Paper No.: 12
Paper Title: FOOD PACKAGING TECHNOLOGY
Module – 35: Recycling of Packaging Materials

1. INTRODUCTION:

Proper waste management is important to protect human health and the environment and to preserve natural resources. Recycling involves the collection of used and discarded materials, processing these materials and making them into new products. It reduces the amount of waste that is thrown into the community dustbins thereby making the environment cleaner and the air fresher to breathe.

World population is growing rapidly and becoming more concentrated in urban areas. Increased urbanization will increase the concentration of packaging wastes, thus improving collection economics. A United Nations study indicates that increased recycling rates are accompanied by job creation and improved living conditions.

Paper and board are the most extensively used packaging materials in weight. In the United Kingdom, paper and board account for 43% by weight of all packaging. Paper and board packaging make up 6.4% of the total content of typical household waste. Plastics account for 20% of the weight of all packaging. Glass accounts for 20% of the weight of all packaging and only 10% of all goods are packaged in glass. Major sources of packaging wastes are grocery stores, restaurants, and office buildings. Residential collection of waste materials is growing, though sorting of the wastes is often a major expense.

Economic factors and governmental regulation are driving recycling. Energy costs associated with recycling are virtually always less than in manufacture from virgin materials. For example, recycled aluminium involves only about 2.8 kWh/kg of metal produced, while primary aluminium production involves about 45 kWh/kg of metal produced. Steel and glass recycling consume about 50% of the energy needed to make them from ore and silica. Plastics recycling needs only 10–15% of the energy needed to refine petroleum and manufacture virgin resins. Incineration of plastics is a less efficient means of saving energy. For example, 45.4 kg of HDPE has a fuel value of 19 kJ. Recycling saves twice this (38 kJ). Lower energy consumption linked with recycling

reduces emissions of CO_2, a greenhouse gas believed to be associated with global warming. For example, aluminium production by recycling generates only about 4% as much CO_2 as is created when virgin aluminium is produced.

Economic and environmental factors, both have led to government regulations aimed to promote recycling. Economic concerns are related to balance of payment issues when virgin raw materials for packaging products are imported. For example, in many countries, limited forest resources means they have to import paper based packaging, but recycling reduces these imports. In fact, Japan imports used paper products from the United States and elsewhere to recycle them.

In some areas, the number of landfill sites is becoming limited. Worries about landfill disposal costs are becoming less of a factor in promoting recycling. Environmental concerns include forest exhaustion and the effects of wastes on the environment. One concern receiving much publicity is the harmful effects that plastics, when eaten, can have on animal life such as dolphins, cows in India.

2. SEPARATION OF MIXED MATERIALS

The wastes are dumped on a tipping floor, where paper products are separated from metals and plastics. Metals and plastics, mostly containers, are pushed onto a conveyer belt. Two types of magnetic separators remove steel and aluminium from plastics and glass. Density differences or manual sorting are used to separate glass from plastics. The glass containers are hand-sorted by colour. The plastics are separated into individual polymer types. Plastic bottles are categorised into: clear PET soft-drink bottles; green PET soft-drink bottles; translucent HDPE milk, water, and juice bottles; pigmented HDPE detergent bottles; PVC water bottles; and food containers such as PP ketchup bottles.

3. METALS

Iron and steel scrap account for more than one-third of the cast iron and steel produced. Tin must be removed when recycling tinplate cans. Little as 0.01% tin can make hard spots in steel and causes troubles in rolling. Therefore, only low levels of steel can scrap can be used directly in furnaces. By processing cans with hot caustic and an oxidizing agent, tin can be removed from tinplated steel cans. The use of steel beverage cans is decreasing. Those used often don’t contain tin. Therefore, few mills operate detinning

operations. Can scrap can be used as a precipitant in copper leaching mining. Yet, this is a low-volume application. Mini-mills using electric arc furnaces use scrap iron and steel as their only feedstock.

An eddy-current separation unit is often used to separate aluminium and other nonferrous metals during processing municipal solid wastes from the waste stream. It is completed after removal of the ferrous metals. The eddy-current separator generates an electromagnetic field through which the waste passes. The nonferrous metals produce currents having a magnetic moment that is phased to repel the moment of the applied magnetic field. The repulsion causes the nonferrous metals to be thrown out of the process stream away from non-metallic objects.

Aluminium is the largest nonferrous metal recycled. More than 95% of carbonated drink containers are two-piece aluminium cans. Aluminium is also used for aerosol containers and as foil–plastic–paper laminates to package cereal and frozen foods. Aluminium is also used for food trays. All of these are found in and collected from municipal solid wastes. Organic coatings need to be removed before the aluminium can be used to make new sheet stock. It is done in special furnaces. About 90% of recycled aluminium cans are converted into new cans. The rest are used to make other aluminium products.

4. GLASS

Glass packaging accounts for 2 % of the volume of municipal solid waste. Beverage and food containers account for nearly 90% of recycled glass. Glass can be crushed into cullet and reprocessed into new container materials. The recycling preserves sand and water, and uses 15% less energy than new production; however the savings must be weighed against the cost for transporting the glass to the recycling facility. New containers are the biggest market for recycled glass but cullet stock is also used in bricks, asphalt, and fiberglass insulation.

