

Poly Vinyl Alcohol And Pomegranate Peel Powder Biofilm– Preparation, Characterization And Usage In Triboelectric Nanogenerator

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Abstract- Polyvinyl alcohol (PVA) and pomegranate peel powder (PPP) composites have been synthesized and characterized for their application in tribo electric nanogenerators (TEGs). PVA, a biocompatible and biodegradable polymer was blended with PPP, a natural waste material rich in polyphenols and antioxidants. The preparation involved the mixing of PVA and PPP followed by casting and drying to form thin films. Characterization techniques such as FTIR spectroscopy, X-Ray diffraction and scanning electron microscopy revealed the structural, morphological and chemical properties of composite films. The triboelectric properties of PVA-PPP composites were evaluated, demonstrating their potential as effective triboelectric materials for energy harvesting applications in TEGs. This study highlights the sustainable utilization of agricultural waste in advanced material for renewable energy technologies.

made of many polymeric compound which releases heat & pollution due to presence of pythgate and some phenolic carbonic compound. Biodegradation becomes little difficult when the plasticizers and additive were added to them and it becomes more complicated than the usual one. But if it is of natural additives then it becomes completely useful and we can be able to create a pollution free environment. To overcome this problem there is solution of creating a biodegradable film using the biopolymers and there were may research regarding this and in this paper the biodegradable film is made of pomegranate peel powder and Poly vinyl alcohol which can be imparted in the for the usage of tribo nano electric generator. Bio polymer based tribo electric nanogenerator is important for the development of green technology. Usage of Pomegranate Peel and Polyvinyl alcohol has a great advantage because of it's pleasing property. So once the characteristics of this film is studied it can be used as element for the tribo electric nano generator. This will be the great replace even for the fossil fuels which getting ruin nowdays and being a non renewable energy source.

I. INTRODUCTION

Plastic is consider as the most important and toxic pollutants among various pollutants in the environment. They play vital role in every application of human life. The word plastic is greek word which means “pliable and easily shaped”. The plasticity is the important property of plastic which can be made and shaped according to our necessity and demand in human life. Though they play an important & advantageous role, it causes great effect to human & living things in the world. The application of plastic is countless. They are mainly used in the field of food packing, building & construction, home appliances, automotive & transport, sports and even in the field of medicine. Even the outspread is more it takes almost 20 years for it's degradation period and it is almost made of polymers ,when it is combined with other polymers it may even taken million of years to degrade. The degradation of plastic through biological process is a great significance for human and ecological health. This has created an great attention to the researcher to develop a degradable plastic from the organic waste which is deposited as landfills. This creation of biodegradable polymer will be the great replacement for the plastic. Plastic is a large polymer chain

II. EXPERIMENTAL PROCEDURE

2.1 Materials

Pomegranate Peel is collected from the fruit juice shop which is damped as landfill and made into powder. Poly vinyl alcohol of molecular weight 125 kg/mol and other element was bought from the Balaji Chemicals.

2.2 Preparation and Characterization of film

The preparation of biodegradable film using PVA and Pomegranate Peel Powder includes the following methodology.

Hot water Soluble PVA is used as the polymer material and pomegranate peel powder of size 20-30 μ m is taken as the bio filler material which can be degraded. Fabrication of the bio-composite film is made using casting method. In this method PVA is dissolved in the distilled water

of 20ml and bath is heated to 900°C and stirred with a magnetic stirrer for 2 hours and after that pomegranate peel powder is added to the reinforcement at particular concentration of 5%, 10%, 15% and it is also made to be stirred for the period of 2 hours and once it is dissolved completely it is poured over the glass plate and allowed to cool at the room temperature for 3 hours and it is removed from the glass plate after the duration.



Fig 1. After the film is getting ready it has been analyzed for its characterization. Photographic images of PVA & PVA/PPPF bio films

The characterization of bio film is made using the following steps and method they are Fourier transform infrared spectroscopy, X-ray Diffract meter, Thermogravimetric analysis, UV-Visual testing and tensile testing.

Fourier transform infrared spectroscopy is used to identify the chemical composition/functional group present in the bio film using infrared rays. This is also useful in identifying the contamination in extract, additives after extraction and also useful in identification of oxidation, decomposition of monomers in failure analysis investigation. All the spectra recorded in 4000-500cm⁻¹ with 32 scans in each case as resolutions of 4 cm⁻¹.

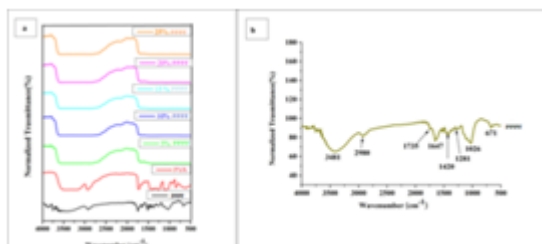


Fig 2. FTIR spectra of (a) PVA, PPPF & PVA/PPPF (5wt% - 25wt% bio films) (b). PPPF peaks

X-ray Diffractometer is used to determine the amorphous and crystalline phases of the material. It is the rapid technical method used to identify the crystalline nature of the material for unit cell and helps in identification even minute particle of clay or other material optically.

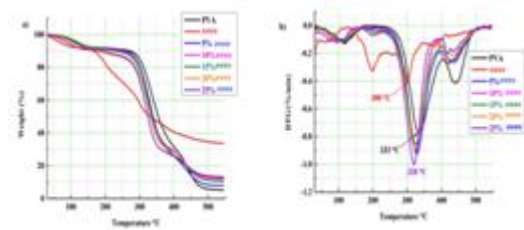


Fig 3. X-ray Diffractograms of (a-e) PVA/PPPF(5wt% - 25wt%) bio-films (f,g) PVA & Pomegranate Peel filler (PPPF)

Thermogravimetric analysis is method using the change in temperature makes a difference that evaporation volatile gaseous etc and it is mainly used to analysis the thermoplastic nature ,elasticity etc.

