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# Preparation and Characterization of Potato Starch Based Film Blended with $CaCo_3$ Nanoparticles

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**Abstract:**
In this research bio films were prepared by casting method as a replacement for the traditional petroleum based plastic. It widened the use of potato starch based film blended with $CaCO_3$ (PSBBCCF) in food packaging film as expected. PSBBCCF was gelatinized in the presence of water and varying amount of glycerol at 90 $^0$C temperature. Potato starch blended with 50% (w/w) of calcium carbonate mechanically to enhance mechanical and physical properties. PSBBCCF were dried under controlled conditions. Physicochemical properties such as water absorption capacity, hardness, solubility in water and mechanical properties of the PSBBCCF were investigated. Results revealed that by increasing plasticizer the crystalline of starch in the film were decreases.

**Keywords:** Potato Starch, calcium carbonate, glycerol, bioplastic.

## I. INTRODUCTION

Starch is one of the major energy sources in plant and can be found grain, root, tubes, stems, leaves and fruits. Starch is one of the natural polymers. Starch is one of raw material used for food packaging, pharmaceutical and medical industries. The bioplastic like starch is a material which has potential of causing a biological reform by means of reducing the amount of pollution caused by other plastic material like thermoplastic and thermoset which contain petroleum derivatives [1, 2]. Some waste thermoplastic product are used for making liquid fuel and some are reuse in road construction for proper waste disposal, but it was very costly, complicated process and very important non biodegradable [3, 4]. The PSBBCCF can be molded into blown film, electrical insulation of cable and other commodity products by using casting, injection molding, and blow molding and extrusion process. PSBBCCF properties were enhanced by using nanoparticles of $CaCO_3$. PSBBCCF have several advantages over synthetic polymer; PSBBCCF are biodegradable and renewable materials [5, 6]. PSBBCCF enhanced the shelf life of the food and other pharmaceuticals products. Mechanical and chemical properties of PSBBCCF are influenced by many factors such as amylase to amylopectin ratio in starch, film forming materials such as soylecittin as surfactant, lemongrass oil as a antimicrobial agent, glycerol as a plasticizers and vinegar that plays an important role for enhancement. The motive of research work was to prepare PSBBCCF and to evaluate the effect of $CaCO_3$ on mechanical and chemical properties [7, 8].

## II. MATERIALS AND METHODS

Starch was extracted from the native potato as shown in fig. 1. Potato purchased from university's lonere village local market. 500 gm of starch can be extracted from 5 kg potato. Starch obtained from potato was dried at atmospheric condition to get a white starch powder. Glycerol and calcium carbonate was purchased from sudesh chemicals, Mahad, Maharashtra, India. White potato starch powder and $CaCO_3$ blended by mechanical means with weight percentages (10%, 20%, 30%, 40%, 50 %) of total starch and heated to 90$^0$C presence of water and glycerol on heating mental. Potato starch, glycerol and $CaCO_3$ were gelatinized at 90$^0$C for 45 minute. After gelatinized, solution was filled in aluminium mould (16x16 $cm^2$). The solution was cooled to room temperature in the mould. PSBBCCF was ejected from cavity after cooling and stored at 23$^0$C and 50% relative humidity until experimentation as shown in fig. 2[9].

