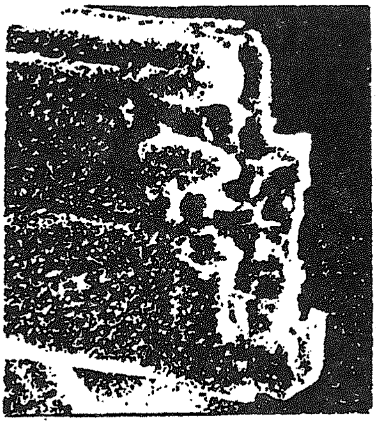

Plate 1 x 1,130
Flax Fibres.

Plate 2 x 2,435
Jute Fibres.

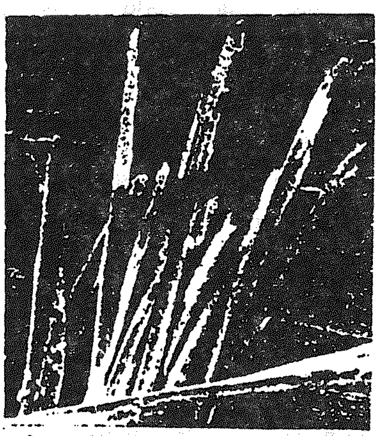

Plate 3 x 300
Hemp Fibres.

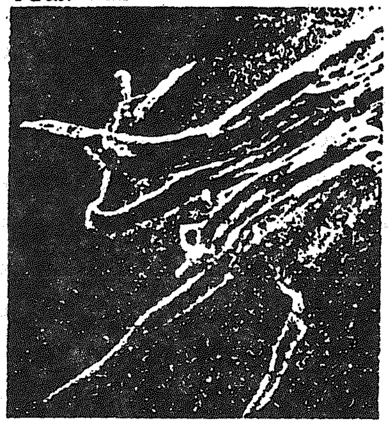

Plate 4 x 340
Jute Fibres.

Plate 5 x 1,250
Flax Fibres.

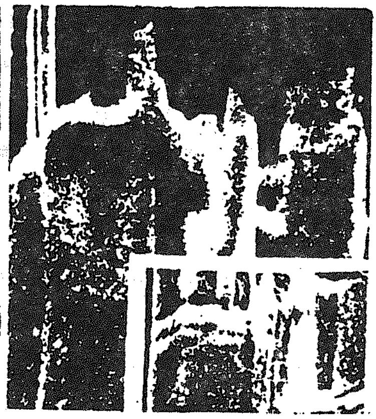

Plate 6 x 1,050
Jute Fibres.

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fibres, the total (world) consumption of bast fibres is second to cotton, little is known about their fracture morphology. In the present study a number of observations were made, using SEM, to study the fracture mode of jute, hemp and flax fibres. However, a more systematic and carefully controlled study will be necessary to arrive at some concrete conclusion; not attempted in the present study.

MATERIALS AND METHODS:

The fibres (jutet hemp and flax), which are free from stray– fibres were sampled by following zoning methods [4]. The fibres were then conditioned, at 65 percent relative humidity at 22°C, after cutting a length of 5 cm. The single fibres were placed on a black velvet pad, and mounted with adhesive ('durofix') on a paper frame, to obtain a test– length of 2 cm. The mounted specimens were next extended on an Instron Tensile Tester at rates of 0.5, 5 and 10 cm/min, respectively, at 65 percent relative humidity and 22°C. In each case about 50 fibres, broken at the middle of the samples during stretching on an Instron, were examined in the SEM.

The broken fibre ends were mounted on the aluminium specimen stub with sellotape as described by Cross et al [5]. Coating of the fibres, with platinum/ carbon, was carried out as described [6– 8] and an accelerating potential of 10 kV maintained throughout. Only representative electron micrographs are reproduced, that were observed in jute, hemp and flax fibres during examination, to show important fracture modes.

RESULTS:

The mode of fracture observed in jute, hemp and flax fibres are tabulated below:

MODE OF FRACTURE	PLATE	JUTE HEMP FLAX
Brittle with multiple cracking	1	OBSERVED
Fracture initiation from the outer cell-wall	2	OBSERVED
Individual ultimate cell separation and fracture initiation from the outer cell-wall	3	OBSERVED
Ultimate cell separation and splitting	4	OBSERVED
Coarse fibrillar fracture	5	OBSERVED
Nodal with fibrillar fracture	6	OBSERVED

It can be seen from the above tabulation, that the general mode of fracture in jute, hemp and flax fibres is more or less the same. As expected, the mode of fracture turns out to be quite different from cotton fibres where fracture follows the spiral angle of the fibrils [1] and the 'crack – growth' morphology of synthetic fibres. Fracture in jute, hemp and flax fibres, as a rule begins i) with the ultimate cell spearation (which is due to the breaking of the tenaceously bonded intercellular cementing materials, such as, lignins, pectins and vegetable waxes & fates etc.) and ii) witht the transverse cracks and then progressing in the direction of the fibre axis. As one expects, there are, of course, minute differences in individual breaks, but over– all the same general mode of fracture has been observed in all the fibres examined, in the present study.

FRACTURE MORPHOLOGY OF JUTE, HEMP AND FLAX FIBRES.

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ABSTRACT

In the present paper an attempt is made to elucidate the important fracture morphology of jute, hemp and flax fibres with Scanning Electron Microscope (SEM). It is observed that the mode of fracture morphology is dependent mainly on the intercellular cementing materials (i. e. lignin, pectin and vegetable wax & fat etc) as well as to a lesser extent on the nature of fibrillation.

INTRODUCTION:

During the last half— century or so, the morphology of keratine fibres, plant fibres, as well as synthetic fibres, was extensively investigated by polarized light microscopy, infra— red spectroscopy, wide and small angle x— ray diffraction, and more recently, transmission electron microscopy and electron diffraction methods. The use of optical microscope is limited in the sense that the morphological details are too small to be resolved (and consequently providing incorrect results [1], as obtained by different authors when studying cotton fracture that "cotton fracture occurs through the reversal zones"); and transmission electron microscopy is tedious as well as very difficult, requiring very thin sectioning or replication.

On the otherhand the availability, operation and advantages of the SCANNING ELECTRON MICROSCOPEY (SEM) have made possible, for the first time, a detailed study of the fracture morphology (qualitative and quantitative) of both natural and man— made fibres. Features of fracture morphology may be examined, in the SEM, at optimum magnification (ranging from x20 to x80,000), position, direction; and can be easily related to the whole fracture surface as well as three— dimensional picture can be readily reconstructed (by using stereo— techniques). With the help of SEM Hearle et al [1], Islings et at[2], Ray [3] have studied the fracture morphology of cotton and jute fibres.

OBJECT:

The study of fracture morphology of textile fibres is of great technological importance in elucidating the behaviour of fibres at various commercial processing. Although, among the natural polymeric (cellulosic)