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BIOPLASTIC PRODUCTION USING CORN STARCH WITH NATURAL FILLERS AND ITS SEM-EDS REPORT

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ABSTRACT

Due to the negative environmental impacts of synthetic plastics, the development of biodegradable plastics for both industrial and commercial applications is essential today. Researchers have developed various starch-based composites for different applications. The present work investigates the corn starch based bio plastic with filler. Glycerol was used as a plasticizing agent. Different parameters such as elongation, solubility in different solvents such as chloroform, ethanol, water, diethyl ether and folding endurance were tested. Morphological characteristics of produced bio plastic was also analyzed by SEM-EDS. Results showed that the bio plastics were completely soluble in water and partially soluble in ethanol, diethyl ether and chloroform and it has only one folding ability. SEM report shows that the surface is homogenous and crystal formation is visible.

Keywords: Bio plastic, pollution, decomposes biodegradation.

INTRODUCTION

Plastic materials have been considered as very important materials because of its flexible properties [Alvarez-Chavez *et al.,,* 2011]. Approximately 300 million tons of plastics have been used worldwideaccording to 2015 report [Halden, 2010]. Many problems have been arised due to the usage of platics mainly landfill problems and accumulation in ocean [Philp, 2013] In a long-term study in the North Atlantic, one seawater sample contained the equivalent of 580,000 pieces of plastic per square kilometer [Law, 2010]. Incineration of plastic also generates toxic emissions such as carbon dioxide and methane. These gases cause greenhouse effect [Barker, 2010]. In recent years, these environmental problems triggered developing of bioplastics [Peelman, 2013].

Bio plastics and bio composites can assume a promising job in such need and are satisfactory in numerous spots where oil based plastics are utilized. These are novel materials of the 21st century and would be of great importance to the materials world [Mohanty, 2002]. Bioplastic production and consumption will grow bigger in the future in the world. Because of this, these materials need to be evaluated carefully for sustainability and waste management. The global bioplastics market is thought to be growing about 20%~25% per year. Approximately 10%~15% bioplastics of the total plastics market will increase its market share to 25%~30% by 2020. The bioplastic market reached over 1 billion US$ in 2007 and it will be over 10 billion by 2020. More and more companies are entering and investing in this market (Ezgi Bezirhan Arikan , 2015). In this work, bioplastic was produced using corn starch, rice husk with glycerol as plasticizer.

MATERIALS AND METHODS

Collection of Raw Materials: Corn starch was collected from the local shop in Selaiyur, Chennai. Rice husk was collected from rice mill located at Vellore and leaves of lotus were collected from the pond nearby Velachery, Chennai.

Production of Bioplastic: An estimated amount of corn starch was heated with 100ml of water in a beaker for 20mins.In this, 3 grams of rice husk and lotus leaf powder was added. These served as filler in plastic. Along with this, 0.1N HCl, 3ml of glycerol and 2ml of vinegar was added and mixed thoroughly. Then the concentrate was spreaded over the silver foil and kept in hot air oven for 1hr at 150^{o}C. After drying in oven, the plastic sheets were cooled at room temperature for 30 minutes.

Analysis of Properties

Solubility Test: Solubility of bioplastic was analysed using ethanol, chloroform and diethyl ether till ten days.

Elongation Test: Produced bioplastic was made into dumbbell shape for analysing elongation. Initial length and final length of bioplastic after elongation was measured.

% Elongation= ((Final length – Initial length)/ Initial length) *100

Folding Endurance: Folding endurance is defined as the logarithm (to the base of ten) of the number of double folds that are required to make a test piece break

