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Cell Wall and Lignin Distribution in Coir Pith of Different Ages

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ABSTRACT:Coir pith, a by-product of industry, renewable sourceis dark brown in color, fibrous in condition. The physical properties and anatomical studies of various ages of coir pith were done to determine the efficiency of formation of primary and secondary cell wall in fresh and old coir pith.The cell wall structure, lignin composition and the anatomical view in the collected coir pith were examined through light microscopy and TEM analysis. It was observed that the cell wall structure of the old coir pith of about 5 years old did not support the structure, which showed poor structure whereas the fresh coir pith of 7 days old had improved cell wall structure identifying both the primary and secondary cell wall. From light microscopy, it was observed that the old coir pith possessed less lignin composition than the fresh coir pith. The fibrils and the cuticle were clear in the fresh coir pith unlike old coir pith. This proved the efficiency of fresh coir pith to be used as a raw material. It was observed that the structure identification in the coir pith is directly proportional to time which tends to lose its structure as it degrades.

KEYWORDS:Coir pith, Light Microscopy, TEM, Cell wall

I. INTRODUCTION

Coir fibresare lignicellulosic materials, are hydrophilic in nature. Coir pith consists of fibres made up of chemical components such as lignin, hemicellulose and cellulose. Lignin in coir pith plays a crucial role, conferring mechanicalsupport and water transport for the plants [1]. The lignin content is very high. Cellulose and hemi-cellulose is a polysaccharide compound while lignin is a macromolecules polyphenolic compound. These organic substances are easy to use, they offer improved availability of nutrients to plants, and in general they provide better physical and chemical properties suitable for best plant growth. Coir pith in the form of biomass proved to be the largest source for cellulose all over the world [3].

This coir pith when left on the ground in the environment, they are meant to cause environmental pollution though it is valued for economical uses. In order to make it valuable, the accumulated coir pith needs to be examined for its basic physical properties and its structure [4].

II. MATERIALS AND METHODS

COLLECTION OF COIR PITH:

The coir pith was collected from the industrial area TANCI, Krishnagiri.

MICROSCOPY STUDIES:

The collected coir pith samples performed for Light microscopy and TEM for viewing the cell wall structure such as Primary cell wall, Secondary cell wall according to TAPPI methods [6].

For the Light microscopy, the collected coir pith fibres were cut into 2x3 mm blocks; the cut samples were then dehydrated in ethanol and polymerized for 24 hour at 60-65 °C [5]. After 24 hours of time, the samples were stained with 1% Toluidine Blue for the determination of physical structures distribution. The samples were viewed under various micrometers in the transverse section. The images were captured under 2 µm and 200 µm for the samples [4].

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TEM ANALYSIS:

The fresh and old coir pith samples were given for TEM analysis in VIT University, Vellore. The coir pith was sealed in polyethylene bags and sent to the laboratory within 24 hours of collection to maintain the moisture content. The samples were stained with 2% uranyl acetate and lead citrate for viewing under Transmission Electron Microscope [2]. The images under 500nm and 200 nm were focused for the samples [4].

III. RESULTS AND DISCUSSION

LIGHT MICROSCOPY ANALYSIS:

Under Light microscope, the stained samples of fresh and old coir pith were examined under several micrometers. In fresh coir pith, the secondary cell wall components such as lignin, cellulose and hemicelluloses were identified clearly whose developed structure was marked. In old coir pith, the all components were not clearly seen; only lignin and hemicelluloses were marked. The coir pith was also viewed at 200 µm, 2 µm, 1 µm and 0.5 µm.

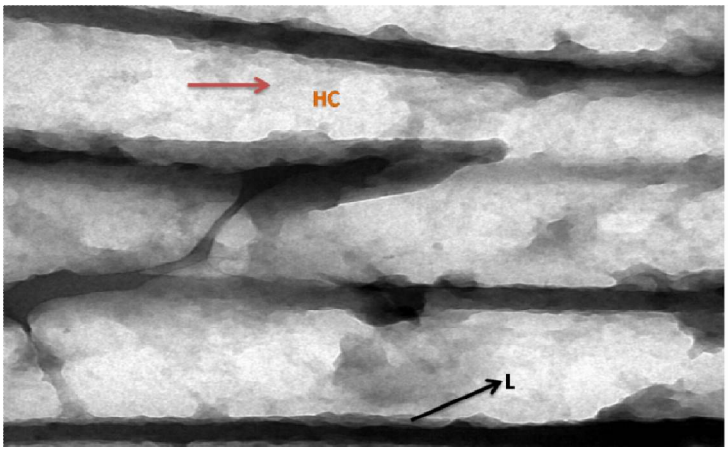

Fig 1: TRANSVERSE SECTION OF OLD COIR PITH AT 200 µm
Key: HC – Hemicelluloses; L- Lignin

