



BANGLADESH JUTE MILLS CORPORATION



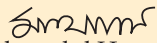
Chairman
Bangladesh Jute Mills Corporation

Preamble

It is my pleasure to introduce a new generation biodegradable and sustainable packaging material from jute based cellulose that has been developed in Bangladesh by Dr. Mubarak Ahmad Khan, former Chief Scientific Officer and Director General, Atomic Energy Research Establishment, Bangladesh Atomic Energy Commission. Presently Dr. Khan is working as Scientific Advisor in Bangladesh Jute Mills Corporation for developing commercial production facility of the biodegradable packaging materials. The developed packaging material can be the alternative to petroleum based plastic bags which are the major cause of the environmental degradation worldwide. The mechanical properties of the biodegradable packaging material are very much comparable to traditional poly bags and thermal properties are higher than that of poly bags. This product is totally biodegradable and water resistance for 6-8 hours. It could be also recyclable. The developed packaging material will be biodegraded in soil within 3-4 months. So, the main problem associated with the conventional plastic bags can be solved by using the developed packaging. This packaging is required not only for Bangladesh but also for the Globe. The key constituent of the packaging is jute cellulose which gives us benefits in two ways, first is by increasing production of jute, and second is by reducing the foreign currency outflow. Jute is not only biodegradable but also it prevents carbon dioxide emission. It is reported that one hectare of jute plants absorb 15 tons of CO₂ from the atmosphere and emits 11 tons of O₂ during its life span of 120 days. Besides, the renewability of jute fiber is much higher than other conventional cellulose sources like wood pulp. For an example a wood plant takes around 10-15 years to be ready for cellulose collection whereas jute plant takes 120 days only.

A trademark named "Sonali bag" has been designated by our honorable Prime Minister. Honorable Minister and State Minister inaugurated the pilot scale production on 12 May 2017. Required land for the industrial production has been selected and the purchasing of required machineries is under processing. I am looking forward to the implementation of this particular important project under the guidance of Dr. Khan. Government has a significant role to play in this esteem, and I wish the fullest support and inspiration as we progress.

I congratulate Dr. Khan for preparing such significant brochure containing scientific analysis and bring on the process of 'Sonali Bag' production from jute.


Md. Mahmudul Hassan, PhD

Introduction

Jute is a long, soft, shiny vegetable fiber that can be spun into coarse, strong threads. It is produced primarily from plants in the genus *Corchorus*, which was once classified with the family Tiliaceae, and more recently with Malvaceae. The primary source of the fiber is *Corchorus olitorius*, but it is considered inferior to *Corchorus capsularis*. "Jute" is the name of the plant or fiber that is used to make burlap, hessian or gunny cloth. The word 'jute' is probably coined from the word *jhuta* or *jota*, an Oriya word. Jute is one of the most affordable natural fibers and it is second only to cotton in amount produced and variety of uses of vegetable fibers. Jute fibers are composed primarily of the plant materials cellulose and lignin. It falls into the bast fiber category (fiber collected from bast, the phloem of the plant, sometimes called the "skin") along with kenaf, industrial hemp, flax (linen), ramie, etc. The industrial term for jute fiber is raw jute. The fibers are off-white to brown, and 1–4 metres (3–13 feet) long. Jute is also called the golden fiber for its color and high cash value.

Jute fiber is chemically composed of

- Cellulose 65.2%
- Hemi-cellulose 22.2%
- Lignin 12.5%
- Water soluble matter 1.5%
- Fat and wax 0.6%

Outline on Biodegradable Packaging

Biodegradable packaging from renewable resources is essential for a less polluted and greener earth. Many researchers are researching to develop biodegradable packaging from various raw materials and some products are already in market. However, none of the products are cost effective compared to conventional polyethylene/polypropylene packaging. That is why, although Bangladesh government has banned the uses of polybags in 2002 there are

polybags everywhere due to lack of any suitable alternative. In this regard Dr. Mubarak Ahmad Khan, Scientific Advisor, Bangladesh Jute Mills Corporation, Bangladesh and former Chief Scientific Officer and Director General, Atomic Energy Research Establishment, Bangladesh Atomic Energy Commission and his team have been working to develop affordable biodegradable packaging material from local raw material. After extensive researches the team has successfully developed a low cost biodegradable sheet from modified jute cellulose. Mechanical properties of the developed sheet are higher than polyethylene sheet and physical properties are quite similar. The product showed complete biodegradability within 3 months of soil burial. The packaging material is named as Sonali Bag.