Fig 1: Bioplastic

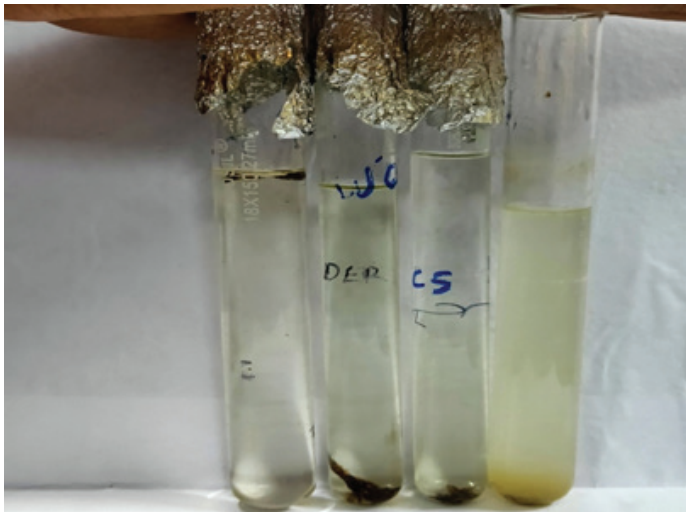

Fig.2 Solubility of bio plastic

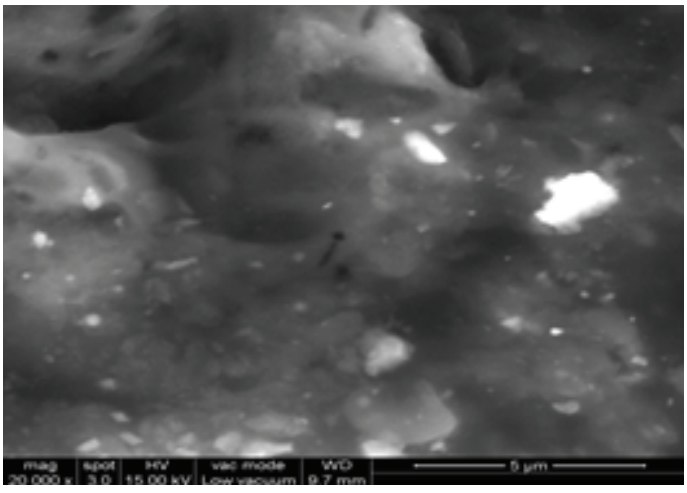

Fig.3 Sem Report Magnificated At 20,000x

under standardized conditions

$F = \log_{10} d$

Where F is folding endurance and d is number of double folding.

SEM-EDS: The produced bio plastic sample was given to SRM university foe SEM-EDS test.