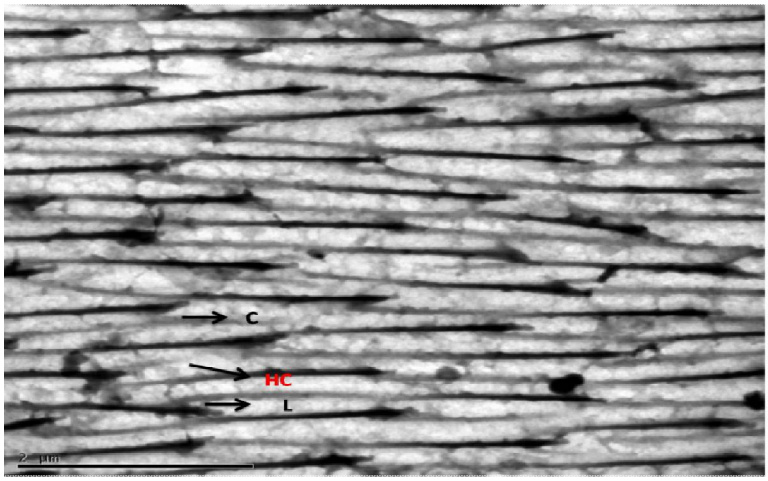

Fig 2: Transverse section of fresh coir pith at 2 µm
Key: HC – Hemicelluloses; L- Lignin C - Cellulose

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TEM ANALYSIS:

The electron Microscope is an effective technique for the examination of cell wall structure. Coir pith cell walls possess a primary cell wall, secondary cell wall, in which 3 layers such as SL1,SL2,SL3 cold be identified. Primary cell wall is responsible continuous cell division whereas the secondary cell wall is thick layered and situated inside the primary cell wall. These cell wall structures were identified at 500 m and 200 nm using TEM which also showed the structure of Middle lamella that helps to stick the cells together.

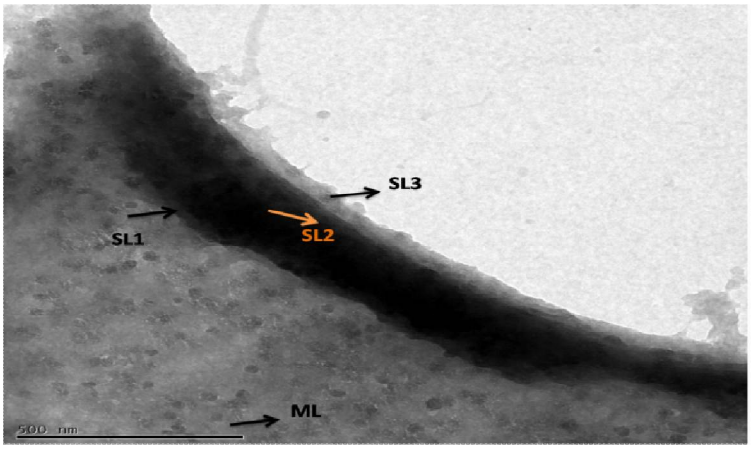

Fig 3: Secondary wall arrangement in fresh coir pith at 200 nm
Key: SL1 – Secondary layer 1; SL2 – Secondary layer 2; SL3 – Secondary layer 3; ML – Middle Lamella

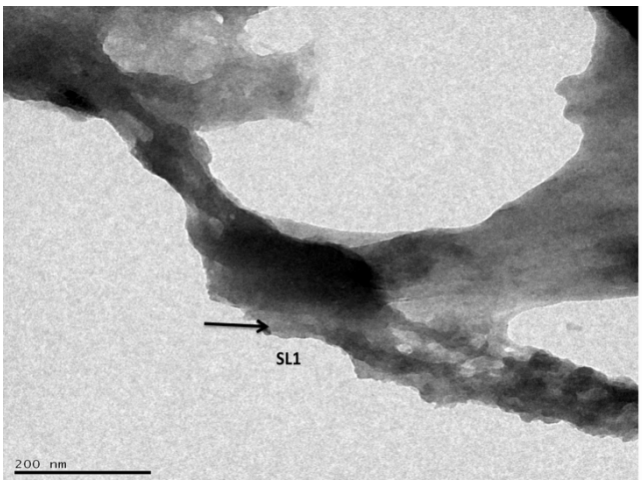

Fig 4: Secondary wall arrangement in old coir pith at 200 nm
Key: SL1 – Secondary layer 1

