Exploring the chemistry of textiles chemistry essay



Textile chemistry is primarily an applied form of chemistry. It is a highly specialized field that applies the principles of the basic fields of chemistry to the understanding of textile materials and to their functional and esthetic modification into useful and desirable items. Textile materials are used in clothing, carpet, tire yarn, sewing thread, and air bags.

Some textile chemists are less oriented toward manufacturing processes and more focused toward fiber technologies.

The study of textile chemistry begins with the knowledge of fibers themselves-both natural and synthetic. Because synthetic fibers are such an important part of today's textile business, the field includes many who are trained as polymer chemists.

The interaction between textile chemistry and materials science is also increasing. Textile chemistry includes the application of the principles of surface chemistry to cleaning processes and modifications such as dyeing and finishing. It relates organic chemistry in the synthesis and formulation of the products used in these processes.

2. is dynamic

"Traditionally, textile chemists have been trained to have an in-depth understanding of the structure and properties of natural and synthetic fibers," says Norman Nemerov, professor of chemistry at the Philadelphia College of Textiles and Sciences. "They have also been taught the posttreatment chemistries, which impart properties such as dye ability, wash freshness, and permanent press. But today there are new demands, such as recyclability. One thing we're looking at is how to make fibers degradable https://assignbuster.com/exploring-the-chemistry-of-textiles-chemistryessay/ over time," he says. " And, in a relatively new area called biotextiles, fibers are being developed for drug delivery systems," Nemorov adds.

"Weaving, dyeing, and finishing cloth is an ancient art, but it's also a modern science," says Fred Miller, vice president of Hickory Dyeing and Winding Company. Jim Hammond, a senior research associate in nylon research and development at Dupont, comments, "I often say that if I took a two-year trip around the world, my knowledge would be obsolete by the time I came back." Miller said, "The field is exciting because there's still so much to know and to learn." After many years in the business, both Hammond and Miller still find their work creative and intellectually challenging.

3. Brings older technology up to date

While new technology abounds, the most commonly used fibers have been around for a long time. But, chemists working with these materials are often focused on modifying them for new applications.

Sushma Kitchloo, a polymer chemist at Globe Manufacturing, is responsible for new product development and troubleshoots problems associated with modification of polymers

Miller's expertise is in the interaction between fibers and the dyes that give them color and luster. Modifying traditional polymers requires adjusting the chemical processes for downstream functions, such as dyeing the fiber.

4. is tangible

" In textiles, you are working with something you can hold and feel." says Ehrhardt. " The skill set for this field includes understanding process manufacturing, being familiar with physical testing of fibers, having knowledge of weaving and knitting, and understanding the evolution of a product through garment form.

Specializing in the field of textile chemistry can provide opportunities for dynamic and creative applications of chemistry. A textile chemist relates knowledge of the organic structures of both fibers and the chemicals used to modify them to specific chemical, physical, and esthetic properties.

The combination of the theoretical and the practical makes possible the development of the thousands of textile chemicals necessary for the production of the finished articles of commerce.

Textile:- Textile is a flexible material consisting of a network of natural or artificial fibres often referred to as thread or yarn.

Yarn is produced by spinning raw wool fibres, linen, cotton, or other material on a spinning wheel to produce long strands known as yarn. Textiles are formed by weaving, knitting, crocheting, knotting, or pressing fibres together

The words fabric and cloth are used in textile assembly trades (such as tailoring and dressmaking) as synonyms for textile. However, there are subtle differences in these terms.

Textile refers to any material made of interlacing fibres.

Fabric refers to any material made through weaving, knitting, crocheting, or bonding.

Cloth refers to a finished piece of fabric that can be used for a purpose such as covering a bed.

Textile Chemistry Terminology

Performance fabrics offer special benefits to consumers, such as stainrepellency, wrinkle-resistance, or odor-control. New technologies are launched every year. CCRC is committed to keeping ahead of the technology curve, assuring that consumers will be satisfied with the home care of the fabrics, as well as performance.

Antimicrobial Agent (AM) – A chemical compound either destroys or inhibits the growth of microscopic and submicroscopic organisms.

Flame Resistant (FR) – The characteristic of a fabric to resist ignition and to self extinguish if ignited.

