ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

PRELIMINARY STUDY FROM RICE HUSK EXTRACTS TO FINISH TEXTILE FABRICS

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Abstract: *Nowadays, envoronmental concern is increasing and textile industry is aware of it. Circular economy are two words which are linked together and frequently used nowadays. In this report, we focus the reseach on the rice husk in order to dimish the problem rice waste generates to farmers. Rice husk was treated with some chemicals (HNO_3). The extract was dried and conveniently dissolved to apply it on textile fabrics made of 100 % cotton and 100 % polyester.. The extract was dissolved on NaOH solution and applied by padding on a cotton and polyester fabric at different concentrations. The dried extract was analysed by FTIR and both the extract and fabrics were observed by FESEM-EDX to detect the presence of some particles Results evidence the presence of some particles on the fibres, despite having applied low concentrations FTIR is sensitive enough to detect its presence on fibers. It was expected to observe Si from the extract but FESEM-EDX could not appreciate it. Once the treatment was applied on the fabric yellowing was observed but also water repellence thus with the FTIR spectrum gives the idea that the extract was mainly comprised of lignin. Further studies will be conducted in order to spcecify the new properties conferred to the textiles.*

Key words: *circular economy; rice waste; functionalise; water repellence; cotton; polyester.*

1. INTRODUCTION

Nowadays, envoronmental concern is increasing and textile industry is aware of it. Textile ecological technologies occupy an important place in the research projects developed at national and international levels [1]. Thus, many natural resources are sought, to look for different applications such as natural dyes [2]

Rice husk is a problem for regions such as Comunitat Valenciana in Spain, it cannot be left on the ground as it rots quickly and damages the ground preventing from growing rice the next years. If it is burned CO_2 is a problem. Some researchs are focused on the new products which can be obtained from this waste. This allows to obtain new resources of materials and include the riece husk into circular economy improving the sustainability of rice.

Some researchers mix pieces of rice husk with wood particles in a rotating drum in order to obtian planks of wood-rice [3]. Others [4] by means of high pressure steam, an separate the cellulose from the rice husk, which is its main compound. The difficulty in separating these two components lies in the strong crystalline structure of cellulose and the presence of a lignin. It can be also used to form transparent film from rice nanofibers with cellulose acetate [5].

Swiss botanist A.P. Candolle (1778-1841) used the term "lignin" (derived from the Latin lignum = wood) for the first time. Later in 1865 Schulze et al. They used the term to describe the dissolved part of wood when treated with nitric acid. In the 1960s, with the development of biochemical and organic chemistry analysis tools, more information of interest regarding this biopolymer was accumulated. Since then, research on lignin has grown at a rapid rate, drawing the attention of the paper industries predominantly [7].

Lignin is one of the most abundant biopolymers in plants and together with cellulose and hemicellulose it forms the cell wall of plants in a regulated arrangement at the nano-structural level, resulting in lignin-carbohydrate networks. The composition or distribution of the three components in these networks varies depending on the type of plant. In the case of wood composition, the most commonly found ranges are: Cellulose: 38-50%; Hemicellulose: 23-32% and Lignin: 15-25% [8].

Lignin is present in all vascular plants, and like many other biomass components, it is formed through the photosynthesis reaction. Lignin is considered as an affordable renewable resource with potential industrial use, whose annual production has been estimated in the range of 5-36 x 10^8 tons [7].

Different percentages of ligning can be extracted depending on the vegetable is usaed as raw material, pines are around 27-28% eucaliptus are areound 22%. Rice husk is supposed to offer about 6% of lignin. In this work we will try to obtain rice husk extranct and characterise it. Later on we will apply extract from rice husk onto textile fibres in order to determine whether it modifies some of the fabric properties.

2. MATERIALS AND METHODS

2.1 Materials

Rice husk was collected from Valencia, Spain. HNO_3 and NaOH were purchuased from Panreac.

A 100 % bleached cotton fabric 220 g/m2 was used for the finishing treatment. A 100 % polyester fabric 120 g/m^2 was also used.

