Text A Making Plastics

To make plastics, chemists and chemical engineers must do the following on an industrial scale:

1. Prepare raw materials and monomers
2. Carry out polymerization reactions
3. Process the polymers into final **polymer resins**
4. Produce finished products

First, they must start with various raw materials that make up the monomers. Ethylene and propylene, for example, come from crude oil, which contains the hydrocarbons that make up the monomers. The hydrocarbon raw materials are obtained from the "cracking process" used in refining oil and natural gas. Once various hydrocarbons are obtained from cracking, they are chemically processed to make hydrocarbon monomers and other carbon monomers (like styrene, vinyl chloride, acrylonitrile) used in plastics.

Next, the monomers carry out polymerization reactions in large polymerization plants. The reactions produce polymer resins, which are collected and further processed. Processing can include the addition of plasticizers, dyes and flame-retardant chemicals. The final polymer resins are usually in the forms of pellets or beads.

Finally, the polymer resins are processed into final plastic products. Generally, they are heated, molded and allowed to cool. There are several processes involved in this stage, depending upon the type of product.

Text B Biopolymers and Recycling

As we mentioned earlier, there are other polymers besides plastics. Naturally occurring polymers, such as starches, cellulose, soy protein, vegetable oil, triglycerides and bacterial polyesters, can be extracted from crops and bacteria. Furthermore, plants and microorganisms can produce substances like lactic acid, which can be polymerized into **bioplastics** (polylactic acid, for example). There are two strategies for producing bioplastics.

Fermentation: Bacteria or other microorganisms mass-produce the biopolymers in bioreactors (fermentation tanks). The biopolymers (lactic acid, polyesters) are extracted from the bioreactors and chemically processed into plastics.

Genetic engineering plants as bioreactors: Biotechnologists introduce bacterial genes into plants. These genes code for the enzymes to make bacterial plastics. The plants are grown and harvested, and the plastics are extracted from the plant material.

In 1997, Cargille Dow made a clear plastic (polylactide) from corn. The polylactide fibers were woven into sports apparel, upholstery fabrics and bioplastic wraps.

Bioplastics have the advantage of being produced from renewable resources (bacteria, plants) rather than nonrenewable resources (oil, natural gas). Furthermore, bioplastics are biodegradable -- they can break down in the environment. Bioplastics is a potentially important industry. With current technology, bioplastics might be more expensive to produce, but biotechnology is rapidly advancing and production may become more economical in the future.

Text C Recycling Plastics

Oil-based plastics don't degrade, but many types (including PP, LDPE, HDPE, PET, and PVC) can be recycled. Each type has a code and identifying number, but some plastics aren't as economically feasible to recycle. So it's important to check with your recycler or municipality about which types of plastics will be accepted.

Once collected, plastics go through the following steps

- Inspection to weed out contaminants and inappropriate types of plastic
- Shredding and washing
- Separation based on density
- Drying
- Melting
- Draining through fine screens to remove more contaminants
- Cooling and shredding into pellets
- Selling back to plastic companies