Flammability – The ability of a material or product to burn with a flame under specified test conditions.

Hydrophilic – Water loving; having a high degree of moisture absorption or attraction.

Hydrophobic – Water repelling; having a low degree of moisture absorption or attraction.

Resiliency – Ability of a fabric to return to its original shape after compressing, bending or other deformation.

Reusable Protective Clothing – Garments which are capable of withstanding a maintenance procedure to remove soil and other contaminants yet retain the garment's protective characteristic.

Stoll Curve – Developed by Alice Stoll in 1960's it is used in many tests to predict the thermal protective performance of textile materials for FR apparel. It is essentially a plot of thermal energy and time predicted to cause a pain sensation, or a second degree burn, in human tissue.

Waterproof – Ability of a fabric to be fully resistant to penetration by water. Example: – rain coat.

History

Late antique textile, Egyptian, now in the Dumbarton Oaks collection.

The production of textiles is an important craft, whose speed and scale of production has been altered almost beyond recognition by industrialization and the introduction of modern manufacturing techniques. However, for the main types of textiles, plain weave, twill or satin weave, there is little difference between the ancient and modern methods.

Incans have been crafting quipus (or khipus) made of fibres either from a protein, such as spun and plied thread like wool or hair from camelids such as alpacas, llamas and camels or from a cellulose like cotton for thousands of years. Khipus are a series of knots along pieces of string. They have been believed to only have acted as a form of accounting, although new evidence conducted by Harvard professor, Gary Urton, indicates there may be more to the khipu than just numbers.

Preservation of khipus found in museum and archive collections follow general textile preservation principles and practice.

Metal fibre, metal foil, and metal wire have a variety of uses, including the production of cloth-of-gold and jewelry. Hardware cloth is a coarse weave of steel wire, used in construction.

Sources and types

[Traditional Romanian fabric]

Textiles can be made from many materials. These materials come from four main sources:

animal,

plant,

mineral, and

synthetic.

In the past, all textiles were made from natural fibres, including plant,

animal, and mineral sources.

In the 20th century, these were supplemented by artificial fibres made from petroleum.

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Textiles are made in various strengths and degrees of durability, from the finest gossamer to the sturdiest canvas. The relative thickness of fibres in cloth is measured in deniers. Microfibre refers to fibres made of strands thinner than one denier.

Animal textiles

Animal textiles are commonly made from hair or fur.

Wool refers to the hair of the domestic goat or sheep, which is distinguished from other types of animal hair in that the individual strands are coated with scales and tightly crimped, and the wool as a whole is coated with an oil known as lanolin, which is waterproof and dirtproof. Woollen refers to a bulkier yarn produced from carded, non-parallel fibre, while worsted refers to a finer yarn which is spun from longer fibres which have been combed to be parallel. Wool is commonly used for warm clothing.

Cashmere, the hair of the Indian cashmere goat, and mohair, the hair of the North African angora goat, are types of wool known for their softness.

Angora refers to the long, thick, soft hair of the angora rabbit

Other animal textiles which are made from hair or fur are alpaca wool, vicuña wool, llama wool, and camel hair, generally used in the production of coats, jackets, ponchos, blankets, and other warm coverings.

Angora refers to the long, thick, soft hair of the angora rabbit.

Wadmal is a coarse cloth made of wool, produced in Scandinavia, mostly 1000~1500CE.

Silk is an animal textile made from the fibres of the cocoon of the Chinese silkworm. This is spun into a smooth, shiny fabric prized for its sleek texture.

Silk

Silk is a "natural" protein fiber, some forms of which can be woven into textiles.

The best-known type of silk is obtained from cocoons made by the larvae of the silkworm Bombyx mori reared in captivity (sericulture).

The shimmering appearance for which silk is prized comes from the fibres' triangular prism-like structure which allows silk cloth to refract incoming light at different angles.

Silk is also the strongest natural fiber known to man.

The length of the silk fiber depends on how it has been prepared. Since the cocoon is made of one strand, if the cocoon is unwound carefully the fibers can be very long.

Wool

Wool is the fiber derived from the fur of animals of the Caprinae family, principally sheep, but the hair of certain species of other mammals such as goats, alpacas, and rabbits may also be called wool.

