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THE EFFECT OF PHASE CHANGE MATERIALS ON THE TENSILE STRENGTH

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Abstract:. *PCM's need some important properties to have use such as high heat storage capacity, easy availability and low cost and can have different effects such as flavour, softness or exchange of heat. They are put inside of microcapsules, so they can be inbedded inside the strain, otherwise it wouldn't be so effective. So basically the microcapsules consist of a core that's the PCM and a polymer shell. This shell needs to be strong enough to hold the PCM and also withstand up to a certain level of heat and mechanical damage. This study investigates the tensile strength of fabrics composed by fibres, some of these fibres have benn inbedded phase change microcapsules (PCM's). The investigated fabrics are divided by composition and by structure. By knitting the fabrics in different structures you could be able to investigate which knitting way could be the most effective to have a high tensile strength. Tensile strength tests are performed on specimens with different structures but also with different compositions which could indicate that some strains are tougher then others and more specifically if the PCM's have a different effect on them*

Keywords: *Tensile strength, PCM, Microcapsules, different knitting structure, different compositions*

1. INTRODUCTION

Everyday new chemical fibers are being developed in order to improve the properties of conventional fibres, because nowadays textiles are required to have extra properties [1]. They should offer active functionality. Now they are also called smart textiles: the term refers to textiles that are able to react when an external effect is present [2]. Fibers are polymers and they are made out of a polymer solution that can be modified in many ways, such as variations in the degree of polymerization and crystallinity whose application depends on the property to be improved.

Phase Change Materials (PCM), such as paraffin waxes, are more and more often used for their thermoregulating properties because they have a great capacity to absorb and slowly release latent heat involved in a phase change process [3-5]. PCM's have been used as thermal storage and control materials because of the heat absorbtion and release that occurs upon a change of phase: the PCM materials absorb energy during the heating process as phase change takes place (from solid to liquid) and release energy to the environment in the phase change during a reverse cooling process (from liquid to solid) [6].

Different compositions have long taken the attention of many researchers and companies to enhance the composites' properties. The tests were performed to analyse these properties, more specifically the mechnanical properties. It's important to know if the fabrics with the PCM's inbedded don't weaken the fabrics and if so in which combination with other fabrics it could be used to reinforce them again and increase their strength again.

2. EXPERIMENTAL

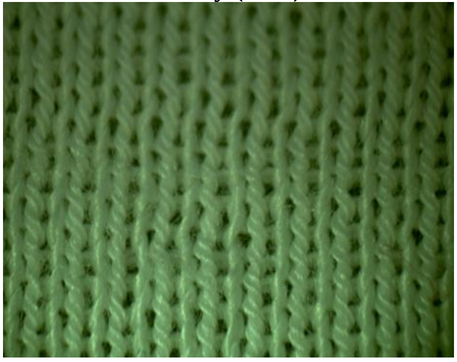
2.1 Materials

A total of 12 fabrics were used in this work, divided by different structures and different compositions. Details of the samples are shown in table 1 and different structures used are shown in figure 1.

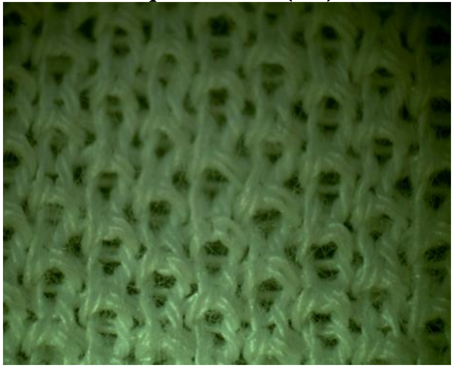
Table 1: *Composition and structures of the different samples*

Sample	**Composition (%)**					**Structure**
	Viscose Outlast	**Cotton**	**Polyester**	**Bioactive fiber**	**Tencel**	
1JER	30	70				Jersey
2JER	30		20	50		
3JER	30				70	
4JER		100				
1PL	30	70				Piqué Lacoste
2PL	30		20	50		
3PL	30				70	
4PL		100				
1PD	30	70				Piqué Dullo
2PD	30		20	50		
3PD	30				70	
4PD		100				

Jersey (JER)



Piqué Lacoste (PL)



Piqué Dullo (PD)

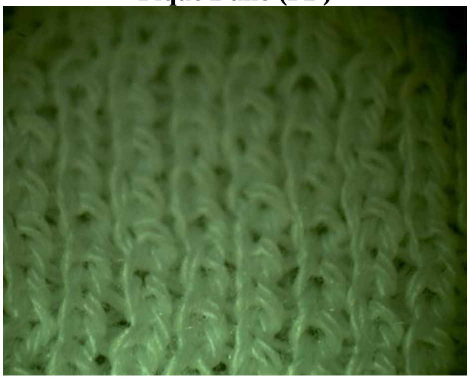


Fig. 1*: *Knitting structures used.

