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CHARACTERIZATION OF MAZRI FIBRE

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Properties like twist on drying, moisture regain and retention for "Mazri", jute and sisal have been recorded. It has been observed that "mazri" twists in a clockwise direction, a property which is similar to the properties of jute and hemp. Moisture absorption, which is related to crystallinity, varies in the following order: Jute 41 % > sisal 38 % > "mazri" 36 %. Observations on moisture loss by wet fibres show a similar trend: jute 29 % > sisal 27.5 % > "mazri" 26 %. "Mazri" fibre has, therefore, been classified among cellulosic fibres of the jute and sisal category but with better orientation compared with the other two.

Key words: Fibres; Vegetative fibres; Ropes and fabrics.

INTRODUCTION

"Mazri", described in an earlier paper [1] is an indigenous palm. Its fibre by general observation is not soft. Fibres, such as, abaca, sisal, henequen, istle, mauritius and phormium are obtained like "mazri" from the leaves of tropical plants but are classified as hard fibres [2]. The fibrous matter in all such cases is located near the surface of the plant leaves and mechanical methods are employed to separate them from the ligninous binding material. A chemical-cum-mechanical method developed by the PCSIR [3] leaches out the lignins and separates the fibres in the leaves as bundles. These bundles, when subjected to further treatment, yield elementary fibres which are soft and can be classed in the category of jute-like materials.

In a previous paper [1], some chemical and physical characteristics of "mazri" fibre were described. The properties of relevance to characterise a fibre for use in textiles are twist on drying and water absorption and retention. It is proposed to discuss these in the present paper with a view to appropriately classifying "mazri" fibre.

EXPERIMENTAL

The leaves for the present set of experiments were cooked in a weakly alkaline solution for 8 hr and when wet they were passed through a roller crusher and separated. The moisture taken up during the wetting process split the fibres out of the pectic and waxy exterior of the leaf when the latter was pressed under the crusher. Fibres relatively free from extraneous impurities, such as sugar and mineral matter were obtained by washing them with water and estimating, as a measure of completion of the process, the potash content in the washings which was approximately 90 ppm in the liquor.

The twist test was performed by placing different fibres on a hot stage and observing the nature of twist, i.e. clockwise or anti-clockwise, on drying when the fibre spiral starts tightening.

Moisture regain and moisture retention were measured by the modified procedure described below.

Moisture regain. 0.5 g fibre was defatted by the usual solvent extraction process. It was then dried at 105-110^o for 4 hr. to constant weight and placed immediately in a desiccator containing water and having a relative humidity of 100 %. The gain in weight listed in Table 1 was noted every half hr. for 12 hr. and also noted at the end of 24 hr. and 72 hr.

Moisture loss. The fibre which had absorbed the maximum moisture after 72 hr. was placed in a desiccator containing sulphuric acid. The loss in weight listed in Table 2 was noted every 20 min. for 10 hr. and also at the end of 24 and 72 hr. The percentage loss was calculated on the basis of moisture saturated weight of fibre.

RESULTS AND DISCUSSION

It was shown earlier from X-ray studies that "Mazri" fibre has considerable crystallinity similar to sisal. Crystallinity is desirable for imparting good fibre properties and if present it suggests high elasticity, stiffness, tenacity and dyeability [4]. The crystalline structure of a fibre suggests regular arrangement of molecular chains in a three dimensional lattice. All natural fibres exhibit certain preferred orientations, depending on their origin and the type of treatment they have been subjected to. Flax and ramie fibres, for example, are oriented in clockwise sprials while jute and hemp have them in anti-clockwise direction. On drying, when the spirals are tightened, the former fibres would twist in an anti-clockwise direction [5]. Accordingly they cannot be blended with the latter. "Mazri" fibre twists on drying in a clockwise direction and it would be reasonable to suggest that it should be classified with jute and hemp and also that it can be blended with them for making ropes and fabrics.

Fibres take up moisture from the air and this is an important property for the determination of their acceptability as textile materials. Absorption of water changes the properties of fibre through swelling and the alteration of its dimension resulting in stiffness, flexibility and in enhancing the permeability of moisture into the yarn and hence the fabric [5]. Such changes affect the mechanical as well as frictional properties and hence the subsequent processing of the fibres and their ultimate use.