Consequences of Plastic Bags Uses

Millions of plastic bags are disposed everyday in Bangladesh from which very few are recycled. 410 million poly-bags are used in only Dhaka city per month and more than 3 meters layer are formed in the base mate of the Buriganga River. Only 10-15% is put into dustbins, most end up in drains, sewage pipes, and open places. 80% of Dhaka's water-logging is caused by plastic bags. These bags create major environmental degradation and air pollution as they emit hydrogen cyanide, carbon dioxide, carbon monoxide and other toxic and harmful gases into the atmosphere throughout their life cycle. Moreover, the manufacturing of plastic bags contributes to the diminishing availability of our natural resources and the damage to the environment from the extraction of petroleum as they are made from non-renewable natural resource: petroleum. Most plastic bags are made of polyethylene - more commonly known as polythene - they are hazardous to manufacture and are said to take up to 1,000 years to decompose on land and 450 years in water. Polythene disturbs the flow of nutrients in the soil and reduces the infiltration of sunlight and water. Polythene destroys beneficial bacteria in the soil, depleting its fertility, which directly affects agriculture.



Figure: Water logging scenarios in Dhaka city

Countless plastic bags end up in our ocean and cause harm to our marine wildlife. Many marine animals and birds mistakenly ingest plastic or become entangled and choke in plastic bags that are floating around. For instance, environmentalists have pointed out that turtles often mistake plastic bags for jellyfish and invariably swallow them. It is estimated 100,000 marine mammals die each year because of plastic litter in our ocean in the North Pacific. (www.algalita.org)

Land animals seem to be victims as well. In countries such as Bangladesh, India etc. cows, goats are mistakenly ingesting plastic bags on the streets as they are scavenging for food and end up choking or starving to death, as the plastic cannot be digested.



Marin pollution caused by plastic deposition



Marin Plastic found in Rainbow Runner fish guts

For human being these bags affect directly as well as indirectly through environmental degradation. Polythene is an agent of cancer, skin diseases, and other health problems. Ingesting polythene wrapped food is harmful for health (especially black polythene shopping bags that emit carcinogenic chemicals) and when burned, polythene releases hydrogen cyanide – an extremely hazardous gas.

One of the major impacts of plastic bags in Bangladesh is their impact on the water drainage system. Plastic bags clog drains and waterways, threatening urban environments and creating severe safety hazards. Drainage systems blocked by plastic bags have been identified as a major cause of flooding in Bangladesh during monsoon season. Following the 1998 flood it was estimated that up to 80% of the city's waterlogging was caused by polyethylene blocking drains.

Concerning the threats of the polythene bags, Bangladesh was the first country to ban plastic bags in 2002 and over a decade later many developed countries are still struggling to emulate this success. However Bangladesh is still struggling with the issue of plastic bags and enforcing the ban due to lack of any alternative material. Recently introduced biodegradable bags in the international market are very costly compared with the polythene bags and thus is not suitable for the mass people of Bangladesh. So, the problem is still in an alarming situation in Bangladesh.

Biodegradable Packaging Material from Jute

In order to meet the packaging needs of today without compromising the ability of future generations to meet those needs, products must be developed and used from renewable resources that are beneficial, safe and healthy for individuals and communities. Scientists are committed to the design and distribution of sustainable packaging products while meeting market criteria for performance and cost. The designers are also dedicated to incorporate environmentally preferred alternatives to create eco-friendly packaging solutions. The research team under Prof. Dr. Mubarak Ahmad Khan, Scientific Advisor, Bangladesh Jute Mills Corporation (BJMC) have been working to develop a low cost biodegradable packaging from locally available resources from several years in Institute of Radiation and Polymer Technology, Bangladesh Atomic Energy Commission. After extensive researches the team has developed a substance which is the new generation biodegradable and sustainable packaging

material from jute based cellulose. This packaging is required not only for Bangladesh but also for the Global. The mechanical properties of the developed packaging are very much comparable to traditional poly bags and thermal properties are higher than that of poly bags.

