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FLAX AND HEMP – NATURAL ALTERNATIVES IN THE FIELD OF MEDICAL TEXTILES

BY

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Abstract. Hygroscopicity, high air permeability and antiseptic properties are characteristics of flax and hemp fibres, allowing their use in the field of medical textiles. These natural fibres offer the possibility of obtaining ecological products with new functional properties which can improve the efficiency of dermatological treatments. They assure conditions for the effective exploitation of national natural resources and the support of the re-launching program for the cultivation of the plants from which they are extracted. In the present paper several properties of the yarns, which lead to their choice as raw material for medical textile products, are analyzed.

Key words: flax, hemp, medical textiles.

1. Introduction

The interest for flax and hemp fibres in non-textile and medical application has increased as a result of the search for new renewable materials [1]. As natural resources, flax and hemp have a number of unique properties such as non-toxicity, biocompatibility and biodegradability.

Antimicrobial finishing is applied on textile fabrics to control bacteria, fungi, mould, mildew and algae, to solve problems of deterioration, staining, odours and health concerns they cause [2]. Natural fibres, such as cotton, flax or hemp, are more susceptible to micro organisms than synthetics because their porous hydrophilic structure retains water, oxygen and nutrients, providing a perfect environment for bacteria, fungi, mould and mildew growth. This research presents the wetting behaviour of yarns and fabrics made of bast fibres, because this is one of the most important properties of textile materials.

Hygroscopicity is the ability of fibres to absorb and to release watery vapours in the atmosphere. This quality depends on many factors, such as: the type of the functional groups from the chain of the polymer that constitutes the

fibres, the energy of intermolecular bonds, the crystallinity index, orientation of crystalline zones and orientation of macromolecules in the amorphous zones in the fibres. The moisture content of the fibres depends on atmospheric conditions. It is directly dependent on the air pressure, relative humidity and air temperature. The accumulation of watery vapours on and inside fibres influences their quality because it leads to the modification of some of the properties of the fibres, especially of the mechanical ones [3], [4].

The transfer of the component fibres' properties and the transfer of the yarns' properties respectively, to the material's characteristics are very complex phenomena, dependent on many factors. Thus, hygroscopicity of the fibres determines their water pick-up degree, influencing the amount of water retained by yarns and by the material, respectively. As for medical products, most of them are used in high-humidity environments. Taking all these into account, the present paper studies the evolution of the water pick-up degree of several types of materials and component fibres, depending on the time they stay into the water.

2. Experimental

The water pick-up degree of the tested materials and yarns was measured according to the standard method presented in SR ISO 6741-1/1998 [5]. Measurements were performed in the same air temperature and humidity conditions. The samples stayed in water for one minute, five minutes, ten minutes and one hour. The excess of water was removed by pressing with filter paper. The thickness of the material was measured with the Schopper micrometer. The air permeability of the materials was measured according to the standard SR EN ISO 9237/1999 [6].

3. Results and Discussions

The tested textile materials and yarns are presented in Table 1.

Table 1
Technical Properties of the Samples

No	Material Parameter		Flax/ Polyester/ Hemp	100% Polyacrylo nitrile	Cotton/ Polyester	100% Jute	100% Hemp	100% Flax
1	Warp/weft density [threads/cm]	Warp	9	8	28	5	5	17
		Weft	8	8	26	5	6	17
2	Weight per sq metre [g/m^2]		232	300	114	388	541	173
3	Fabric thickness [mm]		0.941	0.945	0.300	1.175	1.325	0.380
4	Yarns linear density, [tex]	Warp	206	172	20	407	348	50
		Weft	228	169	20	469	480	50
5	Air permeability [m^3/minutes m^2]		26.55	25.71	24.34	45.02	9.43	15.53

The variation of the water pick-up degree of tested materials, containing flax, hemp, jute, cotton, polyester and PAN fibres, depending on the wetting time, is presented in Fig. 1.