2.2 Methods

Rice Husk extraction

Rice husk (100 g) was rinsed with water in order to remove the dust and other particles which can be on the surface. Later on it was placed on a heater at 80º C for 4 hours. 20 grams of the dired husk were placed in an open reactor with 100 mL of HNO_3 and 100 mL of distilled water. The solution was kept at 70º C for 120 minutes. The liquid was filtered and dried at 70º C for 24 hours.

Textil finishing

The dried extraction was dissolved into NaOH 50 Bé. Two concentrations were tested (10 mL and 20 mL) of the dissolved extract were mixed with 40 mL of distilled water and 1 g of fabric was immersed on the final solution (50 mL) (r:b =1:50). Every sample was refrenced as D51 and D61 respectively.

FTIR

FTIR spectra were recorded in order to characterize the fabrics surface. An FT/IR-4700typeA from JASCO wit ATR accessory was used, 16 spectra were recorded with a 4 cm^{-1}resolution.

FESEM

Samples surface was carried out by means of electron microscopy (Scanning Electron Microscopy, SEM) with a FIELD EMISION MICROSCOPE FESEM (ULTRA 55, ZEISS). Each sample is covered with a layer of carbon in order to transform them into conductive by using a Sputter Coater and being able to analyse samples by EDX. The samples were analyzed with the appropriate magnification and with an acceleration voltage of 1 KV.

3. RESULTS

In order to characterize the extract treatment on the fibres some instrumental techniques have been used. Figure 1 shows the FTIR spectra for cotton (Fig. 1) and for polyester (Fig. 2) fabrics. It can be appreciated for both samples (cotton and polyester) that the region between 1800 cm^{-1} to 1500 cm^{-1} shows an significative change on the fibre spectra.

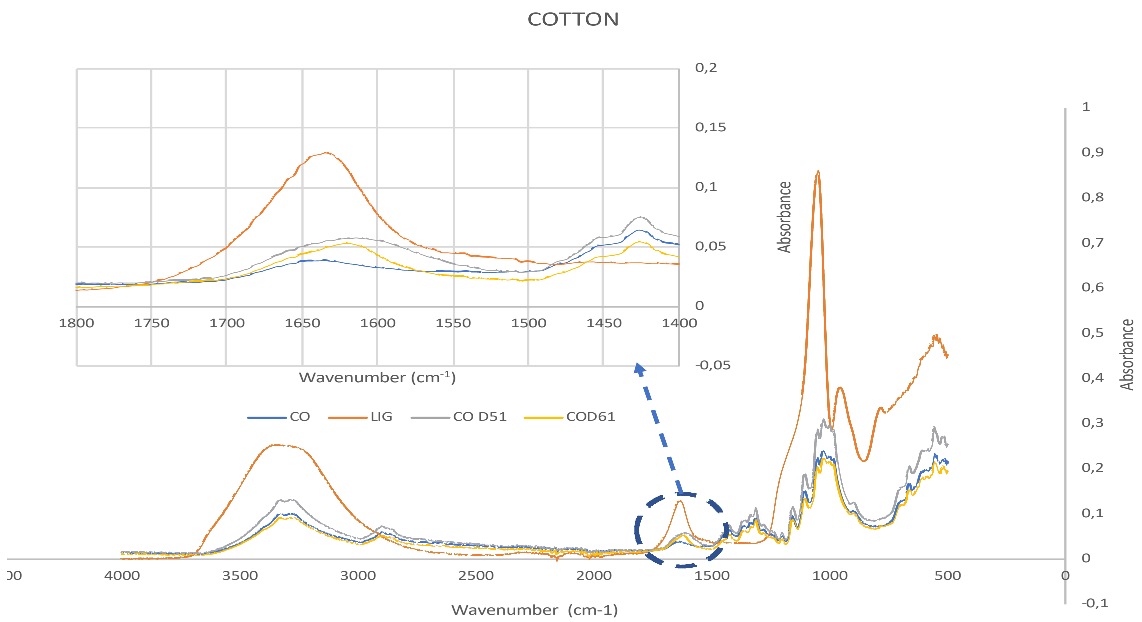


Fig. 1: *FTIR spectrum of cotton finished with rice husk extract. CO = cotton; LIG = extract, COD51 = cotton treated at concentration 1; COD61 = cotton treated at concentration 2.*

As it can be observed from Figure 1 the pick on cotton fiber (blue line) is centered at 1650 cm^{-1} whereas the pure extract shows the pick centered around 1675 cm^{-1} . Treated cotton (grey and yellow line) shifts towards lower wavenumber due to the treatment with the extract.