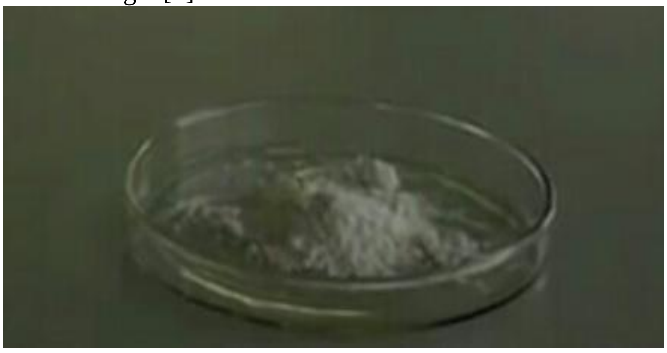

**Figure .1. Starch Extracted from potato**

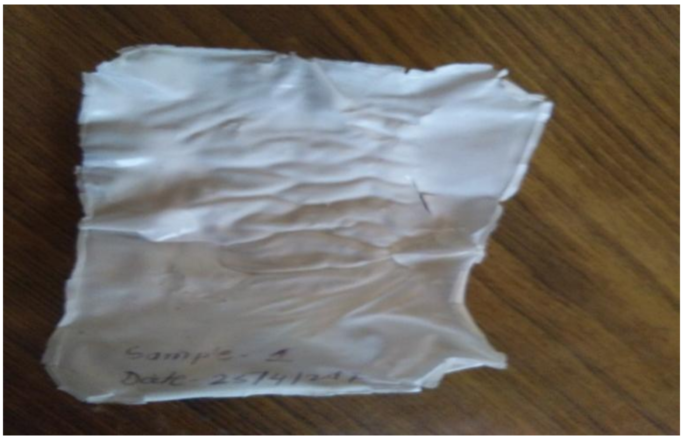

**Figure.2. Sample of PSBBCCF**

Mechanical properties were investigated according to ASTM D638 standard. Opacity testing was carried out on digital opacity testing equipment (model no. sem. 104, S.C.Dey and co. industries). Opacity is that property of subtract that resists the passes of light. This is calculated by measuring the percentage of light which is absorbed by the sheet of paper. The result describes the optical property of the PSBBCCF in the accordance with the transmittance light of the material.
Opacity of the material= 100 % - Transmittance

## III. SOLUBILITY IN WATER

Solubility of PSBBCCF in water was determined according to ASTM standard. PSBBCCF samples were stored a desiccators with $P_2O_5$ for two days. Samples were weighed to the nearest 0.0001 gm and placed into the beaker with 80 ml deionised water (18 minute). The PSBBCCF samples stirred with constant agitation for one hour at room temperature. Samples were filtered using what man no. 1 filter paper. Samples were dried at 60 $^0$C at constant weight. Samples were measured and percentage of total soluble matter was calculated.

**Water absorption capacity**
Water absorption capacity test carried out as per ASTM D570 standard. PSBBCCF were dried in $P_2O_5$ for a week and samples were added to 100 ml distilled water for 30 minute.

**Mechanical properties**
Tensile strength, young's modulus and elongations at break were investigated by using Universal testing machine as per ASTM D638 standard.

**Coefficient of friction**
Coefficient of friction test was carried out on inclined plane tester (Make by Kagjay, international engineering industries, Mumbai) as per ASTM D1894 standard.

## IV. RESULT AND DISCUSSION

Fig.3 showed the effect of $CaCO_3$ nanoparticles on the tensile strength of PSBBCCF. Tensile strength of PSBBCCF significantly increases by increasing the calcium carbonate. The calcium carbonate nanoparticles are likely to bond with hydroxyl group and other possible hydrogen or Vander wall bonds of starch macromolecules strengthen molecular forces between $CaCO_3$ nanoparticles and potato starch.

