Quadrant II – Notes

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Unit: II Production, Chemistry, Properties and Usage of Fibres
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Notes :

Flax fibre

Flax is a versatile crop that is grown throughout the world and in a variety of climates. The translation of its scientific name, 'linen most useful', aptly describes its versatility. Linen, which is used for apparel and interior textiles, comes from the long, strong bast fibers that form in the outer portions of the flax stem.

Flax fibers also are used in industrial applications, eg, composites, geo-textiles, insulation, and specialty papers. Flax seeds are the source of linseed oil, which has been widely used in paints, varnishes, cosmetics, and linoleum.

More recently, flax seeds are being recognized as a health food, with nutritional benefits from lignans and omega-3 fatty acids. Even the woody core tissue (shive), which is removed during cleaning of fiber, is used for particleboards and animal bedding. Linen, which is valued for comfort and its distinctive appearance, remains a favorite in the textile industry.

History and Status of Flax and Linen

Flax was reportedly known as far back as 8000–9000 years to inhabitants in the ancient seacoast regions of modern-day Denmark and Turkey. Flax as a major textile in ancient Egypt, however, is well documented and frequently referenced. While flax is considered to have been first cultivated in Egypt, there is speculation that the origins of the plant might have been in other regions (eg, between the Baltic and the Caspian Sea), subsequently coming to Egypt via China or India. Egyptian shrouds used to wrap mummies have been reported to remain for ~7000 years. Notably, the high-quality linen from Tutankhamun's tomb has survived ~3500 years. Linen along with wool were the primary fibers for Europe throughout the Middle Ages and the Renaissance, with flax fibers used extensively for clothing and a variety of other applications.

Structure and Chemistry of Flax

Bast fibers are produced in the outer regions of the stem between the outermost cuticle–epidermis layer and the innermost, woody tissues. Separated fibers and fiber bundles appear stiff and brittle in longitudinal views under the microscope. The structure of the stem is important in retting, which is the process of separating fiber and non-fiber fractions. Fibers vary in length with a position on the stem. Oval-shaped bundles indicate high-quality fiber, while irregularly shaped bundles indicate poor quality. A thin cambium layer separates fibers and core tissues. These core tissues are comprised of lignified woody cells, which constitute the 'shive' fraction produced during fiber cleaning.

The stem cuticle of flax contains waxes, cutin, and aromatics. This structure serves as a barrier to protect plants from invading organisms and water loss. The cuticle closely covers the epidermis, and this relationship constitutes a rigid and formidable structure that influences the ease of retting. During retting, microorganisms enter the stems through cracks and disruptions

in the cuticle, partially degrade tissues, and thereby separate the cuticle/epidermal barrier from the fibers. Incomplete degradation, ie, poor retting, leaves this protective barrier and fibers still attached and contributes to reduced fiber and yarn quality.

Flax fibers are primarily comprised of cellulose, but pectins, hemicellulose, and phenolic compounds also are present. Compared with cotton fibers, which typically contain ~95% cellulose, flax has a lower percentage of cellulose and more pectin and hemicellulose. For example, in retted ‘‘Ariane’’ flax glucose was the predominant sugar (650 mg/g dry wt.) followed by mannose (39.2 mg/g) and galactose (35.0 mg/g); rhamnose, xylose, arabinose, and uronic acids were also present. In contrast to cotton, flax fibers stained with Oil Red, which indicates the presence of wax.

Flax Fiber Production

Flax can be grown for fiber or linseed. Flax is a temperate weather crop, generally cultivated in areas where the daily temperature remains <30°. Production of flax is environmentally friendly in that few chemicals are required for crop production.

In the traditional production of linen such as that practiced in Europe, flax plants are pulled from the soil, manually in early times and now with specialized equipment. Plants can be harvested by mowing when short flax fiber, rather than a long line of linen, is the objective.

THE LINEN LIFE CYCLE

- **PLANTING**: Planted between mid-March and mid-April, the seed takes 100 days to grow and reach 1 meter when it flowers.
- **FLOWERING**: Though the Linen flower only lives a few hours atop its supple stem, all flowers in a field do not bloom on the same day;

This is what gives the landscape a delicate blue-ish color for a few weeks, moving like an Impressionist sea in the wind.