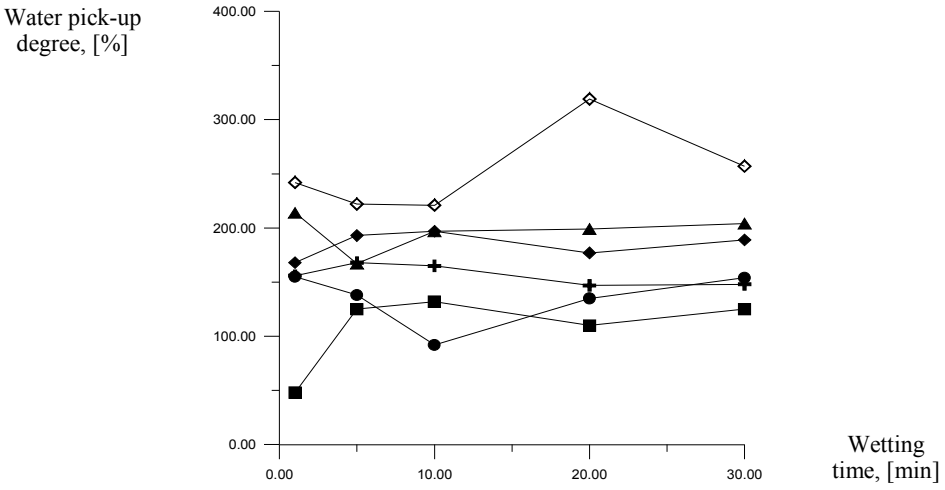

Fig. 1 − The variation of the water pick-up degree of several types of materials containing flax, hemp, jute, cotton, polyester, PAN, depending on the wetting time + *100% PAN;* ◊ *100% jute;* ♦ *100% hemp;* ■ *100% flax;* • *cotton/ polyester;* ▲ *flax/polyester/ hemp.*

The analysis of Fig. 1 leads to the following observations:

− the water pick-up degree is maximum for the 100% jute material, regardless of the time it has stayed into the water;

− the material with flax in the warp and hemp in the weft has a high rate of water absorption, therefore, after 5 min of staying into the water, the amount of absorbed water is maximum and remains almost constant, even after 30 min of staying into the water;

− the 100% hemp, 1.325 mm thick material reaches the maximum moisture content after 10 min of staying into the water ;

− the 100% jute, 1.75 mm thick material, which is 30% thicker than the 100% hemp one, reaches the maximum amount of absorbed water after 20 min of staying into the water;

− the thin 100% bleached flax, 0.38 mm thick material, after 5 min of staying into the water absorbs an amount of water close to the maximum;

− the thickness of the material influences inversely proportional the rate of water absorption.

In Figs. 2, 3, 4 and 5 is represented the variation of the water pick-up degree of each type of analyzed material, comparatively with the water pick-up of the component yarns from warp and weft, depending on the wetting time:

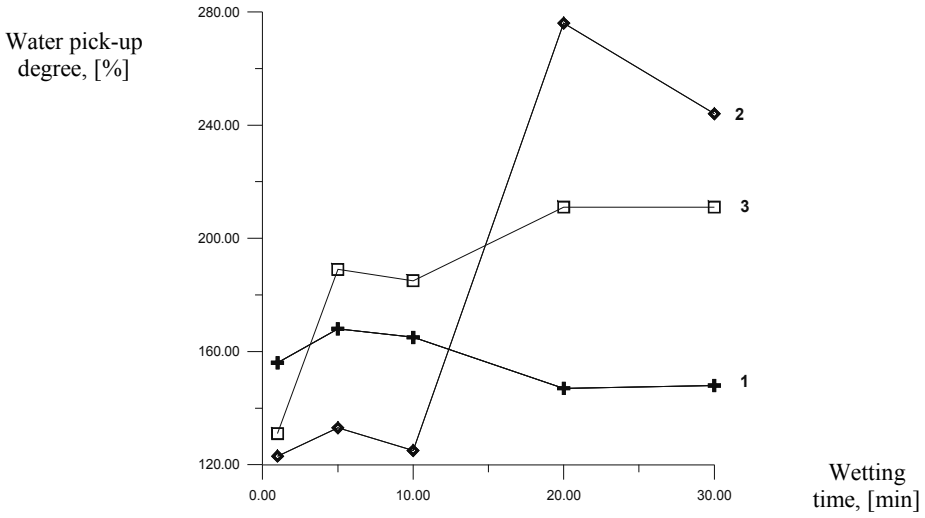

Fig. 2 − Variation of the water pick-up degree of the 100% PAN material comparatively with the water pick-up of the component yarns from weft and warp, depending on the wetting time
1-material, 2-warp yarn, 3-weft yarn.