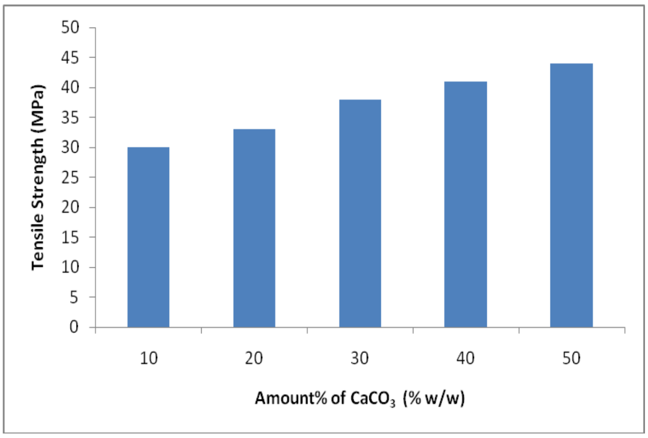


**Figure.3. Showed the effect of $CaCO_3$ nanoparticles on the tensile strength of PSBBCCF**

Fig.4 and Fig.5 showed the effect of $CaCO_3$ nanoparticles on elongation at break and young's modulus properties. Elongation at break decreases as increases in percentages of $CaCO_3$ nanoparticles. Young's modulus increases significantly as increasing the $CaCO_3$ nanoparticles.

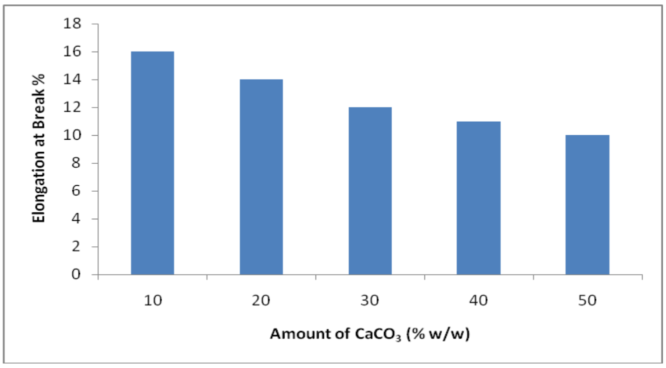


**Figure.4. showed the effect of $CaCO_3$ nanoparticles in elongation at break**

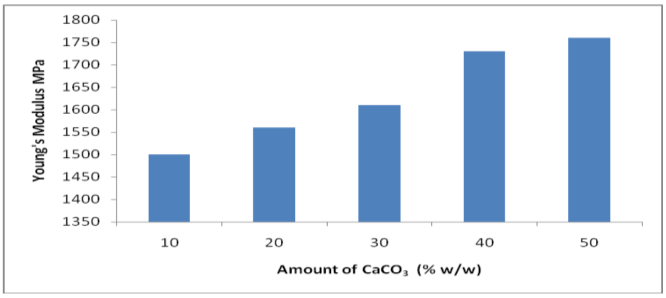


**Figure.5.Showed the effect of $CaCO_3$ nanoparticles on young's modulus properties**

Fig.6 showed the effect of $CaCO_3$ on solubility of PSBBCCF in deionised water after one hour. Incorporation of $CaCO_3$ nanoparticles suppressed the diffusion of water into the structure. Results showed increase in $CaCO_3$ solubility decreases significantly.

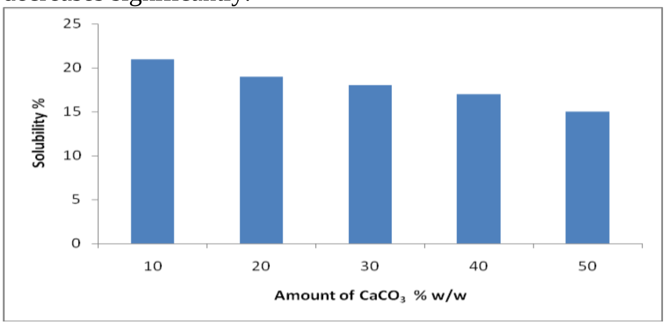


**Figure.6. showed the effect of $CaCO_3$ on solubility of PSBBCCF**

Fig. 7 showed the effect of $CaCO_3$ on the water absorption capacity of PSBBCCF. Results showed water absorption capacity significantly decreases by increasing $CaCO_3$ nanoparticles. It also showed that as increasing $CaCO_3$ nanoparticles more hydrogen bond formed between matrix components.