Placement of fibre in a humid environment allows gain or loss of moisture depending on the dryness of its interior and the surface. Absorption, if any, would proceed at a slow rate until it has reached equilibrium. The latter is attained at a point when the number of water molecules evaporating from the specimen are balanced by those condensing on it. The ability of a fibre to absorb moisture is measured by the amount of water absorbed by a fully dried fibre when exposed to the surrounding air containing a known amount of water vapour. The absorption or regain of moisture is measured in terms of the mass of water absorbed by a dry specimen and is expressed in percentage terms [6]. Drying of the fibre may present difficulties which can be obviated by placing its sample in an oven at 110^{o} till constant weight is achieved.

The values listed in Table 1 and shown graphically in Fig. 1 indicate that the rate of regain of moisture in the case of jute and "mazri" is quite similar and that the transient equilibrium in each case occurs within the time of the first measurement which in the present case is less than 30 min.

Water absorption measurements are indicative of the amount of crystalline region present in the fibre. If it is highly crystalline, the amount of water absorbed would be quite small. Crystallinity in turn is related to the packing of the cellulosic molecules. A closely packed structure would present difficulties for water molecules to penetrate the surface and this is the main reason for low moisture absorption by highly oriented fibres [6].

Water absorption from an environment having a high relative humidity is high for substances containing a large number of hydroxyl groups because of their affinity for water. Accordingly cellulosic fibres absorb large quantities while nylon does not. A high moisture absorption by fibres is desirable in tropical climates since they would reduce the accessibility of dampness to the body in spite of the presence of considerable moisture in the atmosphere.

In the present study, three different fibres viz. sisal, jute and "mazri" were placed in an atmosphere saturated with water vapour. It was observed in each case that the absorption of moisutre is quite rapid in the first 30 min; it slackens thereafter but continues even beyond 50 hr. From Fig. 2 it can be inferred that the absorption of moisture by the fibres takes place in two stages. The initial process is concerned with the interaction of the air containing moisture with the intersticial spaces in the surface of the mass of fibres. The interaction is promoted by the hydroxyl groups of the cellulosics and not by man-made fibres lacking them. The final process is concerned with diffusion from the surface to the interior spirals. Since the filling of the interstices is more rapid than diffusion into the interior, there would be a sharp rise in the curve pertaining to the initial process of regain.

Moisture absorption being related to crystallinity and the presence of closely packed regions in fibres, values of moisture regain would differ from fibre to fibre. For the three fibres under study it is in the following order: jute 41 % > sisal 38 % > "mazri" 36 %. It is interesting to note that moisture regain for "mazri" fibre is similar to jute and

Table 1. Water regain of fibres.

Time (Min.)	Weight g. Jute	Sisal	Mazri
0.0	0.5	0.5	0.5
30.0	0.5248	0.5228	0.5173
60.0	0.5361	0.5385	0.5319
90.0	0.5420	0.5471	0.5410
120.0	0.5450	0.5502	0.5442
150.0	0.5464	0.5520	0.462
180.0	0.5475	0.5535	0.5485
210.0	0.5480	0.5550	0.5503
240.0	0.5497	0.5558	0.5510
270.0	0.5509	0.5576	0.5532
300.0	0.5520	0.5588	0.5541
1440.0	0.6085	0.6076	0.6002
4320	0.7051	0.6910	0.6790

Table 2. Water loss of fibres

Time (min.)	Weight (g)		
	Jute	Sisal	Mazri
0.0	0.7051	0.6910	0.6790
20.0	0.6612	0.6542	0.6452
40.0	0.6410	0.6272	0.6203
80.0	0.5963	0.5883	0.5824
100.0	0.5799	0.5751	0.5697
120.0	0.5645	0.5641	0.5592
140.0	0.5497	0.5551	0.5506
160.0	0.5417	0.5496	0.5463
180.0	0.5354	0.5454	0.5427
200.0	0.5281	0.5410	0.5380
220.0	0.5226	0.5371	0.5357
280.0	0.5153	0.5313	0.5307
340.0	0.5093	0.5259	0.5263
4320	0.5004	0.5005	0.5009