Alpaca

Alpaca fiber is that of an alpaca.

It is warmer than sheep's wool and lighter in weight.

It is soft, fine, glossy, and luxurious.

The thickness of quality fiber is between 12-29 micrometres.

Most alpaca fiber is white, but it also comes in various shades of brown and black.

Angora

Angora wool or Angora fiber refers to the downy coat produced by the Angora rabbit.

Angora is prized for its softness, thin fibers of around 12-16 micrometres for quality fiber, and what knitters refer to as a halo (fluffiness). The fiber felts very easily.

Angora fiber comes in white, black, and various shades of brown.

Cashmere

Cashmere wool is wool obtained from the Cashmere goat.

Cashmere is characterized by its luxuriously soft fibers, with high napability and loft. In order for a natural goat fiber to be considered Cashmere, it must be under 18. 5 micrometers in diameter and be at least 3. 175 centimeters long.

It is noted as providing a natural light-weight insulation without bulk.

Fibers are highly adaptable and are easily constructed into fine or thick yarns, and light to heavy-weight fabrics.

Sheep's wool

Wool has two qualities that distinguish it from hair or fur: it has scales which overlap like shingles on a roof and it is crimped; in some fleeces the wool fibers have more than 20 bends per inch. Wool varies in diameter from below 17 micrometres to over 35 micrometres

The finer the wool, the softer it will be, while coarser grades are more durable and less prone to pilling.

Plant textiles

Grass, rush, hemp, and sisal are all used in making rope. In the first two, the entire plant is used for this purpose, while in the last two, only fibres from the plant are utilized.

Coir (coconut fibre) is used in making twine, and also in floormats, doormats, brushes, mattresses, floor tiles, and sacking.

Straw and bamboo are both used to make hats. Straw, a dried form of grass, is also used for stuffing, as is kapok.

Fibres from pulpwood trees, cotton, rice, hemp, and nettle are used in making paper.

Cotton, flax, jute, hemp and modal are all used in clothing. Piña (pineapple fibre) and ramie are also fibres used in clothing, generally with a blend of other fabrics such as cotton.

Acetate is used to increase the shininess of certain fabrics such as silks,

velvets, and taffetas.

Seaweed is used in the production of textiles. A water-soluble fibre known as alginate is produced and is used as a holding fibre; when the cloth is finished, the alginate is dissolved, leaving an open area

Tencel is a man-made fabric derived from wood pulp. It is often described as a man-made silk equivalent and is a tough fabric which is often blended with other fabrics – cotton for example.

Mineral textiles

or vinyl tiles, sheeting, and adhesives, " transite" panels and siding, acoustical ceilings, stage curtains, and fire blankets.

Glass Fibre is used in the production of spacesuits, ironing board and mattress covers, ropes and cables, reinforcement fibre for composite materials, insect netting, flame-retardant and protective fabric, soundproof, fireproof, and insulating fibres.

Metal fibre, metal foil, and metal wire have a variety of uses, including the production of cloth-of-gold and jewelry. Hardware cloth is a coarse weave of steel wire, used in construction.

Synthetic textiles

[A variety of contemporary fabrics. From the left: evenweave cotton, velvet, printed cotton, calico, felt, satin, silk, hessian, polycotton.]

All synthetic textiles are used primarily in the production of clothing.

Polyester fibre is used in all types of clothing, either alone or blended with

fibres such as cotton.

Aramid fibre (e. g. Twaron) is used for flame-retardant clothing, cutprotection, and armor.

Acrylic is a fibre used to imitate wools, including cashmere, and is often used in replacement of them.

Nylon is a fibre used to imitate silk; it is used in the production of pantyhose. Thicker nylon fibres are used in rope and outdoor clothing.

Nylons are condensation copolymers formed by reacting equal parts of a diamine and a dicarboxylic acid, so that peptide bonds form at both ends of each monomer in a process analogous to polypeptide biopolymers. Chemical elements included are carbon, hydrogen, nitrogen, and oxygen.

The most common variant is nylon 6-6 which refers to the fact that the diamine (hexamethylene diamine) and the diacid (adipic acid) each donate 6 carbons to the polymer chain.