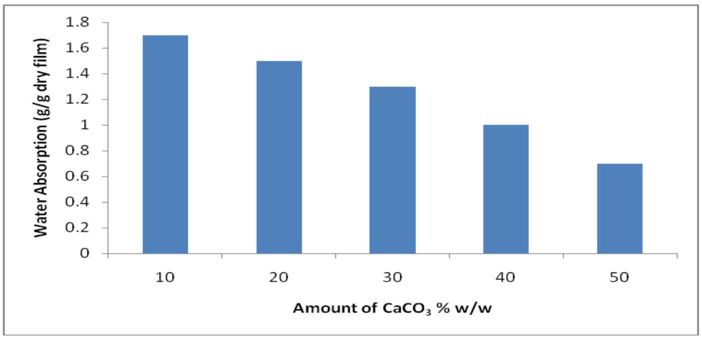


**Figure.7. Showed the effect of $CaCO_3$ on the water absorption capacity of PSBBCCF**

Fig. 8 showed the effect of $CaCO_3$ nanoparticles on the opacity of PSBBCCF. Results showed that opacity increases by decreasing the amount of $CaCO_3$ nanoparticles significantly. Results showed that transmittance of light through material decreases significantly.

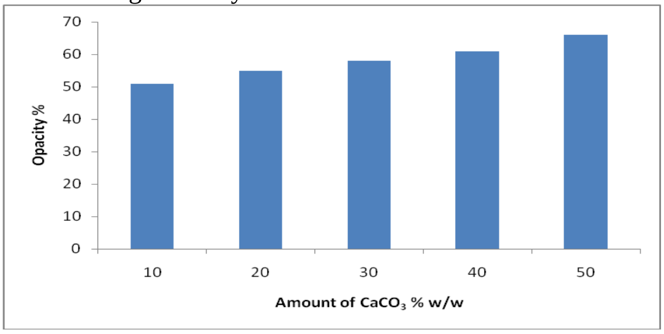


**Figure.8. Showed the effect of $CaCO_3$ nanoparticles on the opacity of PSBBCCF**

Fig. 9 showed the effect of $CaCO_3$ on the coefficient of friction of PSBBCCF. Results showed that coefficient of friction significantly increases as increase in amount of $CaCO_3$. It showed force of friction increases between the film and other subtracts.

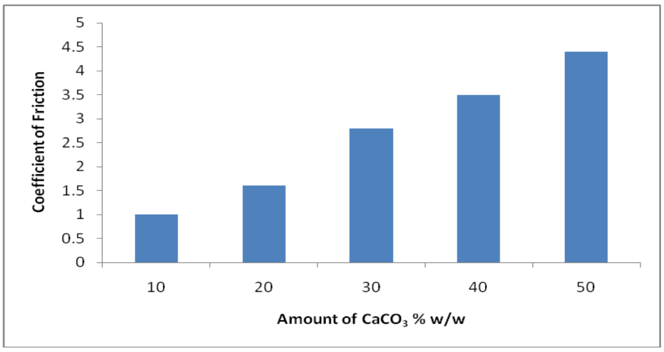


**Figure.9. Showed the effect of $CaCO_3$ on the coefficient of friction of PSBBCCF**

Fig.10 Showed SEM images of sample a, b, c and d having 10%, 20 %, 30%, 40% and 50% $CaCO_3$ in PSBBCCF respectively. SEM showed a compact and homogeneous structure of potato starch and Calcium carbonate.

