

SEMESTER – IV
SKILL ENHANCEMENT COURSE
SERI – TEXTILE TECHNOLOGY (Unit -4)

Silk and its degumming process

Introduction:

Silk is a natural protein filament that can be converted into textile by either knitting or weaving techniques. The protein fibre/filament of silk is composed mainly of fibroin and produced by certain insect larvae to form cocoons. For commercial use it is almost entirely limited to filament from cocoons produced by the caterpillars of several moth species belonging to the genus *Bombyx* and commonly called silkworms reared in captivity (sericulture). The shining appearance of silk is due to the triangular prism-like structure of the silk fibre, which allows silk cloth to refract incoming light at different angles, thus producing different colors. Silks are produced by several other insects, but generally only the silk of moth caterpillars has been used for textile manufacturing.



Fig: Bombyx Mori (Silk Worm)



Fig: Silk Cocoon

Physical Structure & Composition:

Silk is the only natural filament. It is a solid fiber. The filaments are 300-1800 yards long. Silk fiber has a double rod-like structure, covered with lumps of gum. Wild silk fiber is very irregular and resembles flattened, wavy ribbons with longitudinal markings. Cultivated silk is smooth, cylindrical and generally uniform in thickness, like glass rods.

Chemical Composition of Silk Fibre: (Approximate value)

- Fibroin 76%
- Sericin 22%
- Fat & wax 1.5%
- Mineral salt 0.5%

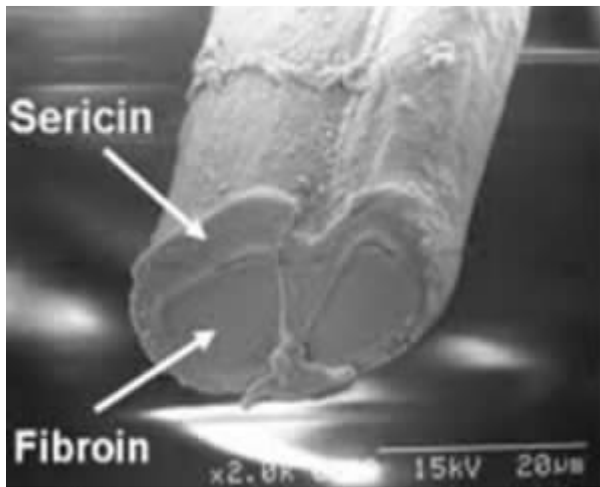








Fig: Cross-sectional view of silk fibre.

Silk fibre contains approximately 20-25 percent Sericin gum. Sericin is a group of soluble glycoproteins expressed in the middle silk gland of *Bombyxmori*. Silk emitted by the silkworm consists mainly of two proteins, sericin and fibroin; fibroin being the structural center of the silk, and sericin being the gum coating the fibres and allowing them to stick to each other. The chemical composition of sericin is $C_{30}H_{40}N_{10}O_{16}$.

Degumming Silk Cocoons:

The natural gum, sericin, is normally left on the silk during reeling, throwing and weaving. It acts as a size which protects the fibres from mechanical injury. After the moths emerge, the cocoons must be degummed before they can be spun into yarn.

Process sequence of silk cocoon degumming:

<p>Step-1: Removing short threads</p>	<p>Each cocoon is surrounded by short threads that the silkworm used to support its structure. These threads tend to be of inferior quality so it's best to remove them before degumming. They pull off quite easily.</p>	
<p>Step-2: Degumming support silk</p>	<p>The support silk can be degummed and used.</p>	
<p>Step-3: Removal of larval and pupal skins</p>	<p>Next, the larval and pupal skins must be removed from the inside of the cocoon. A pair of hemostats comes in handy for this step. Filling the cocoon with water makes the skins float to the top and also prevents them from crumbling inside..</p>	
<p>Step-4: Treating with soap solution</p>	<p>Fill a pot with water and add a generous amount of soap--about 1/2 cup per 100 cocoons. It's important to use only natural soap instead of detergents which may contain enzymes that can harm the silk, or sodium lauryl sulfate which is harmful to us. Some recipes call for washing soda and/or lye but We've gotten good results using only soap. Simmer the cocoons until they collapse onto themselves and lose their shape. This can take anywhere from 30 minutes to several hours depending on the specie of silk. Make sure the cocoons do not boil as this can cause them to tangle up and mat.</p>	
<p>Step-5: Rinsing, Squeezing and Drying</p>	<p>When they look like fluffy cotton balls they are sufficiently degummed. Protein fibers do best in an acid state so add a splash of vinegar or acetic acid to the final rinse water. About 1/4 cup per gallon of water. Rinse and gently squeeze out the excess water and hang to dry.</p>	
<p>Step-6: Pulling apart</p>	<p>They will look matted up when dried but we should be able to pull them apart with fingers and fluff them. If not, then repeat the degumming process. They are now ready to spin.</p>	

Degumming is the process of removing the sericin, a sticky substance produced by the silkworm that holds the strands of silk together. It is also known as silk scouring. Removing the gum improves the lusture, color, hand, and texture of the silk.

As much as one-third of the weight may be lost when the gum is removed. Raw silk with the gum still on the filament is called 'Hard silk'. Degummed silk is 'soft silk'.

Silk degumming can also be accomplished by treated with different alkaline, neutral and acid proteases (Enzymes).



The degumming waste liquor that is rich in sericin content is being used as a raw material for the production of sericin powder. The sericin powder is being used in the cosmetic industry as moisturizer, in hair-care products and also as a sustainable natural textile finish. Removal of sericin from the waste degumming liquor also substantially reduces the effluent.

Conclusion:

Preprocessing of silk commonly known as degumming or silk scouring is an essential process to obtain an ideal fibre because of its modified fibre structure. Silk degumming process is scouring the sericin and some impurities from silk fibre. As the major amino acids groups in sericin is hydrophilic, water and heat treatment destroys the hydrogen bonding of the sericin so that sericin dissolves into the water during the degumming process.