Spandex (trade name Lycra) is a polyurethane fibre that stretches easily and can be made tight-fitting without impeding movement. It is used to make activewear, bras, and swimsuits.

Olefin fibre is a fibre used in activewear, linings, and warm clothing. Olefins are hydrophobic, allowing them to dry quickly. A sintered felt of olefin fibres is sold under the trade name Tyvek.

Ingeo is a polylactide fibre blended with other fibres such as cotton and used in clothing. It is more hydrophilic than most other synthetics, allowing it to wick away perspiration

The most common types of microfibers are made from polyesters, polyamides (nylon), and or a conjugation of polyester and polyamide. The shape, size and combinations of synthetic fibers are selected for specific

characteristics, including: softness, durability, absorption, wicking abilities, water repellency, electrodynamics, and filtering capabilities.

Names

Characteristics

Major Domestic and Industrial Uses ACETATE

Luxurious feel and appearance

Wide range of colors and lusters

Excellent drapability and softness

Relatively fast-drying

Shrink-, moth-, and mildew-resistant

Apparel: Blouses, dresses, and foundation garments. lingerie, linings, shirts, slacks, sportswear.

Fabrics: Brocade, crepe, double knits, faille, knitted jerseys, lace, satin, taffeta, tricot.

Home Furnishings: Draperies, upholstery.

Other: Cigarette filters, fiberfill for pillows, quilted products

ACRYLIC

Soft and warm

Wool-like

Retains shape

Resilient

Quick-drying

Resistant to moths, sunlight, oil and chemicals

Apparel: Dresses, infant wear, knitted garments, ski wear, socks, sportswear, sweaters.

Fabrics: Fleece and pile fabrics, face fabrics in bonded fabrics, simulated furs, jerseys.

Home Furnishings: Blankets. carpets, draperies, upholstery.

Other: Auto tops, awnings, hand-knitting and craft yarns, industrial and geotextile fabrics.

ARAMID

Does not melt

Highly flame-resistant

High strength

High resistance to stretch

Maintains its shape and form at high temperatures

Hot-gas filtration fabrics, protective clothing, military helmets, protective vests, structural composites for aircraft and boats, sailcloth, tires, ropes and cables, mechanical rubber goods, marine and sporting goods.

MELAMINE

White and dyeable

Flame resistance and low thermal conductivity

High heat dimensional stability

Process able on standard textile equipment

Fire Blocking Fabrics: Aircraft seating, fire blockers for upholstered furniture in high-risk occupancies (e. g., to meet California TB 133 requirements)

Protective Clothing: Firefighters'turnout gear, insulating thermal liners, knit hoods, molten metal splash apparel.

NAMES

CHARACTERSTICS

USES

NYLON

Exceptionally strong

Abrasion-resistant

Lustrous

Easy to wash

Resists damage from oil and many chemicals

Resilient

Low in moisture absorbency

Apparel: Blouses, dresses, foundation garments, hosiery, lingerie and underwear, raincoats, ski and snow apparel, suits, windbreakers.

Home Furnishings: Bedspreads, carpets, draperies, curtains, upholstery.

Other: Air hoses, conveyor and seat belts, parachutes, racket strings, ropes and nets, sleeping bags, tarpaulins, tents, thread, tire cord, geotextiles.

OLEFIN

Unique wicking properties that make it very comfortable

Abrasion-resistant

Quick-drying

Resistant to deterioration from chemicals, mildew, perspiration, rot, and weather

Sensitive to heat

Soil resistant

Strong; very lightweight

Excellent colorfastness

Apparel: Pantyhose, underwear, knitted sports shirts, men's half hose, men's knitted sportswear, sweaters.

Home Furnishings: Carpet and carpet backing, slipcovers, upholstery.

Other: Dye nets, filter fabrics, laundry and sandbags, geotextiles, automotive interiors, cordage, doll hair, industrial sewing thread.

POLYESTER

Strong

Resistant to stretching and shrinking

Resistant to most chemicals

Quick-drying

Crisp and resilient when wet or dry

Wrinkle- and abrasion-resistant

Retains heat-set pleats and creases

Easy to wash

Apparel: Blouses, shirts, career apparel, children's wear, dresses, half hose, insulated garments, ties, lingerie and underwear, permanent press garments, slacks, suits.