2.2 Methods

The machine used to analyse the tensile strength of the fabrics was Zwick/Roell 2005 testing unit according to UNE EN ISO 13934-1 standart.

3. RESULTS AND DISCUSSION

The tensile behaviour of each fabric in both directions, columns and row, are compared by a graphic in figure 2.

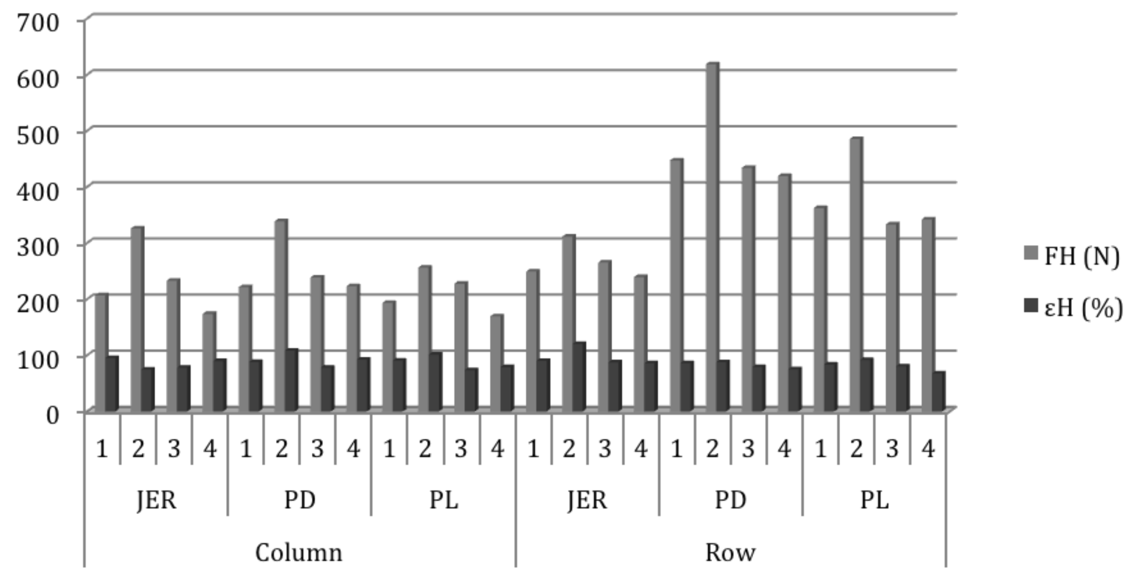


Fig. 2 : *The tensile strength and elongation of all samples in row and column direction*

The graphic can be separated in two pieces: the row section and the column section. As can be seen in figure 2 the column samples all have approximately the same value, except for 2PD and 2JER. All the other samples are around 200N while 2JER and 2PD of the column samples are significantly higher at around 300N.

By comparing the different row structures, it can be clearly seen that PD_{ROW} has the biggest Tensile strength. This is followed by PL_{ROW} and finally by JER_{ROW} which has the lowest tensile strengths of the ROW samples. If we don't look at them in groups but each separately you can see a clear consistency: 2PD (618N) has a higher value than 2PL (485N) which is higher than 2JER (311N). 1PD (430N) is followed by 1PL (362N) and then finally again by 1JER (249N). This is the same for 3PD (433N) is bigger than 3PL (332N) which is again bigger than 3JER (265N). And finally the 4 row samples have the same effect: 4PD (419N) which is bigger than 4PL (341N) which is bigger than 4JER (239N).

The elongation is for all the samples practically the same, around 90%.

4. CONCLUSIONS

By comparing the different composition and different structures we could distinguish a clear difference in what sample(s) are the strongest. It can be concluded that by comparing the different structures we can see that the PD-structure in column direction has the highest tensile strength and is therefor the strongest of the 3 different structures and that the row direction does not have much effect on the tensile strength.

From comparing the different compositions we could see with all of them that the 2 samples were the strongest and the 1, 3 and 4 were more or less the same. So for those 3 samples it's not a big influence which one is used to make a fabric with high tensile strength, but it's clear that a 2PD sample cut in row direction has the highest tensile strength.

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