For every six tons of recycled container glass used, one less ton of carbon dioxide, a greenhouse gas, is reduced compared to manufacturing glass. When processing municipal solid wastes, glass is generally removed by hand sorting after separating paper and metals. The mineral jig may be used to separate glass from other particles. Particles should be less than 5 cm in their longest dimension. Glass occurs in the middle layer of the slurry formed by the mineral jig. Froth flotation is used to separate glass from denser

particles. Froth flotation is most efficient for particles less than 850 μm in size. A cationic fatty-acid amine surfactant has been used to improve the efficiency of froth flotation of glass.

Most collected glass containers are used in the manufacture of new glass containers. The amount of recovered glass used in glass manufacture usually constitutes about 46% of the charge used to manufacture amber soda-lime container glass. Recycled glass used at levels as high as 80 % when available. Since glass has an unlimited life, it can be recycled repeatedly.

5. PAPER

The primary process steps in recycling old corrugated containers and other paper packing materials are pulping, high-density cleaning, coarse and fine screening, centrifugal cleaning, fibre fractionation, and refining. Pulping degenerates the containers into individual fibres dispersed in water. High-density cleaning take away large dense particles like nails and large staples. Coarse screening removes big low-density contaminants like unpulped tapes and big adhesive particles if any. Coarse screen size ranges from 6 to 20 mm. Fine screens are fitted with slots as small as 0.15–0.30 mm. They separates smaller particles such as plastic, wax, and adhesive particles. A type of hydro-cyclone device called a centrifugal or reverse cleaner is used to remove low-density particles in the 70 to 250 μm size range.

Fractionation process separates fine particles and short, weak fibres from longer, stronger fibres. Refining is used to improve the pulp drainage properties on the paper machine and control paper bulk and density, strength, surface smoothness, and porosity. Caustic soaking is also used to improve recycled fibre properties. Extensive bleaching of recycled paper can yield a high-brightness pulp suitable for office paper manufacturing.

6. PLASTICS

Plastics recycling has several advantages:

1. Preservation of non-renewable fossil fuels: Plastic production uses 8% of the world oil production, 4% as feedstock and 4% for manufacture.
2. Reduced intake of energy.
3. Reduced emission of carbon dioxide, nitrogen oxide and sulphur dioxide.
4. Reduced quantities of solid waste going to landfills.

The economic attraction of plastics recycling is dependent upon the cost of the plastics feedstock, crude oil, and natural gas. For example, the price of recycled PE can vary from 85% to 105% of the virgin PE, depending upon feedstock prices. If the crude oil price doubles, and energy cost is only 25% of the total cost of polymer, virgin polymer cost rises 75% while recycled polymer cost rises only 25%.

There are many problems in the recycling of plastic wastes. A range of different types of plastics are used. The plastics contain a wide range of additives, and many objects contain plastics as well as other materials. The sorting of plastics is difficult, unhygienic and expensive process. Recycling of plastic packaging, which makes up about 9% of municipal solid waste is comparatively new process. Usually, six types of resins are used: PET in soft drink bottles; HDPE in boil-in-bag pouches and milk jugs; PVC in meat wraps; LDPE and PP, in syrup bottles, yoghurt tubs and milk pouches; and PS in disposable dishes and cups. The plastic is sorted by their type before they can be recycled. To simplify identification of type the society of plastics industry has made an easy to use, numerical coding system for use by plastic container manufacturers.

Sorted plastic materials are shipped, usually in bundles, to processing plants to be converted to polymer resins. The bundles are broken and the bottles sorted to ensure that only one type of polymer is further processed. Processing consists of chopping and grinding the bottles into flakes and washed. Processing steps like flotation are used to remove polymeric contaminants from the flakes. The flakes are melted and converted into pellets. Market for recycled plastics include roofing material, package strapping, pipes, yard furniture, automotive parts and flowerpots. More than 50% of the plastic waste generated in the country is recycled and used in the manufacture of various plastic products.

Designing eco-friendly, biodegradable plastics is the need of the hour. However partially biodegradable plastics have been designed and used, completely biodegradable plastics based on renewable starch rather than petrochemicals have only recently been developed and are in the early stages of commercialisation.

7. PACKAGING INDUSTRY RECYCLING AWARENESS

There is a high level of awareness across the packaging industry. Progressive organizations are aware of current environmental issues specifically relating to packaging

materials. They function as per certain goals in order to reduce pollution arising due to packaging. These include:

1. Run the industry in compliance with all applicable laws and regulations;
2. To work towards reducing the effect of product packaging by taking steps to eliminate heavy metals, inks, colorants, additives which leave hazardous residues when disposed of,
3. Decrease the volume and weight of packaging;
4. Use recycled and recyclable materials in packaging;
5. Support efforts to train consumers on how they become part of recycling solution.

Even though the reduction in materials itself has a positive impact on the issues, because smaller is better, yet there are still problems to face. There is little doubt that improved packaging is a vital part of India's progress in developing the internal food market. The best sort of packaging is that which can be used a number of times, such as second-hand pallets, reusable plastic crates, cardboard or wooden boxes, milk bottles etc.

8. CONCLUSION

The challenge for the packaging industry will be for all the relevant people to work together to device the increasing global regulatory policies on food contact safety, reducing atmospheric pollution during package manufacture and deal effectively on package waste management by recycling. Needless to say, these objectives can be met only when all the three segments of the packaging industry, namely, the material manufacturer, converter and user work together in an integrated manner.

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