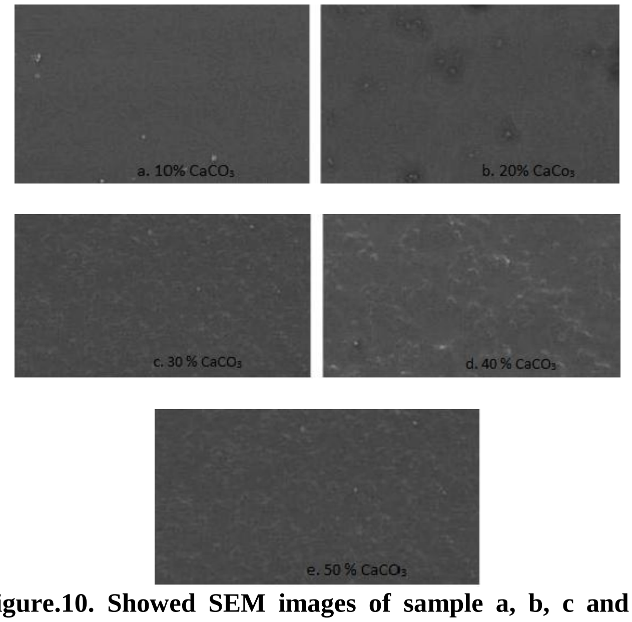


**Figure.10. Showed SEM images of sample a, b, c and d having 10%, 20 %, 30%, 40% and 50% $CaCO_3$ in PSBBCCF respectively.**

## V. CONCLUSION

In this research PSBBCCF was prepared with composition of potato starch, $CaCO_3$ nanoparticles and glycerol using casting method. Mechanical properties like tensile strength, elongation at break and young's modulus of PSBBCCF increased with addition of $CaCO_3$ nanoparticles could be used to enhance film strength. Water absorption capacity and water solubility of PSBBCCF significantly decreases. The results showed that PSBBCCF may have potential applications in the food packaging, medical and pharmaceutical industries. PSBBCCF maybe use an alternative material for synthetic plastic to avoid waste generation and disposal.


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## VII. REFERENCES


[1]. Lacroix M., Mechanical and Permeability Properties of Edible Films and Coatings for Food and Pharmaceutical Applications. In: Huber KC, Embuscado ME, eds. Edible Films and Coatings for Food Applications: Springer New York; 2009:347.

[2]. Mohammadi Nafchi A., Moradpour M., Saeidi M., Alias A.K., Thermoplastic starches: Properties, challenges, and prospects. Starch – Stärke, 2013. 65(1-2):61. doi: 10.1002/star 201200201.

[3]. S. A. Dawale, Preparation of liquid fuel from polypropylene waste using catalytic pyrolysis. Journal of Environmental Friendly Processes, vol. 5, issue 3, December 2017, 66.

[4]. S. A. Dawale, Use of waste plastic coated aggregates in bituminous road construction. International journal of advancement in engineering technology, management and applied science, volume 3, issue 6 June 2016, page 118-126.

[5]. Li J. H., Hong R. Y., Li M. Y., Li H. Z., Zheng Y., Ding J., Effects of ZnO nanoparticles on the mechanical and antibacterial properties of polyurethane coatings. Progress in Organic Coatings. 3// 2009. 64(4):504. doi: http://dx.doi.org /10.1016/j.porgcoat.2008.08.013.

[6]. Simo R., Cordenunsi B., Characterization of starch granules. Starches. Vol null: CRC Press, 2009.

[7]. Ellis R. P., Cochrane M. P., Dale M. F. B., Duffus C. M., Lynn A., Morrison I. M., Starch production and industrial use. Journal of the Science of Food and Agriculture, 1998. 77(3):289. doi: 10.1002/(SICI)10970010( 199807)77:3 <289::AID-JSFA38>3.0.CO;2D.

[8]. Laohakunjit N., Noomhorm A., Effect of plasticizers on mechanical and barrier properties of rice starch film. Starch/Staerke, 2004. 56(8):348.

[9]. Myllärinen P., Buleon A., Lahtinen R., Forssell P., The crystallinity of amylose and amylopectin films. Carbohydrate Polymers, 4/1/ 2002.48(1):41. doi: http://dx.doi.org/10.1016 /S0144-8617(01)00208-9.

[10]. Maizura M., Fazilah A., Norziah M., Karim A., Antibacterial Activity and Mechanical Properties of Partially Hydrolyzed Sago Starch– Alginate Edible Film Containing Lemongrass Oil. Journal of Food Science, 2007. 72(6):C324. doi: 10.1111/j.1750-3841.2007.00427.x.