point of view of the phthalates previously seen for PET.

- **PVC or polyvinyl chloride**
  It is considered the most dangerous plastic as it can contain one of the most dangerous phthalates, **DEHP**, a compound that can damage the bones, liver and kidneys. It is usually used to make plastic more resistant, flexible and soft and, therefore, especially in textile uses.
  Once burned, it creates Dioxin.

- **PLA**
  PLA polylactic acid or polylactide is the polymer of lactic acid. It is produced starting from fermented vegetable starch such as corn, sugar cane, sugar beet, cassava. Starch (a sugar) is extracted from plants and transformed using enzymes into glucose. Glucose is subjected to fermentation and polymerization obtaining molecular sequences like those of petroleum-based polymers. An elastic fiber is obtained.
  The production of PLA involves a **significant consumption of carbon**, **fossil fuels and water** to produce the raw materials from which it

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derives. To produce **1 kg of PLA**, approximately **2.60 kg of corn** are needed. The replacement of the entire global plastic production (around 300 million tons) with PLA it would require approximately 750 million tons of corn which would be removed from the food chain and therefore replaced. Declared biodegradable in a few years (from 1 to 4) sometimes assimilated to common household waste deriving from food waste, in fact PLA is an element and a fiber that must be intended exclusively for **the industrial composting facility**. PLA is compostable only and exclusively in controlled temperature conditions (above 50/70 degrees) and humidity of industrial waste.
PLA must not be left in the environment as if not treated appropriately it contributes to a **high level of environmental pollution**. The decomposition times of PLA in the environment are approximately **80/90 years**.
It is not recyclable as there is currently no PLA recycling and reuse chain in place. PLA is collected precisely for the need to send it to industrial treatments, together with high plastics (especially PET) which increase and cause contamination.PLA, especially if incinerated or brought close to intense heat sources, **emits a significant quantity of nanoparticles** capable, due to penetration and size, of crossing the different capillary barriers of our body:

- **lactide particles**.
- **toxic particles of colomethyl and styrene** together with other harmful and potentially **carcinogenic elements**: PLA is rarely 100% pure. It hides within it a series of additives used in the various phases of its production (up to 40%).