

V
SUMMARY

S U M M A R Y

Fibres are characterized by flexibility, fineness and high ratio of length to thickness. Fibres may be classified according to their origin into two groups : (i) natural fibres and (ii) man made fibres.

Natural fibres can be sub-classified as vegetable, animal and mineral fibres. Man made fibres are sub-classified as mineral fibres and fibres of synthetic polymers. Natural fibres are also modified by various physical and chemical treatments.

Cellulose is a polymer biosynthesized in nature in the plant kingdom. It forms the basis for several industries such as pulp, paper and allied products, cotton textiles, regenerated fibres such as viscose, rayon, etc., cellulose derivatives such as cellulose acetate, carboxy methyl cellulose, methyl and ethyl celluloses, etc.

Properties of fibres depend, in general, on their composition and structure. Properties such as elasticity, dyeability, flammability, soiling, static build up, crease recovery, strength, etc. can be altered by chemical modifications, such as derivatizing, crosslinking and grafting.

Cotton fibre is a single cell that grows as a seed hair on a plant belonging to genus "gossypium". Raw cotton is 88-95% cellulose. Cellulose is a natural high polymer and its building blocks are anhydroglucose units. Its degree of polymerization

is about 5000 (1). Structurally, cellulose is a ($1 \longrightarrow 4$), β linked condensation polymer of glucose. Conformational analysis (2) shows that anhydroglucose in chair form unites through ($1 \longrightarrow 4$) β linkage to give a thread like structure. The spatial arrangement of the chain involves interlinking through hydrogen bonding.

Roelfsen (3), Tripp and coworkers (4) and Ramnathan (5) showed that two types of fibrils running parallel and transverse to the fibre axis make the network structure.

Herzog and Jancke (6) showed with the help of X-rays, that cotton is crystalline. It was suggested from X-ray studies and IR spectroscopy (7) that cellulose chains are held together by van der Waals forces, intermolecular hydrogen bonding between hydroxyl at C_6 and the bridge oxygen of the adjacent molecular chain and intramolecular hydrogen bonding between adjacent anhydroglucose rings, resulting into a strong hydrogen bonded network structure with unit cell repeating itself to build polycrystalline aggregates.

The chemical structure of cellulose can be changed by the chemical methods such as (i) esterification (ii) formalization, (iii) etherification, (iv) grafting, etc.

Cotton fabrics and fibres have been modified by chemical methods (8-12). We considered to study the modifications of cotton fibres grown in Gujarat by various chemical treatments and their effect

on some of the fibre properties. Hence it was planned,

1. to prepare
 - (i) anhydrides from various acids such as adipic acid, fumaric acid, cinnamic acid, etc and
 - (ii) acid chlorides from various acids such as adipic acid, fumaric acid, sebacic acid, acrylic acid, methacrylic acid, LAB acid, etc ;
2. to esterify the cellulose fibres and fabrics with acid anhydrides and acid chlorides and to study their IR spectra, TG analysis, SEM photographs, crease recovery, diameter, etc ;
3. to modify cellulose fabrics with
 - (a) poly vinyl alcohol (PVA) and formaldehyde, (b) PVA and paraformaldehyde, (c) PVA, paraformaldehyde and resorcinol (or melamine), (d) PVA, formaldehyde, another aldehyde, and resorcinol (or melamine), etc ;
4. to study the formalized and resinified cotton fabrics by determining their properties such as % add-on, break strength, crease recovery, SEM photographs, X-ray diffractograms, etc ;
5. to copolymerize cotton fibres and fabrics with various vinyl monomers such as acrylonitrile, acrylamide, methyl

methacrylate, methacrylic acid, vinyl acetate, etc using free-radical initiators for polymerization;

6. to study the properties of grafted fabrics and fibres by measuring their properties like % add-on, diameter, crease recovery, SEM photographs, etc;
7. to study water sorption characteristics of some of the modified fabrics.

The experiments were carried out as planned and the results of the investigations are presented and discussed.

Cotton fibres and fabrics were esterified with various acid anhydrides and acid chlorides. Alcohol soluble cellulose esters were extracted from treated fibres. IR Spectra, thermograms, and SEM photographs of treated fibres and fabrics were obtained. Thermograms of treated fabrics were comparable to that of untreated fabrics. The degree of substitution per anhydroglucose unit in the esterified products was evaluated and related to the diameter, crease recovery, etc (13).

Cotton fibres and fabrics were formalized with formaldehyde, paraldehyde, butyraldehyde, etc in presence of polyvinyl alcohol and then resinified with resorcinol or melamine. Deleterious effects of acid on fabrics during reaction were observed. SEM photographs and X-ray diffractogram of some of the products were obtained. The degree of substitution per anhydroglucose unit was evaluated for the products. Break strength, % elongation,

crease recovery, etc were determined and related to formalization, resinification, etc (14).

Graft copolymerization of fibres and fabrics was carried out with various vinyl monomers. % grafting and efficiency of grafting were evaluated. SEM photographs, diameter, crease recovery, etc of some of the grafted products were obtained and are discussed.

The modified fabrics were studied for their % add-on and crease recovery, and products with better crease recovery were identified.

Some of these treated fabrics were studied for sorption from water and salt solutions and sorption is discussed in relation to perspiration (15).

References :

1. C.Y. Liang and R.M. Manchersault, J.Polym.Sci., 37, 385 (1959)
2. R.S.Reeves, Advn. Carbohydrate Chem., 6, 107 (1951)
3. P.A.Roelofsen, Biochem. Biophys Acta, 13, 155 (1954)
4. V.W.Tripp, R.Gluffria and I.V.de Gruy, Text. Res.J., 27, 14 (1967)
5. N. Ramnathan, J.Sci. Ind. Res., 436 (1957)
6. R.O.Herzog and W.Jancke, Z.Phys.Chem., A 139, 235 (1928)
7. P.H. Hermans, Kolloid-z, 102, 169 (1943)
8. S. Singh and J. C. Arthur (Jr.), Carbohydrate Res., 18(3), 449 (1971)

9. S.M. Gilbert and B.F.Smith., Text.Res.J., 40(8), 720 (1970)
10. I. Tetsuo, Hiroshima Joshi Diagaku Kaseigakubu Kiyo, (15), 37 (1980)
11. R. D. Mehta, Amer. Dyest. Rep., 63(6), 46, 89 (1974)
12. T.Waichiro, I.Fusayo, H. Satomi and N.Tokie, Sen-i-Gakkaishi, 35 (7), T 315 (1979)
13. A. Harald, Textilveredlung, 7(12), 793 (1972)
14. G.N.Richards, J.Appl. Polym. Sci., 5, 539 (1961)
15. A.R.Gwosdow, J.C.Stevens, L.G.Berglund and J.A.J. Stolwijk, Text. Res.J., 56(9), 574 (1986)