PERSPECTIVE

Overview: need for sustainable packaging

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ABSTRACT

Packaging materials are an important aspect of our lives since they are used on a regular basis in grocery shops, supermarkets, restaurants, medicines, and other establishments. Packaging is critical in ensuring that items are preserved during handling, transportation, and storage. Similarly, it aids in the maintenance and extension of product shelf life. These materials are used in the packaging of meat, poultry, and fish items, as well as food and drinks, cosmetics, and pharmaceuticals. Several applications of packaging materials have been extensively discussed, but little attention has been paid to their end-of-life and continuous availability without negatively impacting the environment.

Key Words: *Sustainability; Biodegradable; Biopolymer*

INTRODUCTION

Human well-being, the economy, and the environment are the three main categories used to classify sustainability. These three categories can be seen as a way to sustain the ecosystem's resilience while also enhancing human well-being (i.e., equitable burden sharing and social equity) .When considering sustainability from an ecological point of view, one must make a contribution to ensure that the environment and a healthy ecosystem are always maintained. Materials used for packaging can also be related to this. If fewer virgin resources are used and post-consumer materials can be recycled or reused from readily available materials, packaging materials are said to be sustainable.

The sustainability of a material depends on a number of variables, from the economic to the environmental, including costs and impacts, the usefulness of aesthetic qualities, production to end-of-life processing, and effects at local to global scales.

Due to their frequent use in grocery stores, supermarkets, restaurants, pharmacies, etc., packaging materials play a significant role in our daily lives. When handling, transporting, and storing products or contents, packaging is crucial in preserving their quality.

Due to the materials used and the labor-intensive procedure involved in making them, packaging materials add to the cost of the product. There has been a lot of research done in this area because of the significant environmental impact that such materials have, both during manufacture and after they have reached the end of their useful lives. Therefore, it is necessary to critically assess the various packaging materials; the application areas for each material as well as the benefits and drawbacks of each packaging material are equally crucial. Plastic, paper, glass, metal, and a variety of other materials are used as packaging materials, but this list is not exhaustive.

A sustainable strategy needs to be looked at to make sure that packaging materials are always available without harming the environment. Among these strategies are material reuse and recycling material selection and the use of bio-based and biodegradable materials.The study thus concentrates on the requirement for sustainable packaging.

TYPES OF PACKAGING MATERIALS

The quality of the product is significantly influenced by the packaging materials.When packaging material is used to convey information, it must be designed in such a way that it can hold the printed text or graphics.

A key element of product presentation and preservation is the choice of packaging materials. When selecting packaging materials, the type of product is also a deciding factor.

Plastics

Petroleum-based polymeric polymers have long been a popular choice for packaging. Polyethylene (PE), polypropylene (PP), polystyrene (PS), and polyester (PET) make up the majority of these polymers .The most common types of packaging are made of plastic, and 26% of all polymers are used in packaging, making it the largest use of plastics.

In the next 20 years, it's anticipated that the amount of plastic used will double as it quickly replaces other packaging materials. This is because of the product's inherent qualities, which include strong barrier properties, lightweight construction, low price, etc.Plastic packing materials have a lot of advantages, but they also have drawbacks because of how bad their effects on the environment are. Carbon dioxide (CO_2) is released into the atmosphere during the manufacture of products based on petroleum. Additionally, improper collection/recycling of packaging plastics will cause them to end up in landfills and water bodies, pollu-

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-ting and contaminating the land and oceans. Alternative sustainable and environmentally friendly materials are being investigated by numerous industries.The genesis of biodegradable polymers might be either natural or artificial. Biopolymer materials and biodegradable materials differ from one another. Not all biodegradable materials are biopolymers, but all biopolymer materials are biodegradable. Starch is an example of a renewable resource that can be used to create biopolymers, whereas biodegradable materials are those that can break down into inorganic compounds like carbon dioxide, methane, water, or biomass.

The following are the top three sources of biopolymer materials

1. Biomass sources: the direct extraction of biopolymers from proteins and polysaccharides including cellulose, starch, and galactomannans (e.g., gluten and casein)
2. Microorganism sources: microorganisms that produce biopolymers Polyhydroxyalkanoates (PHA) and polysaccharides are examples of these polymers.
3. Chemical sources include the chemical synthesis of bio-based monomers like polylactic acid (PLA) and the thermoplastic aliphatic polyester made from lactic acid.

Drawbacks of Plastics as a packaging materials

Due to their low cost and simple processing, plastic materials have seen enormous expansion in the packaging industry during the past few decades. Although there are advantages to using plastics for packaging, there are also disadvantages in terms of the health and environmental risks associated with their manufacture, use, and disposal. An accumulation in landfills that eventually makes its way downstream into water bodies and eventually into the ocean due to improper disposal and recycling methods can cause serious damage.

Glass

Glass is acknowledged as a significant material on a global scale. Contrary to other industries that have switched to alternative materials like plastic and metal, the food and pharmaceutical industries still utilise glass for packaging. The food industry has continued to use glass for packaging for a number of reasons. These factors include the preservation of sensory attributes, quality preservation, food safety, and chemical attack resistance. Used glass containers can be recycled to create new glass containers, or glass can be produced using various techniques that require melting a mixture of silica, sodium carbonate, and limestone/calcium carbonate at a high temperature and then dispensing the molten material into a mold Glass may be formed into a variety of forms and sizes.