Besides, the key constituent of the packaging is jute cellulose which gives us benefits in two ways, 1. By increasing production of jute and 2.Reducing the foreign currencies outflow. Jute is not only biodegradable but also it prevents carbon dioxide emission.It is reported that one hectare of jute plants absorb 15 tons of CO₂ from the atmosphere and add 11 tons of O₂ during its life span of 120 days. Besides, the renewability of jute fiber is much higher than other conventional cellulose sources like wood pulp. For an example a wood plant takes around 10 years to be ready for cellulose collection whereas jute plant only takes 120 days.

Inauguration of the Facilities for Commercialization



Honorable Minister and State Minister are visiting the Jute-Polymer Unit, Latif Bawani Jute Mill after inaugurating the facility

Bangladesh Jute Mills Corporation (BJMC) has taken initiatives to develop protocols and to commercialize the produced jute based biodegradable packaging under direction of Ministry of Textiles and Jute, Bangladesh. BJMC is already established Jute-Polymer Unit in Latif Bawani Jute Mill, Demra, Dhaka



Continuous biodegradable sheet production in Latif Bawany Jute Mills Ltd., Demra, Dhaka



Sonalibag

which is by inaugurated honorable Minister Mr. Md. Emaz Uddin Pramanik MP as well as honorable State Minister Mr. Mirza Azam MP, Ministry of Textiles and Jute in 12 May, 2017. One senior scientist, two scientists and a research associate are working there under direction of Dr. Mubarak Ahmad Khan, Scientific Advisor, BJMC to scale up the technology from laboratory scale to pilot scale.

Machineries for pilot scale production are already designed and work order is given to the machineries manufacturer to supply the machineries. The designated team of BJMC is closely monitoring the machine manufacture process and the machines are expected to be supplied by July 2017. Besides, the designated team is also working to automate the whole production procedure and is already contacted with machineries designers and manufacturers of Europe, America, Japan, India, China and Malaysia. Various designing concept and ideas have provided by the designers and manufacturers companies. The BJMC team is now reviewing the proposal to initiate the automation process as early as possible.

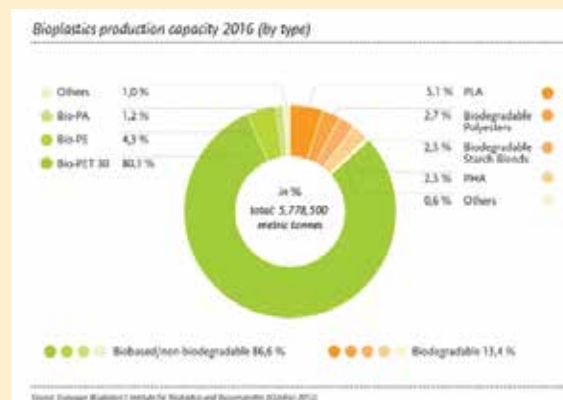
Worldwide Demand

The biodegradable packaging market is expected to witness the fastest growth than that compared to the plastics packaging market. The biodegradable packaging market is a relatively new market however; it is expected to capture the existing market share of the non-biodegradable plastic packaging market. The food packaging and beverage packaging market is expected to play a crucial role in driving the overall global biodegradable packaging market. However, lack of government support especially in the developed countries is expected to curb the growth of the market. The presence of huge price difference between the biodegradable packaging and other conventional packaging is further expected to hamper the growth of the market.

The global bio plastics market was 19.54 billion USD in 2016 and is estimated to reach US\$ 65.58 billion in 2022 at an estimated CAGR of 22.36% for the forecasted period.

Europe and North America are expected to dominate the overall market of biodegradable packaging. North America is expected to be the largest consumer of the biodegradable packaging market. The developed regions are expected to dominate the overall biodegradable packaging market owing to the presence of mature markets that consist of highly environmental conscious consumers. In addition, the presence of high-spending population is also expected to increase the overall demand for biodegradable packaging in the developed regions.

The presence of large populations in Asia Pacific is expected to boost the biodegradable packaging market. Owing to the increase in the contract manufacturing process coupled with increased governmental interest to promote biodegradable products by providing incentives in some countries such as China and India is further expected to contribute to the growth of the market.



