Extraction of Lignosulphonates from Coir Pith - An Agrowaste

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ABSTRACT

The untapped potentials of coir pith, an abundantly available lignocellulosic by-product of the coir industry is today being recognised with its worth being confirmed in various applications. This paper reports the investigations conducted on extraction of industrially useful lignosulphonates from coir pith. This is the first report on any study on extraction of lignosulphonates from coir waste.

KEYWORDS

Coir
Coir pith
Lignin
Lignosulphonates

INTRODUCTION

A well known by-product of the coconut is the husk which is the source of the coir fibre. The by-product of the coir industry is "pith" which is a lignocellulosic material forming about 70% of the coconut husk. The total quantity of coconut pith in India is estimated to be 5,00,000 tonnes per annum. The chemical composition of coir pith is furnished in Table I (Reported by Pillai and Warrier 1952). Although the economical utilisation of the coir pith for agricultural and horticultural purposes have been studied, the industrial exploitation of coir pith has so far been limited. The benefits of utilisation of the coir pith in augmenting the farm output have been reported after conducting experimental field

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studies on several agricultural and horticultural crops.

Since the main contributor of manurial value to the soil will be the cellulose part of the pith, it was envisaged to conduct this study on the possibility of extraction of industrially valuable products from the lignin portion of the coir pith. Coir waste, being lignocellulosic in nature consists of about 25% lignin and this study attempted to extract the lignin in its sodium salt form as LIGNOSULPHONATE.

Background

Lignin (from the latin "lignum", wood) is, after cellulose, the principal constituent of wood. Always closely associated with cellulose in woody tissue, it is probably chemically combined with some of the cellulose, carbohydrates, or other constituents.

Structural studies have shown that lignin is a major polymeric component composed of repeating phenyl propane units which are linked together through a phenolic oxygen para to the propyl side chain and in part by other linkages. Lignin can be separated from polysaccharides by pulping reactions that convert the organophilic lignin into degraded derivatives soluble in the aqueous pulping liquor. Acid pulping methods by bisulfite solutions sulphonate the lignin and degrade it, perhaps by acid catalyzed hydrolysis. The extraction process adopted for this report is the sodium bisulfite pulping method.

Other methods for separation of lignins are the soda process using a sodium hydroxide solution and the kraft process using sodium sulfide and sodium hydroxide. These processes liberate the phenolic groups and make

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the lignin alkali soluble. In order to avoid the inherent pollution problems associated with sulfides, aqueous ethanol delignification was also attempted in the absence of sulfides independently by Morton at al and April at al.

Importance of Lignosulphonates

Lignosulphonates have gained importance in industrial applications as a low cost wetting agent. They are also the major raw material for the production of Vanillin. Commercially, they can be used for road and briquette binding, as tanning agents, drilling mud additives, protein coagulants as fillers for synthetic rubbers and phenolic plastics, as a component of linoleum as soil conditioners and hardeners. In India lignosulphonates are being marketted under different trade names and sodium lignosulphonate is being extensively sold. It finds use as a filler, wetting agent, dispersing agent and adhesion compound for Pesticide and Fertilizers. Other applications include its use as a dispersing and levelling agent, as grinding aids, anticaking agent, protective colloids in addition to be used for slowing down some processes in Dyestuff and Pigments.

MATERIALS AND METHODS

Raw coir pith from retted husks which is abundently available in Kerala was the raw material used for the study. The digestion process adopted was the sulfite one using a 2% solution (on the weight of the material) of sodium bisulfite. The material to liquor ratio was 1:10 and the pH maintained at an acidic range with a dilute solution of hydrochloric acid. The digestion was carried out in an autoclave used for microbio-

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logical studies. The digestion was conducted at 115°C for 30 minutes and then the temperature raised to 135°C and maintained for 90 minutes.

The lignins are extracted during this process in two stages - in the first, the lignin reacts to form solid lignosulphonic acid which in the second stage is made soluble by hydrolysis. This soluble compound is acidic and combines with the base present to form a salt. Since sodium is the base present during the cooking process, thus soluble sodium lignosulphonate is formed as a black liquor.

Chemical analysis of the Sodium Lignosulphonate from coir pith

The lignosulphonate in the form of black liquor was subjected to analysis on the HPLC (High Performance Liquid Chromatogram). The instrument used was of Spectra Physics SP8800 make with 250cm x 8mm column packed with Lichosorb R-18 support. A linear solvent gradient of 80:20 metharol was delivered with SP8800 ternary HPLC pumps which facilitated the separation of the sample. The flow rate of the solvent was maintained at 2 ml per minute. The column outlet was monitored by a Spectra 100 variable wavelength detector set at 280 nanometers in the ultraviolet range.

A sample of the extracted liquor was also subjected to a scan between 250 - 300nms on a Beckman Du-6 Spectrophotometer. The maximum absorption was observed to be at 276nm which indicates presence of compounds absorbing in the UV range. A sample of the extracted spray dried material was subjected to Infra Red Spectroscopy. The IR Spectra is found to be consistent with the IR Spectra

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f lignin samples reported earlier. A weak band at 1663cm^{-1} indicates the presence of carbonyl groups. The two bands one at 1666-1668 cm^{-1} and one at 1705-1710cm^{-1} presumably originate from conjugated aldehydes and ketone carbonyl groups respectively Ref. 9,10,11,12. Fig. I & II depict the analytical results of the tests on HPLC and Spectrophotometer respectively. Thus in the present study, several aspects of chemical properties related to the lignosulphonates from coir pith could be established.

Results and discussions

The lignosulphonate extract was concentrated under low pressure on a Rota Vap Aspirator Model A-35. The concentration of 325 ml of the extracted material could yield 6gms of lignosulphonate powder indicating a percentage yield of 18.5% with respect to the pith.

The coir industry is centered in several states of the country viz. Kerala, Tamil Nadu, Karnataka, Andhra Pradesh, Orissa and West Bengal.

Conclusions

With the available 5,00,000 tonnes of coir pith per annum, there is immense potential for extraction of lignosulphonates. At present, the lignosulphonates manufactured in India are mainly from the spent liquor of digested wood pulp. One of the main buyers of lignosulphonates in India is the ONGC which utilises the same as a mud thinner in oilwell drilling. The rates of lignosulphonates range between Rs.12,500/- to Rs.28,000/- per tonne excluding taxes The price is fixed on the basis of the salt used for the extraction purpose.

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Thus the arena of extraction of lignosulphonates from coir pith is presently in its budding stage. Further, areas of investigations on the subject include extraction of different salts of lignosulphonates and standardisation of the extraction process. To conclude, it can be stated that a material which is encountered as a menace to the coir fibre extraction units due to problems of disposal, can now be a raw material for valuable products with versatile applications.

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TABLE I

Chemical Analysis of Raw Coir Pith

1. Moisture (on air dry sample)	11.9%
2. Ash	8.7%
3. Fats & Resins	1.8%
4. Lignin	25.2%
5. Pentosans	7.45%
6. Cellulose	35.0%
7. Loss on boiling with 1% Na oH	12.0%

Reported by Pillai & Warrier (1952)

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