Glass containers have a significant yet declining role in packaging industries, especially in the food and beverage industries. Although there is a decreasing usage of glass ‑ based packaging materials, they will always remain one of the safest packaging materials in the food and beverages.

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Drawbacks of Glass Packaging Material

Glass packaging has its limits, much like any other type of packaging material, including its high weight, susceptibility to fracture, and fragility to thermal expansion or contraction. Extreme temperatures are not suitable for glass packing. Physical dangers might result from improper handling of glass during handling and transit. Glass packing shouldn't be heated above 65°C, and glass containers shouldn't cool down quickly more than a 40°C difference.

Paper

The use of paper and paperboard for packaging has been prevalent in the furniture, tobacco, building and construction, machinery, electrical and electronic equipment, and food and beverage industries. In the market, you hardly ever discover items that have been opened. This packaging was chosen for a variety of reasons, including customer education, product protection, safety, and ease of handling. When it comes to cost and sustainability, paper and paperboard outperform plastics, metals, and glass as packaging materials. However, this material has certain drawbacks, including a poor resistance to chemicals and water as well as a low strength. Paper can be used as a passive packaging material or directly. Paper packaging materials could be utilised as plates, cartons, trays, etc. to surround the product or product container and serve as cardboard surfaces on which to display information. A few changes must be made to the paperboard when packaging a liquid product. The swelling of paper-based packaging is caused by the product's moisture being absorbed.

The majority of damp or moisture-related products exhibit this. The paperboard can be coated with specific polymers to prevent these occurrences by providing the necessary barrier against chemical attacks and moisture absorption. The coating also gives the paperboard some kind of enhancement, like strengthening and chemical resistance.

APPLICATIONS OF PACKAGING MATERIALS

Food

Because the quality of the packaging materials affects the shelf life of packaged foods, careful consideration should be given to the selection of materials and the manufacturing process. Consequently, careful consideration should be given to the material selection and manufacturing procedure utilised to create the food packaging materials. The food business is one of the key sectors where packaging materials are extensively used. The growing demand for packaged food is a result of the expanding global population and technological improvement.

Food packaging polymers come in two varieties: biodegradable and non-biodegradable. Nanoparticles can be added to various materials to enhance their qualities. Improved biodegradable-based packaging materials have a number of advantages over conventional (unimproved, non-biodegradable) packaging materials. As a result of the ongoing demand for safer, healthier, and longer-lasting food products, packaging materials will continue to be useful in the food and beverage industry.

Cosmetics

The most common packaging materials in the cosmetics business are made of plastic and glass. This is a result of their close proximity to the product. Paper and paperboard might also be utilised, but to prevent the packing material from absorbing the contents, they would need to be coated with polymers or aluminium foil. When it comes to marketing, packaging can convey information about the product while also shielding the content from microbial contamination and light. Leaching, which refers to the migration of specific compounds from the packaging material to its content is another crucial factor to take into account when developing packaging materials for cosmetics, food, or pharmaceuticals. So, when making these materials, careful material selection and improvement should come first. Glass is yet another crucial component in cosmetics packaging. One of the oldest packaging materials is thought to be glass. This is due to glass's propertiesas an impermeable, nonporous, chemically inert, recyclable, and non-deg-

-radable material. Glass containers for cosmetics come in a variety of sizes and styles. Glass jars can be used for liquid foundation, lip balms, eye shadow, and other cosmetics. Depending on what's within and how appealing it is to buyers, it may also be made of clear or coloured glass. No matter what qualities other packaging materials have, glass will always be the preferred solution in the cosmetics sector.

PACKAGING SUSTAINABILITY IMPROVEMENT STRATEGIES

A strong demand for virgin resources could result in their eventual depletion. Another potential resulting from the depletion of virgin materials is the lack of raw materials for the production of packaging materials. The overuse of raw materials for packaging materials—from their extraction to their refinement—contributes to worldwide environmental problems. Recycling used materials to make identical items or other potential products is necessary to ensure sustainable packaging. There are many various kinds of packaging materials, from paper to plastic to metal to glass. The sustainability of the packaging industry depends on several factors, such as the availability of raw materials, good recycling practices, the use of renewable resources and the effective and efficient policy on product packaging materials.

Manufacturers of other packaging materials (such as glass, metals, and paper/paperboards) should base their manufacturing on environmental protection, meaning they should take into account recyclable and reusable materials. Aluminum and other metals can be recycled 100 percent. When compared to virgin pulp, recycled paper uses less energy and water and has less of a negative environmental impact. Glass, on the other hand, can be recycled or transformed into other materials and utilised, for example, as fine aggregate in mortar or concrete. The percentage of material that can be recycled is the ideal metric for determining how sustainable a given packaging material is. Therefore, producers of packaging materials should strive to use materials that are biodegradable, sustainable, and have a high rate of recycling.