Something similar is observed when the treated fabric is polyester. It can be appreciated for both samples (cotton and polyester) that the region between 1800 cm^{-1} to 1500 cm^{-1} shows an significative change on the fibre spectra.

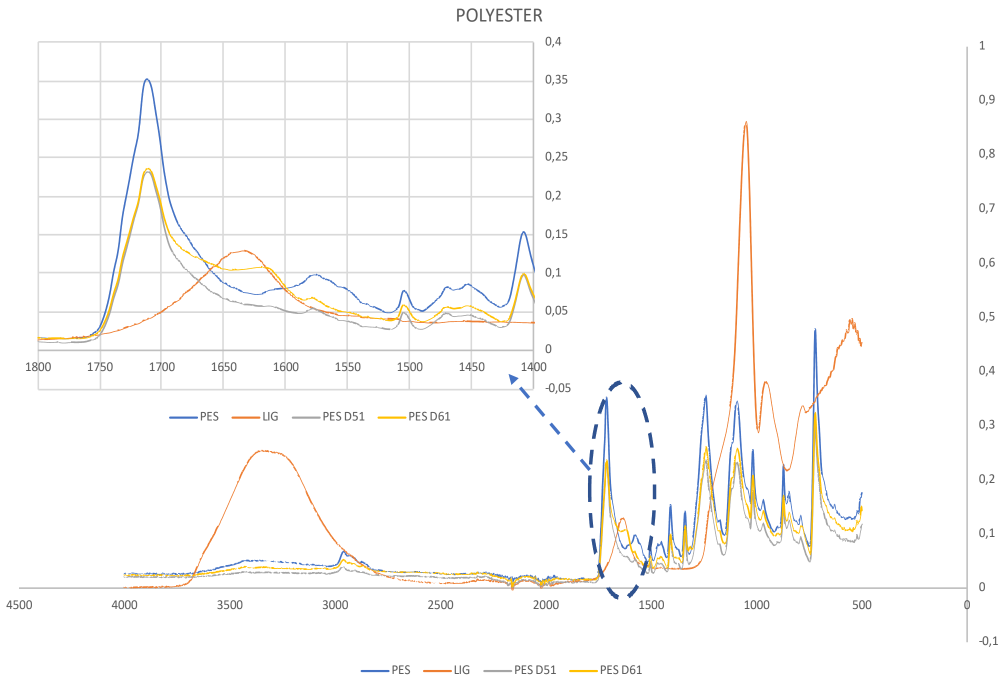
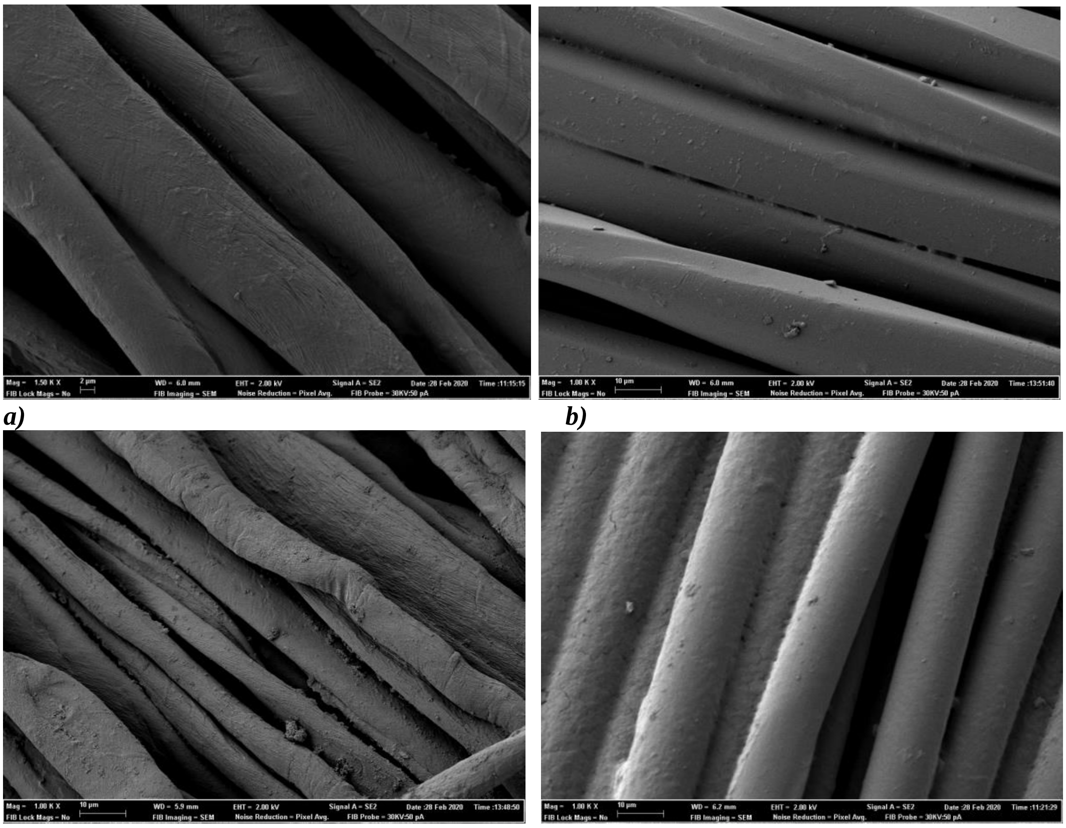