- **HARVESTING**: We don't reap linen, we pull it up! It is pulled up when the leaves have dropped off the bottom third of the stem. The plants are then placed in swaths of cloth (one – meter wide linen sheets) which give the field a graphic beauty. The capsules holding the seeds take on a brownish-yellow color.

- **RETTING**:

Retting, which is the separation or loosening of fiber bundles from nonfibrous tissues, is a major problem in processing flax. In retting, fiber bundles are separated from the cuticularized epidermis and the woody core cells and subdivided into smaller bundles and ultimate fibers. Under-retted flax results in coarser fibers heavily contaminated with shive and cuticular fragments, while over-retting can reduce fiber strength due to excessive thinning of bundles or microbial attack on fiber cellulose. Two primary methods for retting, namely water-retting and dew-retting, have been used traditionally over millennia to separate fibers for textile and other commercial applications.

- **SCUTCHING**: The second phase for mechanically transforming the plant into fibers: to use the linen fibers which surround the central wood-like skin, it is necessary to separate them.
- **COMBING**: Combing is the preparation for spinning, a homogenization of fibers into soft, lustrous ribbons like blond hair.
- **SPINNING**: The spinning process comprises various operations which make it possible to transform the fibers into yarn. There are two main techniques: thick yarns for decoration are obtained by dry spinning; Fine yarns for clothing and household linen, by "wet" spinning.

Linen Properties

- **Strength:** An important property of linen is its strength. Linen is a durable fiber, as is two-three times as strong as cotton. It is second in strength to silk. It gives the same comfort like Cotton fiber.

- **Elasticity:** Elasticity is the extent to which a fiber can be elongated or stretched and then returned to its normal condition and size. Linen is the least elastic natural fabric.

- **Resilience:** Resilience refers to the extent to which a fabric can be deformed by crushing or compressing it, and finally returning it to its original condition. Linen is quite stiff and wrinkles easily.

- **Absorbency:** Absorbency refers to the extent to which moisture can penetrate into a fiber. Another linen property is that the fiber absorbs moisture and dries more quickly. It is excellent for manufacturing towels and handkerchiefs.

- **Heat Conductivity:** Heat conductivity refers to the extent to which heat can be conveyed through a fiber. Heat conductivity of linen is five times as high as that of wool and 19 times as that of silk. It is most suitable for use in summers, as the fiber allows the heat to escape, leaving a cool effect.Studies have shown that with linen clothes perspiration is 1.5 times less than when dressed in cotton clothes. It is twice less than when dressed in viscose clothes. Meanwhile in cold seasons linen is an ideal warmth-keeper.

- **Comfortable**: Linen is a comfortable fabric. Being a natural vegetable fibers it has huge amount of Air Porosity hole, which make the linen clothes very comfortable to wear.

- **Crisp:** The linen fabric has a crisp feel with a distinctive outlook and feel. Linen possesses a natural crispness when ironed damp. Hence it does not require starching, and has a natural lustre.

- **Lightweight/Heavyweight:** You will find any kind of linen fabric or linen fibers in any weight in the market.

- **Good Abrasion Resistant:** As the linen fiber is good in strength, it also has good abrasion resistance.

- **Resistant to Allergy:** No kind of allergic reactions are caused using linen and hence it is helpful in treating a number of allergic disorders.

- **Anti inflammatory property**: Linen is helpful in dealing with inflammatory conditions, reducing fever, regulating air ventilation, in some neurological ailments.

- **No static electricity**: Another property of linen is that it does not accumulate static electricity. Since line is made of flax, even a small addition of flax fibers to a cloth is sufficient to reduce or eliminate the static electricity effect.

Flax Fiber Properties and Grading

For traditional long-line flax used in textiles, a number of factors are subjectively judged by experienced graders and include weight in hand, strength.

ADVANTAGES OF LINEN FABRIC:

- Excellent strength gains strength when wet
- Hydrophilic: absorbs water and dries quickly

- Cool in warm weather
- Washable
- Withstands very high temperatures when washing and ironing
- No static, pilling, or lint problems
- Unique texture from the thick-and-thin pattern of the fibers

DISADVANTAGES OF LINEN FABRIC:

- Wrinkles very easily
- Fair abrasion, low durability
- Poor drape and elasticity
- Expensive

END USES OF LINEN FABRIC:

- Apparel: suits, skirts, jackets, dresses
- Interiors: tablecloths, napkins, wallpaper