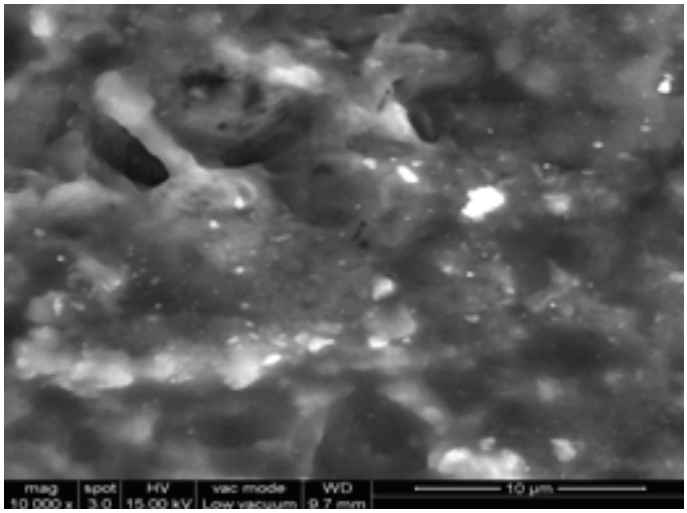

Fig.4 Sem Report Magnificated At 10,000x

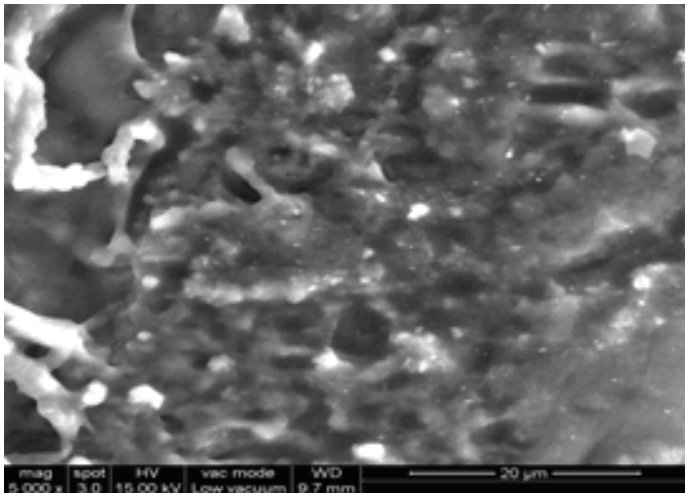

Fig.5 Sem Report Magnificated At 5000x

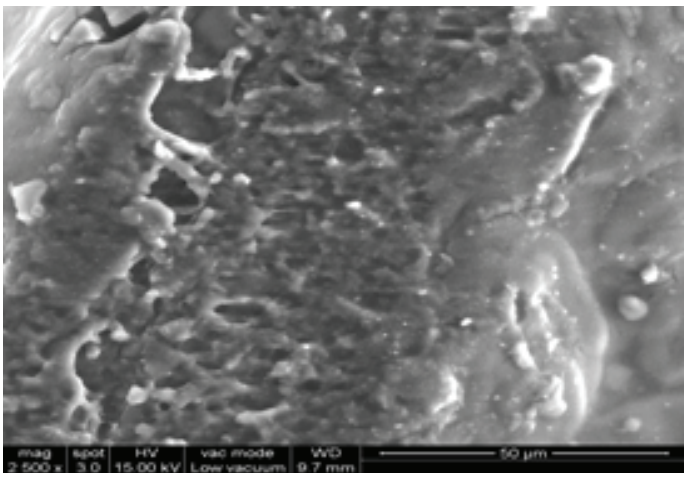

Fig.6 Sem Report Magnificated At 2500x

RESULTS AND DISCUSSIONS

In this study, bioplastic was produced using natural materials such as corn starch. Rice husk and lotus leaf which were served as fillers in plastic (Fig.1)

Solubility Test: Solubility is one of the important parameter of bio plastic. It determines the ability of dissolution of the sample. In this work, solubility was checked with various solvents with different time interval. The result showed that the bio plastic was easily soluble

Table.1 Solubility of bio plastic

Days	Water	Chloroform	Ethanol	Diethyl ether
Day 1	No change	No change	No change	No change
Day 2	No change	No change	No change	No change
Day 3	No change	No change	No change	No change
Day 4	Partially soluble	Partially soluble	No change	No change
Day 5	Partially soluble	Partially soluble	No change	No change
Day 6	Partially soluble	Partially soluble	No change	No change