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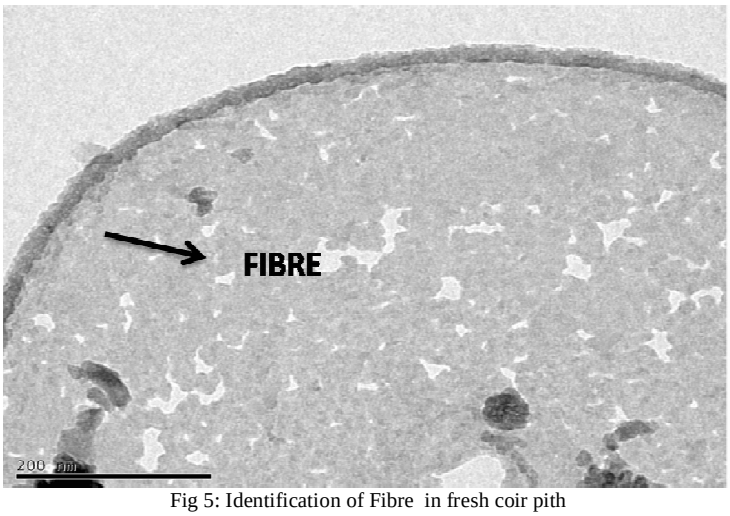

Fig 5: Identification of Fibre in fresh coir pith

In fresh coir pith, the Fibre was identified in the cell wall which was distributed all over the cell, the chemical distribution like Lignin, Cellulose and Hemicellulose are usually present inside the fibre

IV.CONCLUSION

In comparison with the Fresh coir pith and Old coir pith, the fresh coir pith have developed cell wall structure with chemical distribution whereas in the old coir pith, as the degradation takes place, the cell wall structure and the chemical distribution found to get unstructured gradually. This proves the ability of the fresh coir pith to be used as a raw material rather accumulating in the environment. Being fresh byproduct, the morphological characteristics of the coir pith remains same. Using these natural characteristics, fresh coir pith for the raw material for several processes helps in the elimination of Environmental pollution.

V.PATENT DETAILS

This part of the work is patented vide under the application number 201641002069.

VI. ACKNOWLEDGEMENT

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REFERENCES

[1] J. Paramanandham and P. Ronald Ross, "Scanning electron microscopic analysis of coir pith after subjected to different treatments", International Journal of Research in Pure and Applied Chemistry, vol. 2, no.1, pp. 1-3, 2015.
[2] **P**. Ronald Ross, J. Paramanandham, P. Thenmozhi, K.S. Abbiramy and M. Muthulingam, "Determination of physico-chemical properties of coir pith in relation to particle size suitable for potting medium", International Journal of Research in Environmental Science and Technology, vol.2, no.2, pp. 45-47, 2012.
[3] K. G. Satyanarayana, C. K. S. Pillai, K. Sukumaran and S. G. K. Plllai, "Structure property studies of fibres fromvarious parts of the coconut tree", J o u r n a l of Materials S c i e n c e, vol.1 7, pp. 2 4 5 3- 2 4 6 2, 1982.
[4] H.P.S.Abdul Khalil, M. Siti Alwani and A.K.Mohd Omar, "Chemical Composition, Anatomy, Lignin Distribution and Cell wall structure of Malaysian plant waste fibres", Bioresources, vol.1, no.2, pp.220-232, 2006.
[5]Z. H. Zhang, Z. Ji, J. F. Ma and F. Xu, "Anatomy, cell wall ultrastructure and inhomogeneity inlignin distribution of *Broussonetia Papyrifer"*, Cellulose Chemistry and Technology, vol.46, no.3-4, pp.157-164, 2012.
[6] TAPPI (Technical Association of Pulp and Paper Industry) Test Methods. TAPPI Press, Atlanda, Georgia, 1994