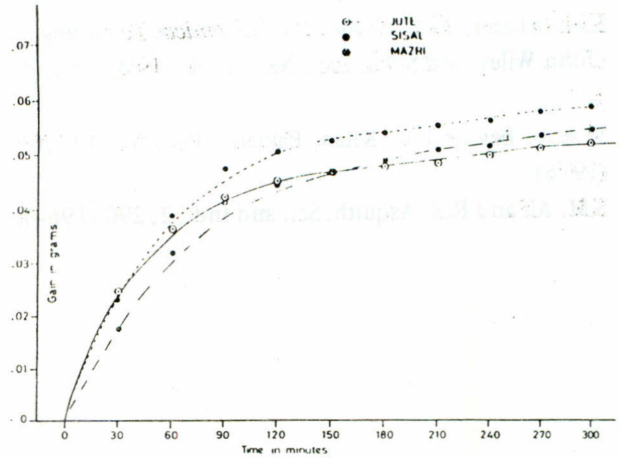

Fig. 1

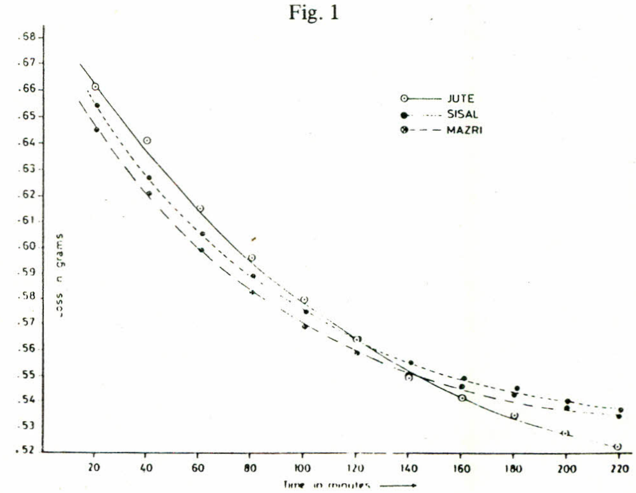

Fig. 2

sisal whose crystallinity is as would be expected of cellulosic fibres.

In a completely dry system, the number of crosslinks are higher than in the wet state and this property allows high initial water absorption compared with wet specimens.

When the process of water regain is reversed to drying, cross-links which were broken due to the absorption of water on the hydroxyls of the cellulosic residues are formed once again. In forming the cross-links the same would appear first in the region exposed to the dry atmosphere. The innermost absorption sites holding water molecules may be accessible after long standing in a dry environment. Cross-linkage of these sites may be introduced through an input of thermal energy and may be difficult through just the diffusion process [6].

The rate of loss in moisute by the wet fibre listed in Table 2 is indicative of the presence of a diffuse and not sharp boundary separating the surface from the interior and of the mass from the surface. This may be apparent from the figures drawn for regain (Fig. 1) and loss (Fig. 2). They suggest that the rate of loss of moisture is not of the same order as the regain. The curves in the two cases are also not mirror images of each another. The initial rise in regain is quite steep as compared with the loss during the same stage. For jute the rate of loss is rapid after 120 min and a comparison with sisal and "mazri" suggests that the boundary is not so diffuse in the case of the former.

The diffuse nature of the boundary indicated by loss of moisture is perhaps because of the breakdown of cross links and insertion of water molecules in the interstices. Extra energy would be needed to pull out the water molecules. The loss of moisture is, therefore, likely to be at a slower rate compared with that for the dry fibre. Water molecules can be pulled out at a rate that is average between that for a sharp boundary and no boundary in which case it is likely to be flat as observed when the fibres are saturated.

The maximum loss by the three fibres falls in the order jute, 29 %; sisal, 27.5 % and "mazri",. 26 % The water retained by these fibres, deduced from the data on regain and loss, is 12, 11.5 and 10 % respectively. The lower value for "mazri" may reasonably be due to its higher crystallinity.

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