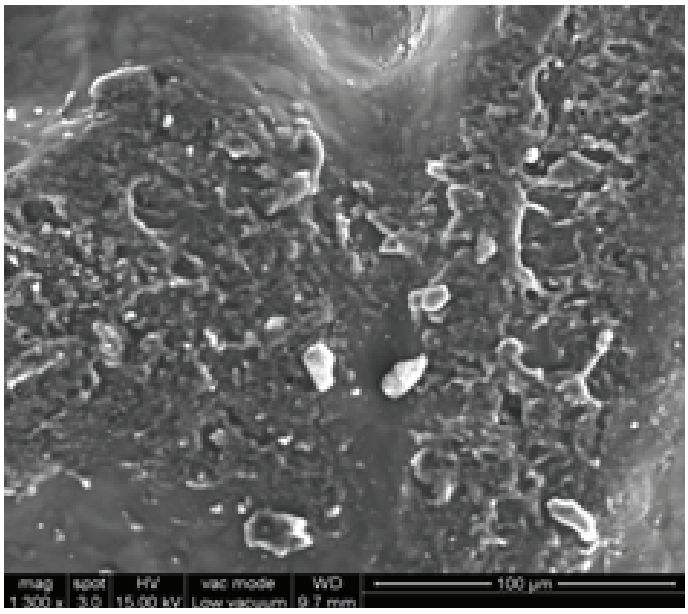

Fig.7 Sem Report Magnificated At 1300x

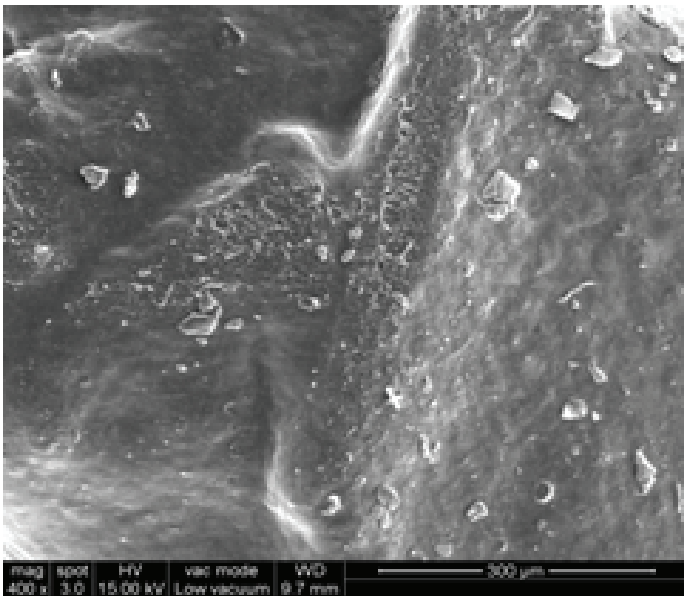

Fig.9 Sem Report Magnificated At 400x

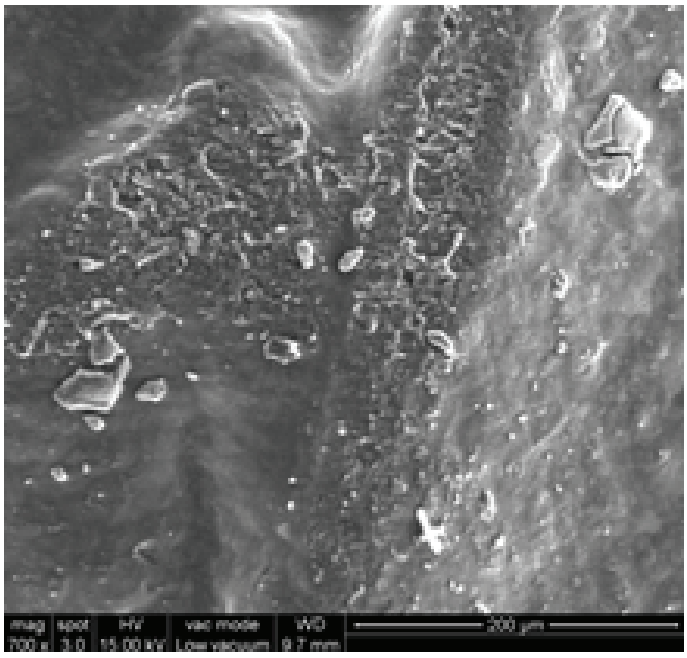

Fig.8 Sem Report Magnificated At 700x

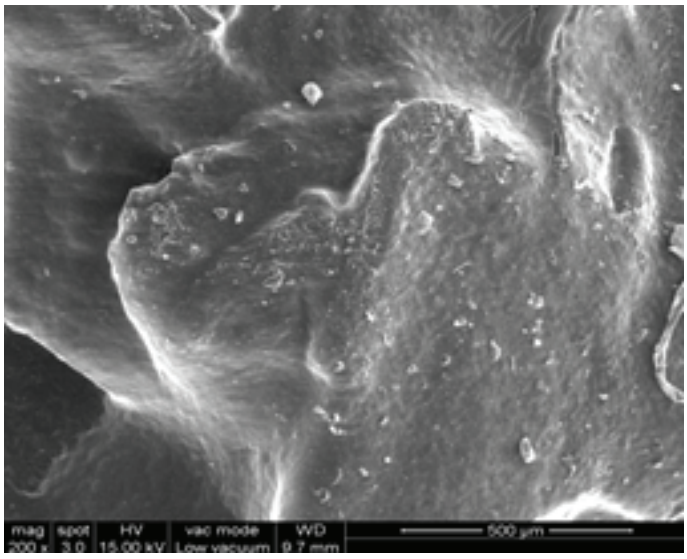

Fig.10 Sem Report Magnificated At 200x

in water and partially soluble in chloroform (Table.1 and Fig.2). This result confirms that the bio plastic are easily and naturally degradable one by water.

Elongation Test: Elongation is the measure of ductility of product. It is the ability to resist breaking under tensile stress. Rigid plastics often exhibit 5% but in this research, bio plastic had 0% elongation. It shows that, it is more rigid than normal plastic. It may be due to the presence of fillers.

Folding Endurance: The folding endurance test measures a combination of tensile strength, stretch, and fatigue properties. Slight increase in relative humidity causes increase in folding endurance. In this work the bio plastic broke in 1 fold. The number of folding for folding endurance is 0. It may be due to increase in ductility.

SEM- EDS: The sample was tested at different

magnification. At 20,000X the bio plastic sample is non homogenous and crystal formation is visible (Fig 3). At 10,000 magnification, the bio plastic sample is slightly homogenous and clump like structure is visible (Fig 4). SEM-EDS report showed that the small crystal like structure present in bioplastic which might be due to the presence of fillers (Fig.5-10).

CONCLUSION

The results showed that the produced bioplastic has good degradability than the other plastic materials. It can be concluded that the starch based bio plastics can be used as an alternative to prepare poly bags with assumed lower cost. Investigation of the hybridization of proposed starch materials with other bio materials and with different plasticizers would be an interesting scope for the research.

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