Home Furnishings: Carpets, curtains, draperies, sheets and pillow cases.

Other: Fiberfill for various products, fire hose, power belting, ropes and nets, tire cord, sail, V-belts.

PBI

Highly flame resistant

Outstanding comfort factor combined with thermal and chemical stability properties

Will not burn or melt

Low shrinkage, when exposed to flame.

Suitable for high-performance protective apparel such as firemen's turnout coats, astronaut space suits and applications where fire resistance is important.

NAMES

CHARACTERISTICS

USES

RAYON

Highly absorbent

Soft and comfortable

Easy to dye

Versatile

Good drapability

Apparel: Blouses, coats, dresses, jackets, lingerie, linings, millinery. rainwear, slacks, sports shirts, sportswear, suits, ties, work clothes.

Home Furnishings: Bedspreads, blankets, carpets, curtains, draperies, sheets, slipcovers, tablecloths, upholstery.

Other: Industrial products, medical, surgical products, non-woven products, tire cord.

SPANDEX

Can be stretched 500 percent without breaking

Can be stretched repeatedly and recover original length

Light-weight

Stronger and more durable than rubber

Resistant to body oils

Articles (where stretch is desired): Athletic apparel, bathing suits, delicate

laces, foundation garments, golf jackets, ski pants, slacks, support and

surgical hose.

Production Methods:-

Textile Manufacturing:-

The manufacture of textiles is one of the oldest of human technologies. In order to make textiles, the first requirement is a source of fibre from which a yarn can be made, primarily by spinning. (Both fibre and fiber are used in this article.) The yarn is processed by knitting or weaving, which turns yarn into cloth. The machine used for weaving is the loom. For decoration, the process of colouring yarn or the finished material is dyeing. For more information of the various steps, see textile manufacturing..

Typical textile processing includes 4 stages:

yarn formation,

fabric formation,

wet processing, and

fabrication.

The three main types of fibers include

natural vegetable fibers (such as cotton, linen, jute and hemp),

man-made fibers (those made artificially, but from natural raw materials such as rayon, acetate, Modal, cupro, and the more recently developed Lyocell), synthetic fibers (a subset of man-made fibers, which are based on synthetic chemicals rather than arising from natural chemicals by a purely physical process) and protein based fi

1. Hand processing: yarn formation

Wool

Flax

2. Machine Processing: yarn formation

Cotton

Cotton Gin

Picking

Carding

Combining the Slivers

Spinning

Plying

Yucca

Leaf to Rolag

3. Hand Processing- Fabric Formation

Knitting

Crochet

Lace

Weaving

Loom

Process

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Knitting

Lace

Weaving

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Textile printing

Design for a hand woodblock printed textile, showing the complexity of the blocks used to make repeating patterns. Evenlode by William Morris, 1883.

Evenlode block-printed fabric.

Textile printing is the process of applying colour to fabric in definite patterns or designs. In properly printed fabrics the colour is bonded with the fiber, so as to resist washing and friction. Textile printing is related to dyeing but, whereas in dyeing proper the whole fabric is uniformly covered with one colour, in printing one or more colours are applied to it in certain parts only, and in sharply defined patterns.

In printing, wooden blocks, stencils, engraved plates, rollers, or silkscreens are used to place colours on the fabric. Colourants used in printing contain dyes thickened to prevent the colour from spreading by capillary attraction beyond the limits of the pattern or design. Traditional textile printing techniques may be broadly categorised into four styles:

Direct printing, in which colourants containing dyes, thickeners, and the mordants or substances necessary for fixing the colour on the cloth are printed in the desired pattern.

The printing of a mordant in the desired pattern prior to dyeing cloth; the color adheres only where the mordant was printed.

Resist dyeing, in which a wax or other substance is printed onto fabric which is subsequently dyed. The waxed areas do not accept the dye, leaving uncoloured patterns against a coloured ground.

Discharge printing, in which a bleaching agent is printed onto previously dyed fabrics to remove some or all of the colour.

Resist and discharge techniques were particularly fashionable in the 19th century, as were combination techniques in which indigo resist was used to create blue backgrounds prior to block-printing of other colours. Most modern industrialised printing uses direct printing techniques.

