ABSTRACT

The organic complexes taken for the present investigations are the locally available natural (Plant and Silk) fibres which are composed of macromolecular crystallographic structures. The readily available synthetic Polyester fibres are also used for their thermo-physical studies so as to find out the means about the possibility of blending of these fibres with natural fibres for their textile and other industrial utilities.

Detailed studies on thermal behaviours of the plant (Ramie, Jute and Cotton) and synthetic Polyester fibres under different conditions have been undertaken by various methods such as X-ray diffraction (XRD), Scanning Electron Microscopy (SEM), Infrared (IR) Spectroscopy, Differential Thermal Analysis (DTA), Differential Scanning Calorimetry (DSC), Thermo-gravimetry (TG), Derivative Thermo-gravimetry (DTG), Dielectric properties and DC Conductivity Analysis. In addition to the plant fibres, the locally available silk fibres (Muga, Eri and Pat) are also used to study the various thermo dynamical properties.

Some portions of each fibrous raw products, collected from different localities of North Eastern Region of India, have been degummed. The thermal treatments (such as annealing and quenching) of some part of the fibres have been made up to the temperature quite below to their decomposition points.
The crystallinity and structural behaviours of raw, degummed and thermally treated fibrous samples have been studied by X-ray diffraction analysis. The detection of functional groups and their behaviours under different thermal conditions have been made by Infrared spectroscopy. The surface features have been studied by Scanning Electron Microscopic photographs.

The detailed investigations on thermodynamical properties of silk, plant and synthetic fibres have been carried out by DTA, DSC, TG and DTG techniques. The experiments have been carried out in the temperature range from 298K to 673K. The two steps activities dehydration and decomposition attributed in natural fibres. The first transition peak has been revealed the dehydration of the water molecules from the semi-crystalline hosts. The second peak has confirmed the irreversible dissociation of the crystallites. The variations of the different thermo-dynamical parameters at these steps have been studied in details by computed analysis of the endothermic and exothermic peaks of DTA, DSC thermograms, weightloss curves of TG and endothermic peaks of DTG thermograms.

The thermo-electrical properties such as dielectric constant and DC conductivity of plant and synthetic fibres have been studied in the audio frequency range from 1KHz to 20KHz. The experiments have been carried out in the temperature range 296K to 523K for all raw, degummed and thermally treated fibres. The hygroscopicity of plant fibres plays a role for variation of electrical properties.
The anomalous behaviours of thermodynamical properties, variation of crystallinity, increase in capacitance and conductance are attributed to the formation of lattice defects in the fibrous complexes mainly due to decomposition.

The values of activation energies for various processes such as dehydration and decomposition activated at different temperatures have been determined.

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