

Ron Bennett first spoke about the problem of waste plastic in the environment, which has recently become a major international worry particularly in the oceans. Poly Vinyl Chloride, PVC, cheap and easy to manufacture and with extensive usage, is a major contaminant; but in the long term few plastics are environmentally friendly.

Natural plastics have always been with us, but in the last 150 years or so the number of types has risen dramatically.

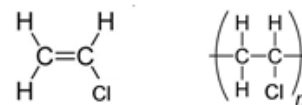
Shellac is a natural resin and has been used since antiquity.

An early man-made plastic was celluloid, derived from nitrocellulose.

Bakelite, a phenol formaldehyde resin, followed; this is a *thermosetting* plastic formed by heating its constituents - once made it cannot be unmade. A more recent thermoplastic is Kevlar, with repeating six-carbon benzene ring units.

In the 1930s-1950s period there was a surge in plastic developments by such companies as ICI and Dupont, with polythene, polypropylene, PVC, etc becoming commercially viable. Since then more plastics have come on the scene, the choice of which to use for a particular purpose depending on its cost of manufacture. PVC often finding itself at the top of the list.

Most plastics are made from a repeating monomer, eg PVC, $(C_2H_3Cl)_n$: In other plastics with this vinyl based structure the chlorine is replaced by Fluorine, CH_2 Phenol, etc. Other plastics of this type are Polyamide, Polyurethane, and Polyester. PET is a polyester and, at one third the price, has replaced Celluloid. Such polymers are made at suitable temperatures and (high) pressures, with catalysts, etc.



The larger the number n of the resulting molecule the more viscous the plastic will be while being extruded or cast; and the product stiffer.

Greater strength can be achieved by cross linking the molecules, eg uPVC, used for window frames.

Styrene can be added to (some of) the monomer to provide toughness and flexibility, eg in spectacle frames.

Amorphous plastics can be clear, but may shatter (Perspex).

There are biodegradable plastics, compostable over half a year. And plastic can be recycled – either to be used as mixed plastic in items that can be made from it – or by sorting, quite rigorously, it into those types which can be taken back to the monomer and reused.

Most plastics are made from the products of crude oil, currently taking about 4% of the world's production. This is likely to continue, though as oil fuels are replaced by electricity, the proportion will rise. Crops, being vital for food, are never likely to feature significantly; fermentation is another niche player.

It is estimated that about 300 million tons of plastic are produced per year worldwide. Even if more is recycled than not, the amount dumped on Mother Nature's lap is considerable. If burnt, PVC gives off chlorine ions which react in the atmosphere to give phosgene and other nasties. Some food wrapping is done with double skin films - of different plastics which cannot be separated. Other plastics come with metal attachments. Even relatively benign plastics incorporate plasticisers, dyes, fire retardant chemicals etc, which may be harmful to life when released during decomposition.

Nowadays we cannot cope without plastics, and the job of the plastics scientists and engineers is secure – even if environmental issues change their approach.