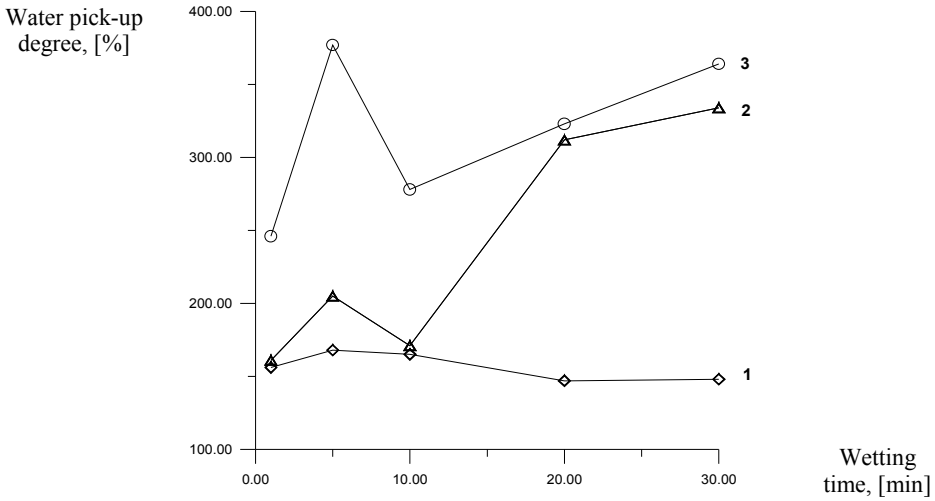

Fig. 3 − Variation of the water pick-up degree of the 100% jute material comparatively with the water pick-up of the component yarns from weft and warp, depending on the wetting time
1-material, 2-warp yarn, 3-weft yarn.

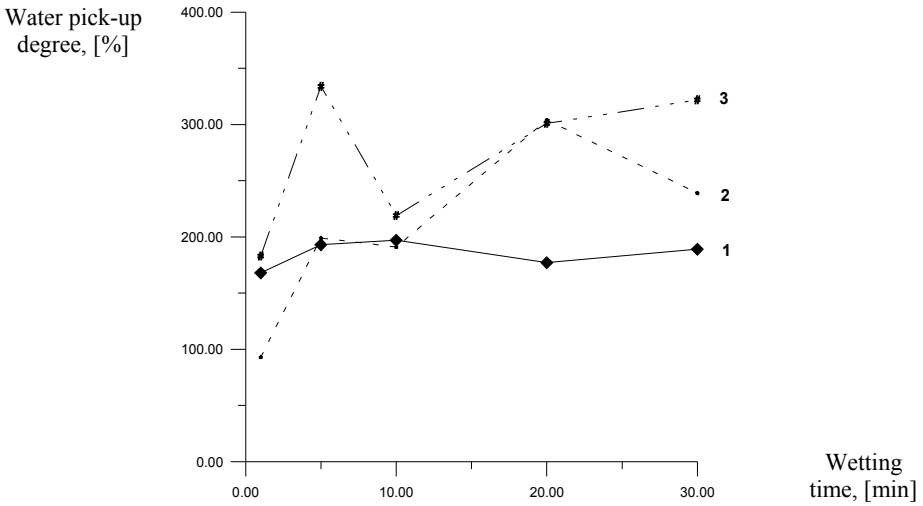

Fig. 4 − Variation of the water pick-up degree of the 100% jute material comparatively with the water pick-up of the component yarns from weft and warp, depending on the wetting time
1- material, 2 - warp yarn, 3 - weft yarn.

