

Bioplastic using sabudana and fly ash: An alternative to polythene bags

Introduction

Humankind worked hard from the earliest times to develop materials which would offer benefits not found in natural products. His constant efforts for such material lead to wide range of completely synthetic material that we would recognise as modern plastics.

The term 'plastic' is derived from the Greek word 'plastikos' meaning fit for moulding, and "plastos" meaning moulded. It refers to the material's malleability or plasticity during manufacture that allows it to be cast, pressed, or extruded into a variety of shapes - such as films, fibres, plates, tubes, bottles, boxes, and much more. Modern life is unthinkable without plastic. Plastic products make our lives cleaner, easier, safer and more enjoyable.

Plastic waste: A serious environmental concern

One of the great advantages of many types of plastic is that they're designed to last - for a very long time. Though this is an advantage from application point of view, the plastic once generated remains in the environment for very long time. The properties like its low cost, light weight and durability that make it so useful, also make it hard to dispose of. Thus we are facing serious problem of plastic waste. We are witnessing the perilous impact of the waste plastic material on the environment.

Plastic pollution can unfavourably affect lands, waterways and oceans. Living organisms, particularly marine animals, can also be affected through entanglement, direct ingestion of plastic waste, or through exposure to chemicals within plastics that cause interruptions in biological functions. Humans are also affected by plastic pollution as plastic waste enters the food chain.

Comprehensive policy is the need of the day to reduce the plastic waste. To address the issue to some extent, researchers are working on biodegradable plastic.

Bioplastic

Bioplastics are a form of plastics derived from plant sources such as sweet potatoes, sugarcane or corn starch etc.

Bioplastics are environmentally friendly as their production results in less emission of CO₂ compared with traditional plastic and they are biodegradable that means the material get decomposed when buried in the ground without polluting environment.

General Method of Preparation of bio plastic

Mixture of Starch, water and additives (like glycerol, glue, or sugar) is heated slowly still it get thickened. The mixture is then poured on flat surface and allowed to settle till it dries completely. A dried film is then used as bioplastic.

Literature survey revealed that people have prepared bioplastic from various starch sources like potato, banana peels etc.

Limitations of Bioplastic

The bioplastic prepared by this method lacks strength and durability. It cannot be used as substitute of polythene bags due to these limitations.

To overcome these limitations we decided to develop modified Bioplastic preparation method.

In present work we have prepared bioplastic using sabudana as starch source and fly ash as additives to give strength to material.

Justification for use of Sabudana and Fly ash

Sabudana is actually a form of tapioca, also known as cassava root. Sabudana refers to the starch which is then processed to form spherical pearls that may vary in size. The pearls are produced by passing the moist starch through a sieve under pressure & then dried. It is good source of carbohydrates & due to its high starch content, tapioca is commonly used to thickening agent in foods.

Since it is a good source of starch and it has ability to form a thin sheet, we decided to use it for preparation of Bioplastic.

Fly-ash is a coal combustion product composed of fine particles that are driven out of the boiler with the flue gases. Fly ash was generally released into the atmosphere which causes air pollution. It is thus a major concern to deal with large amount of fly ash generated. Researchers are now trying to use fly ash in constructive ways. One of such use is in concrete production.[43% of total amount is reused].

We decided to use it as additive as it would give strength to the plastic and would serve the cause of constructive use to overcome environmental issues.

Preparation of bioplastic using sabudana and fly ash

Sabudana was first finely ground. The sabudana powder, fly ash, PVA (poly vinyl alcohol) was then mixed in water in proper proportion to make a paste. The proportion of starch and additives were fixed by trial and error method. The mixture was then heated till it was thickened. The mixture was then poured over a surface to form a thin film.

The film was dried in air. The various properties of resultant bioplastic were then tested. The properties of bioplastic prepared were compared with bioplastic prepared from other starch sources.

Sample 1	Bioplastic prepared using sabudana and fly ash
Sample 2	Bioplastic prepared using potato

Following is the table showing comparison of properties.

Sample	Thickness (m)	Width (m)	Cross-sectional Area(m ²) =Thickness x width	Max. applied force (Kgm)	Max. applied force (N)	Tensile Strength N/m ² or Pa=F/area	Tensile Strength MPa
1	0.045×10^{-2}	2×10^{-2}	0.09×10^{-4}	1.71	16.758	1.862×10^6	1.862
2	0.144×10^{-2}	2×10^{-2}	0.29×10^{-4}	0.23	2.254	7.826×10^4	0.078



Conclusion

The bioplastic prepared using sabudana and fly ash has better properties compared to bioplastic prepared using traditional methods. The developed method for preparation of bioplastic yields bioplastic with good tensile strength. Though the developed bioplastic is biodegradable it has good durability.