Market Dynamics

Europe dominated the global biodegradable packaging market in 2016 and the trend is expected to remain the same during 2017-2025. This is due to the various factors such as increasing environmental awareness among consumers, strict

implementation of environment friendly laws and growing R&D activities in developing bioplastics by key manufactures. The European Union has passed a strict resolution to reduce overall consumption of thin plastic bags in the region by around 80% by 2019, which in turn is expected to create major growth opportunities for biodegradable plastics & paper manufacturers over the following years. However, the reduction in the usage of conventional plastic bags is expected to directly boost the consumption of biodegradable plastic bags in malls, retail outlets and loose packaging applications. The increased cost-competitiveness of biodegradable polymers, growing support from authorities for addressing solid waste disposal needs, and increasing public awareness on the environmental issues related to conventional packaging waste are the major factors for making North America as the second largest region in the global biodegradable packaging market.

Future Strategies for Commercialization

- ⇒ Several units of the developed continuous production facility will be established and their productivity will be increased by optimizing the production parameters. Completely separate site has been selected for the establishment of the jute-polymer unit. Physical construction for the new facility will be started very soon.
- ⇒ A research and development facility will also be established to increase physical and mechanical properties of the biodegradable packaging material (sonali bag™). There will also be a quality assurance and quality control team to ensure the product quality.
- ⇒ Finally, the technology will be transferred to the private entrepreneurs to meet up the huge demand worldwide.

Conclusion

Currently, extensive researches are conducting in the area of biodegradable plastic worldwide. The goal is to develop a type of plastic that can naturally break down to non toxic compound. Some companies already commercialized some biodegradable packaging which are mainly starch or synthetic bioplastic based compound. However, several drawbacks are still there such as low strength and low stability in aqueous environment, high moisture uptake etc. for starch based materials and high cost, low biodegradability etc. for synthetic bioplastics. Currently, BASF does make biodegradable polyester called Ecoflex that is used for food packaging applications. Unfortunately, carbon gets locked up in these biodegradable plastics and is released into the atmosphere as carbon dioxide. Another downside to these biodegradable plastics is that they require sunlight to degrade. Plastics buried in landfills will not receive the sun they need to degrade and, therefore, can still last for decades. While there are still many questions left unanswered when it comes to the environment and plastic, it is clear that plastic is here to stay for a very long time. In one word answer of the unresolved question is our new product jute based biodegradable packaging materials because of its low cost, high biodegradability, higher strength, renewable raw materials, higher stability in water etc. The product will keep our earth green and increase the economic growth of Bangladesh. "The impossible missions are the only ones which succeed."



Inventor Prof. Dr. Mubarak Ahmad Khan

Dr. Mubarak Ahmad Khan is former Chief Scientific Officer (CSO) and Director General of Atomic Energy Research Establishment, Bangladesh Atomic Energy Commission. He is now working as Scientific Advisor of Bangladesh Jute Mills Corporation, Ministry of Jute and Textiles, Bangladesh. He has completed B.Sc. and M.Sc. in Chemistry and PhD. in Polymer and Radiation Chemistry. He is working in several promising areas of nanotechnology, material science, biodegradable polymers, biomedical science, applied science etc. His focus is to develop sustainable technologies for related to environment and human health. He worked in Germany (Technical University of Berlin, Fraunhofer Institute of Applied Polymer Research) as DAAD and AvH fellow, in Japan as JSPS and MIF Fellow, in USA (Michigan State University) as visiting scientist, in Australia (University of New South Wells) as IAEA fellow. His name was published Who's Who in the World 1998. He is also selected as a Fellow of IUPAC.

He is author/co-author of about 600 publications including 17 book chapters and a patent. The total number of his research articles is 6957, h-index is 38 and i10-index is 193 (Google Scholar 21st January 2018) and his ResearchGate Score of 43.87 is higher than 97.5% of the 11 million ResearchGate members (ResearchGate 21st January 2018). He supervised more than 250 M.Sc. 8 M. Phil and 20 PhD students. He has invented biodegradable polybag (Sonali Bag) from jute, advanced wound dressing material from cow bone, liquid bio-fertilizer from textile effluent, natural plant growth promoter from prawn shell etc. He is also the inventor of Jutin (Jute Reinforced Polymer Corrugated Sheet), the outstanding housing material from jute plastic composite. He received several national and international awards for his remarkable contributions to scientific community. At present he is the number one scientist in Jute sector all over the World with respect to international publications cited by Scopus.

Flow Chart of Sonali Bag Production



যোগাযোগঃ ড. মোবারক আহমদ খান, বৈজ্ঞানিক উপদেষ্টা, বিজেএমসি, ঢাকা। মোবাইল নং- +৮৮০১৮১৯-২৫২২৯২, ই-মেইল : makhan.inst@gmail.com
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