Textile recycling

Textile recycling is the method of reusing or reprocessing used clothing, fibrous material and clothing scraps from the manufacturing process.

Textiles in municipal solid waste are found mainly in discarded clothing, although other sources include furniture, carpets, tires, footwear, and nondurable goods such as sheets and towels.

Textiles and leather recycling categories

Cotton Recycling

Wool Recycling

Burlap, Jute and Sisal Recycling

Polyurethane Foam Recycling

Polyester and Polyester Fiber Recycling

Nylon and Nylon Fiber Recycling

Other Synthetic Fiber Recycling

Carpet Recycling

Rags and Wipers

Used and Recycled Bags

Used Clothing

Used Footwear

Leather Recycling

Textile Recycling Employment

Statistics

Year

Percent of textile recovered in the U. S. 1960 2. 8% 1980 6. 3% 2005

15.3%

Textile preservation

Textile preservation refers to the processes by which textiles are cared for and maintained to be preserved from future damage. The field falls under the category of art conservation as well as library preservation, depending on the type of collection. In this case, the concept of textile preservation applies to a wide range of artifacts, including tapestries, carpets, quilts, clothing, flags and curtains, as well as objects which " contain" textiles, such as upholstered furniture, dolls, and accessories such as fans, parasols, gloves and hats or bonnets. Many of these artifacts require specialized care, often by a professional conservator.

Treatments

[Embroidered skirts by the Alfaro-Nùñez family of Cochas, Peru, using

traditional Peruvian embroidery production methods.]

Textiles are often dyed, with fabrics available in almost every colour.

Coloured designs in textiles can be created by

weaving together fibres of different colours ,

adding coloured stitches to finished fabric (embroidery),

creating patterns by resist dyeing methods,

tying off areas of cloth and dyeing the rest (tie-dye), or drawing wax designs on cloth and dyeing in between them (batik), or

using various printing processes on finished fabric.

Woodblock printing, still used in India and elsewhere today, is the oldest of these dating back to at least 220CE in China.

Textiles are also sometimes bleached. In this process, the original colour of the textile is removed by chemicals or exposure to sunlight, turning the textile pale or white.

Textiles are sometimes finished by chemical processes to change their characteristics

More recently, nanomaterials research has led to additional advancements, with companies such as Nano-Tex and NanoHorizons developing permanent treatments based on metallic nanoparticles for making textiles more resistant to things such as water, stains, wrinkles, and pathogens such as bacteria and fungi. Fabric Care

Admittedly, laundry is not a beloved chore. The trick is to make clothes care fast and efficient, yet thorough. Poor care shortens the lifespan of apparel. Cutting corners in the laundry room only means spending more time in the dressing room, which wastes both time and money.

Science Delivers Smarter Washers and Dryers

Consumers seek a lot of performance from their appliances. They want the best possible clothing care in the least amount of time.

Some people want precise control over each load,

college students – just want to pack as much into each load and get the chore done quickly.

Engineering advancements have reduced energy and water consumption while improving clothing care from washers and dryers. CCRC studies emerging equipment technologies to evaluate their impact on fabric care and wash chemistries.

Using a variety of instruments, Over by can determine what kind of finish was used on a fabric, how much was applied, the fiber content of a fabric, and the effects that these and any number of other factors might have had on a sample. More often than not, Over by can offer specific reasons for a diversity of problems.

Uses

Textiles have an assortment of uses,

the most common of which are for clothing and containers such as bags and baskets.

In the household, they are used in carpeting, upholstered furnishings, window shades, towels, covering for tables, beds, and other flat surfaces, and in art.

In the workplace, they are used in industrial and scientific processes such as filtering.

Miscellaneous uses include flags, backpacks, tents, nets, cleaning devices, such as handkerchiefs; transportation devices such as balloons, kites, sails, and parachutes; strengthening in composite materials such as fibre glass and industrial geotextiles, and smaller cloths are used in washing by " soaping up" the cloth and washing with it rather than using just soap.

Textiles used for industrial purposes, and chosen for characteristics other than their appearance, are commonly referred to as technical textiles. Technical textiles include

textile structures for automotive applications,

medical textiles (e. g. implants),

geotextiles (reinforcement of embankments),

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