***Fig. 2**: FTIR spectrum of polyester finished with rice husk extract. CO = cotton; LIG = extract, COD51 = cotton treated at concentration 1; COD61 = cotton treated at concentration 2.*

The FESEM images show the presence of some little particles on the fibre surface for both cotton (Fig. 3a) and polyester (Fig. 3b).

According to some references [6] rice husk should contain Silica. FESEM-EDX was performed but results showed no evidence of Si particles on the fabrics surface. The Si absence canbe due to the extraction procedure conditons. In our experiment we worked in open reactor and with temperatures lower than 100º C.

It cannot be observd by FESEM images, but it should be noticed that when fabrics were treated, a yellowish colour is observed for both cotton an polyester fabrics. In order to determine the effect of the extract on the fibres, apprat from the colour variation, some drops of water were placed on every treated fabric (cotton and polyester) and it was compared with the original ones without the finishing treatment applied. Results evidenced an increase on the water repellency (cotton 3 seconds, and treated cotton 10 seconds; polyester 15 seconds and treated polyester 21 second) as the wettability of the fabric was higher for non treated fabrics, considering the time the water drop miss the shape. Further research, with objective tests will be conducted in order to determine if theere is a sensitive difference due to the higher concentration of the extract on fabric.



a) ***b)*** ***c)*** ***d)***

Fig. 3: *FESEM images from fabrics treated with the extract. a) cotton; b) polyester; c) treated cotton; d) treated polyester.*

5. CONCLUSIONS

In this project authors, conscius of the envrinmental problems and aweare of reducing pollution from textil industry, aim to develop a preliminar sutdy to rice husk. The objective was ot obtain a new priduct which could be used as a new functional finish for textile products.

Despite having applied low concentrations of the extract onto the textile fabrics, FTIR demonstrated to be sensitive enough to detect the extract presence on the fibers for both cotton and polyester. It was expected to observe Silica from the extract but FESEM-EDX analysis could not appreciate it, probably due to the fact that the extraction was conducted on open reactor with temperature below 100º C and not at high presure and temperature.

Once the treatment was applied on the fabric, at first sight yellowing was observed but preliminary tests also evidenced water repellence behaviour.

Thus, we can conclude that Silica was not extracted but due to the FTIR spectrum and the water repellency increase, it gives the idea that the extract was mainly comprised of lignin.

Further studies will be conducted in order to spcecify the new properties conferred to the textiles

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