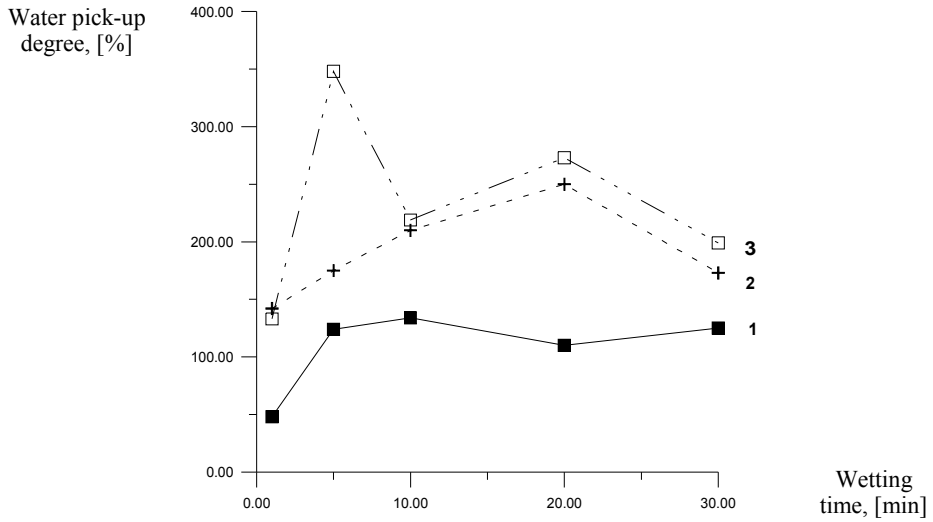

Fig. 5 − Variation of the water pick-up degree of the 100% flax material comparatively with the water pick-up of the component yarns from weft and warp, depending on the wetting time
1 - material, 2 - warp yarn, 3 - weft yarn.

The analysis of Figs. 2, 3, 4 and 5 leads to the following observations:

− the yarns that compose materials have registered water pick-up degrees higher than the materials, in all the cases;

− the high hygroscopicity of the cellulosic flax, hemp, jute, cotton fibres is reflected by the high water index of the fibres;

− the flax, hemp, jute yarns have a high water absorption rate, reaching the maximum water pick-up degree after 5 min of staying into the water.

4. Conclusions

The hydrophilic structure of bast fibres allows the retention of water, oxygen and different substances that can represent a favourable environment for the development of bacteria, fungi, or mould. When these fibres are to be processed to obtain medical products, different chemical treatments are necessary, which, in order to be well performed, should be based on previous analyses on the water pick-up degree of the fibrous material and its behaviour in a wet environment.

In the framework of the present research, a series of tests were performed, analyzing the behaviour of bast fibres in a wet environment, leading to the following conclusions:

− the yarns that compose materials register water pick-up degrees higher than materials;

− the flax, hemp, jute yarns have a higher water absorption rate and reach the maximum water pick-up degree after 5 min of staying into the water;

− the influence of the fabric thickness is inversely proportional the water absorption.

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INUL ŞI CÂNEPA – ALTERNATIVE NATURALE ÎN DOMENIUL TEXTILELOR MEDICALE

(Rezumat)

Caracteristicile fibrelor de in şi cânepă sunt higroscopicitatea, permeabilitatea ridicată la aer şi proprietăţile antiseptice, permiţând aplicarea acestora în domeniul textilelor medicale. Aceste fibre naturale oferă posibilitatea obţinerii de produse ecologice cu proprietăţi funcţionale noi care pot îmbunătăţi eficienţa tratamentelor dermatologice. Ele asigură condiţiile pentru exploatarea eficientă a resurselor naturale naţionale şi sprijină relansarea programului de cultivare a plantelor din care sunt extrase. În acest articol sunt analizate câteva proprietăţi ale firelor care au condus la alegerea lor ca materii prime pentru produsele textile medicale.