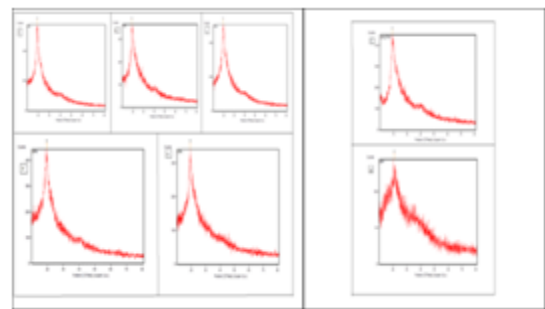


Fig 4. TGA – Curves of PVA, PPPF & PVA/PPPF bio films; (b). DTG – Curves of PVA, PPPF & PVA/PPPF bio films

UV-Visual testing is used to find the movement and location of the atoms and molecules present in it which is most important for nanogenerator.

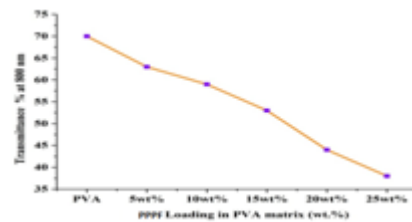


Fig5. Light Transmittance of PVA & PVA/PPPF bio-film

Tensile Test is used to the mechanical property of Pomegranate peel powder and PVA under different tensile strength it is proved that it has great mechanical property comparing to other material and composites

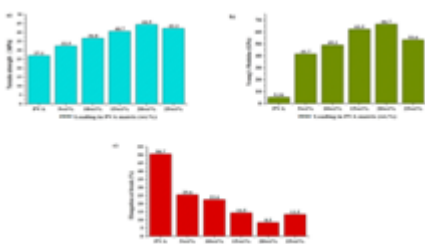


Fig 6. Variations in (a) Tensile strength, (b) Tensile modulus and (c) % Elongation at break PVA matrix and PVA/ 5wt% to 25wt% of PPPFBio film

III. RESULT AND DISCUSSION

In this article usage of waste filler like pomegranate peel powder is discussed as per the characterization and the test carried out it is that from FTIR analysis it has been proven that presence of cellulose and protein in pomegranate peel powder is a great extent. It is discussed that comparing the spectra of the Pomegranate peel powder film with poly vinyl alcohol matrix indicating that the intensity of the OH group. The CH₂ group is in the range of 3010 to 285cm⁻¹ with higher intensity compared to the matrix. It indicates the presence of cellulose & hemicelluloses group in it. There is strong peak observed at 1735cm⁻¹ for the filler corresponding to the CO stretching vibrations and it's final analysis that pomegranate peel powder film has lignocelluloses in excess with high compatibility and hydrogen bonding. It is proved that it has a -OH-C=O, CH₂ & CH₃ groups available in both PVA and PPPFBio group. It is noted that C=O bond which has been shifted from 1727 to 1692cm⁻¹ for the incorporation of PPPFBio in the PVA matrix. Both PVA & PPPFBio are hydrophilic in nature so that it has a good dispersion of nano particle. XRD analysis is useful for providing information about the degree of sample crystalline. The PPPFBio which has a peak range of 2θ=209° shows that intensity of the matrix so therefore intensity of PVA/PPPFBio biofilms can be reduced with increase in the filler content. The thermal stability of polyvinyl alcohol and pomegranate peel powder bio films was tested using thermogravimetric analysis and resulting TGA and DTG curve. TGA curve shows the weight loss pattern with increasing temperature and the DTG curve evidently proven that decomposition temperature at each stage of thermal degradation. First stage of thermal decomposition is moisture content removal and the second stage of thermal degradation is from 200°C to 380°C which indicate the putrefaction of polymeric network of lignin, cellulose. The third stage of thermal decomposition occurs between 400°C to 550°C which proves the deprivation of wax and ash content in the films. Hence it is proved that there is a strong interfacial interaction & chemical bonding between PVA/PPPFBio and methylene group is also available in PPPFBio so that it has shown the lower glass transition temperature. PVA/PPPFBio biofilms has low light

transmittance & the observation on the transparency level of the film when the rays are passed over the PVA it shows the transmittance of 70% and if it's of composite film then it shows a good result and has an optical clarity for food packing & other application. The tensile strength is used to find the mechanical property of the PVA/PPPFBio hence it has a toughness and cannot be torn easily. PXRD profile of PVA and PPPFBio which has a bragg angle at 19.62° is attributed to the string inter and intermolecular hydrogen bonding in the film and a shoulder peak at 22.8° represent a strong crystalline reflection. From above results and discussion it can be used for the element of tribo electric nano generator.

IV. CONCLUSION

The Pomegranate Peel Powder filler which is incorporated with the polyvinyl alcohol has been made as biofilm using casting method. Through various it has been concluded that FTIR-Spectra showed a hydrogen bonding for OH-groups of PVA/PPPFBio. The degree of crystallinity of all PVA/PPPFBio biofilms to be superior to the PVA. It has the ability to withstand a high temperature of 300°C which is proved by thermal analysis. Tensile strength was enriched to 91.99% and also a Bragg Angle shows a good result with this it has been concluded that it can be used as a pollution free material for packing, wrapping and mulching and even in the field of medicine.

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