CHAPTER II

Literature Review

2.1 Cotton Structure

A cotton fibre is constructed from so-called elementary fibrils which are, in effect, long, thin crystals of cellulose, apparently very strong as it is very difficult to disintegrate them mechanically. In the cross-section of a mature fibre there will be several millions of such crystalline fibrils which aggregate together into bundles of a few hundreds. These fibrillar bundles are packed together in concentric layers to form the fibre axis, but spiral around at an angle which varies about 55° near the fibre surface to about 20° at the inside. Periodically along the length, the direction of the spiral changes at a so-called fibrillar reversal zone (Fig 2.1) (1).

2.2 Chemical Composition of Cotton

The composition of cotton fibre is given in Table 2.1 (2).

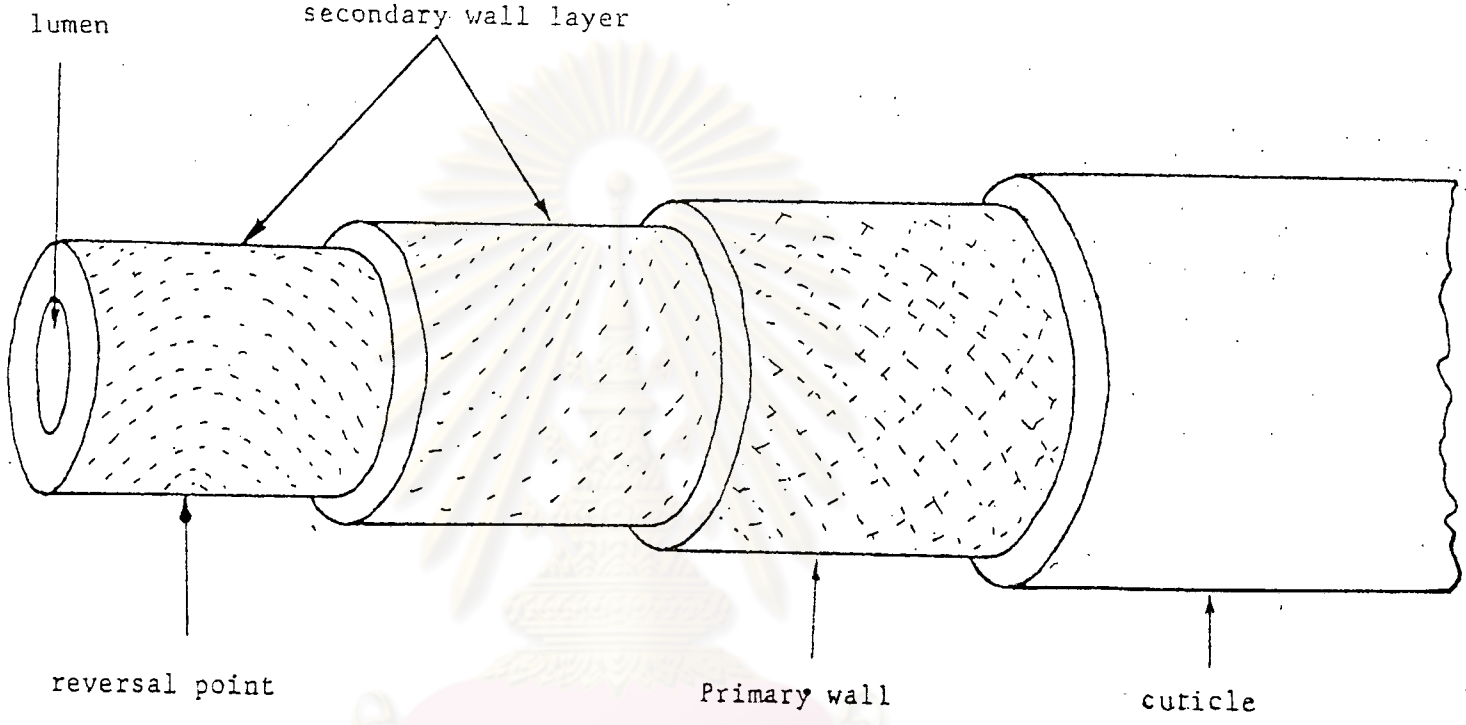

Fig. 2.1 Cotton fibre structure

Table 2.1 Chemical Composition of Cotton

constituents	percent
cellulose	94.0
protein	1.30
pectic substances	0.90
ash	1.20
wax	0.60
malic, citric and other organic acids	0.80
total sugars	0.30
pigment	trace
others	0.9

2.2.1 Cellulose

Raw cotton fibre contains cellulose from 88 to 96 %, but this may be reached as high as 99 % after scouring and bleaching (2).

2.2.2 Waxes

Extraction of the raw fibre with organic solvents e.g. chloroform, alcohol etc., yields a product known as cotton wax. These waxes are esters of higher alcohols and fatty acids.

2.2.3 Pectic substances

Pectic subsutances consist of many complex substances, the chief constituent is polygalacturonic acid which a considerable proportion of the carboxyl groups have been methylated.

2.2.4 Protein

Most of the protein is found in the lumen of the fibre, its average value is about 1.3 %.

2.2.5 Ash

The raw fibre contains about 1.2 % of ash, this amount may be decreased by 85% by boiling with water. However, most of the calcium, iron and aluminium remain.

2.2.6 Organic acids

Raw cotton fibre contains about 0.8 % of organic acids (not including pectic acid), the most important constituents are L-malic and citric acids.

2.3 Penetration of Caustic Soda (1,2)

Measurement of the degree of penetration of caustic soda into scoured and bleached yarn has been determined by the very painstaking method of staining the individual fibres with iodine

preparations and counting the number of stained and non-stained fibres. In these experiments, the stained fibres are the mercerized ones. Penetration occured easily into yarn which were not under tension during mercerization. When the yarn were treated under tension over a range of concentrations and times, the penetration was found to be affected by the viscosity (μ) of the liquor, swelling (z) of the fibre diameter and the time (t). An empirical relation was obtained between the percentage (p) of unstained fibre and these variables as shown below.

$$p = \frac{\mu z^2}{t-1} \qquad (2.1)$$

Mercerization was also studied as a function of tension, when it was found that p varied linearly with the logarithm of the tensions (S)(given in grams/thread). This result has been combined with equation (2.1) over a range of liquor concentrations of greater than 15 % but less than 24 % of caustic soda (w/w) to give equation (2.2). This equation is of interest

$$p = \frac{20\ \mu z^2}{t-1} (\log S - 1.16) \qquad (2.2)$$

since it brings out the dependence of penetration on the viscosity (μ) and the swelling (z), both of which decrease as temperature increases, the rate of mercerization will therefore be more rapid at the higher temperature.