Completely biodegradable polymers

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About 50 per cent of all municipal solid waste can be economically recycled as a compost in a high-quality humus that can be re-used in soil farming. Biodegradable polymers like Novon are designed to biodegrade fully in biologically active composting sites. Novon polymer technology is based on starch which is modified with well-known non-toxic, fully biodegradable additives and processed into a useable polymeric material. Application opportunities include food packaging and health care.

To understand what role biodegradable polymers can play in responsible waste management today, let us consider how our current waste management efforts might appear to the "garbologists" of the future.

Look ahead 100 years and think for a moment about how an anthropologist like Dr William Rathje might view the evidence of how we as a society handled our garbage. Chances are he will not be kind.

He will excavate a monofill filled with toxic ash and see that we incinerated 27 per cent of our waste. He will also see other sites that indicate when incineration was not possible, or when public concern prevented it, we entombed over 60 per cent of our wastes in air-tight, waterproof sanitary landfills.

By reading a 100-year-old, non-degraded copy of the Frankfurter Allgemeine Zeitung in a British landfill, he will see that when we ran out of room, we shipped our trash from one country to another or merely dumped it in the ocean.

We do this today despite the fact that the oldest waste treatment process used by man is probably still the best. Composting has been around for centuries, recycling leaves and branches into nutrients. It is simple, natural and ultimately costs less than incineration or landfill.

Further, it is safe, free of toxic emissions, and requires minimum fuel resources. And, when input materials and processes are carefully controlled, a valuable, marketable product — humus — is produced. The only problem with it is — we don't use it enough!

Instead, today we work against nature. Our current landfill practices are not designed to promote biodegradation. Further, with the limited available landfill space, there will not be any room for tomorrow's waste. According to a study by the H Kaiser research firm, over 50 per cent of Germany's present landfill capacity will be exhausted within five years. Add to this, the design and operation of landfills which do not promote biodegradation. The problem was dramatically illustrated in a recent article in *National Geographic*. The story carried a photograph of a hot-dog buried in 1974 which was recognisably still a hot-dog.

Many people fear that the "sanitary" landfills will eventually leak and become the superfund sites of tomorrow. Our belief that the Earth is not a gift from our parents but a loan to our children is fitting. Hence, as the solid waste crisis is unavoidable, the industry, the consumer and the legislators would want to see a significant portion of the wastes we send to landfill each day recycled instead.

Now, when I say recycle, no doubt many of you are thinking aluminium, glass, and paper — the recycling success stories. Aluminium is recycled at the rate of 35 per cent in Europe. Recycling of clean, sorted office papers, newspapers, and corrugated containers, gives paper an overall recycling rate of 30-40 per cent. Glass is recycled at 30 per cent. Despite terrific strides made for PET, olefinic and styrenic resins, post-consumer plastics in general are recycled at only about 1 per cent.

However, collectively these materials make up about 50 per cent by weight and 75 per cent by volume of materials headed for the landfill. There are many things in our refuse that do not lend themselves to recycling.

This includes food-contaminated packaging, unsorted food service waste, multi-material composite in packaging and low density/low value foam which is costly to collect, transport and recycle.

Add to this by volume 22 per cent of organic food and yard wastes, and an estimated 22 per cent of foodsoiled, wet or unsanitary paper that is unrecyclable and you end up with approximately 50 per cent of all the refuse entering our landfills each day.

None of this can be easily and economically recycled and yet all of it can be easily and economically composted. We must target this 50 per cent through composting. As the European Community hierarchy for solid waste disposal points out, we should be thinking along the lines of reduction first, then reuse, then recycling, and only finally incinerating or landfilling.

Consumers have begun to reduce and Europe is recycling more every day. But recycling glass, aluminium, paper and some plastics is not enough.

We must target recycling of organic, biodegradable wastes through composting to divert all of them from landfills and mass burning. Novon™ polymers, and other fully biodegradable polymers can play a crucial role in helping consumers divert wastes from landfills.

Biodegradable materials can make many formerly non-degradable products "compost-compatible", resulting in high-value, high-quality humus that contains no synthetic, hazardous or toxic residues.

Novon polymer is not a traditional plastic. Nor is it a starch-filled plastic. Novon polymer is made primarily from starch. It decomposes into carbon dioxide, water, and minerals leaving no toxic, hazardous or synthetic residues. This means that a package, fork, tampon applicator or loose fill made of Novon polymers will decompose completely and safely when disposed of properly.

To avoid any misunderstanding, I will set out our definition of a completely degradable material. This means the material can be completely mineralised by micro-organisms, at a rate consistent with their likely disposal, leaving behind no synthetic, hazardous or toxic residues.

Companies and organisations that represent partially degradable materials as "truly biodegradable" only do a disservice to consumers who expect truly biodegradable materials marketed in a responsible way.

By "responsible", we mean setting high standards for what constitutes a biodegradable material and what constitutes a reasonable time for biodegradation to occur. Hence, we have committed over $US one million to a two-year research programme to substantiate the claims of biodegradability.

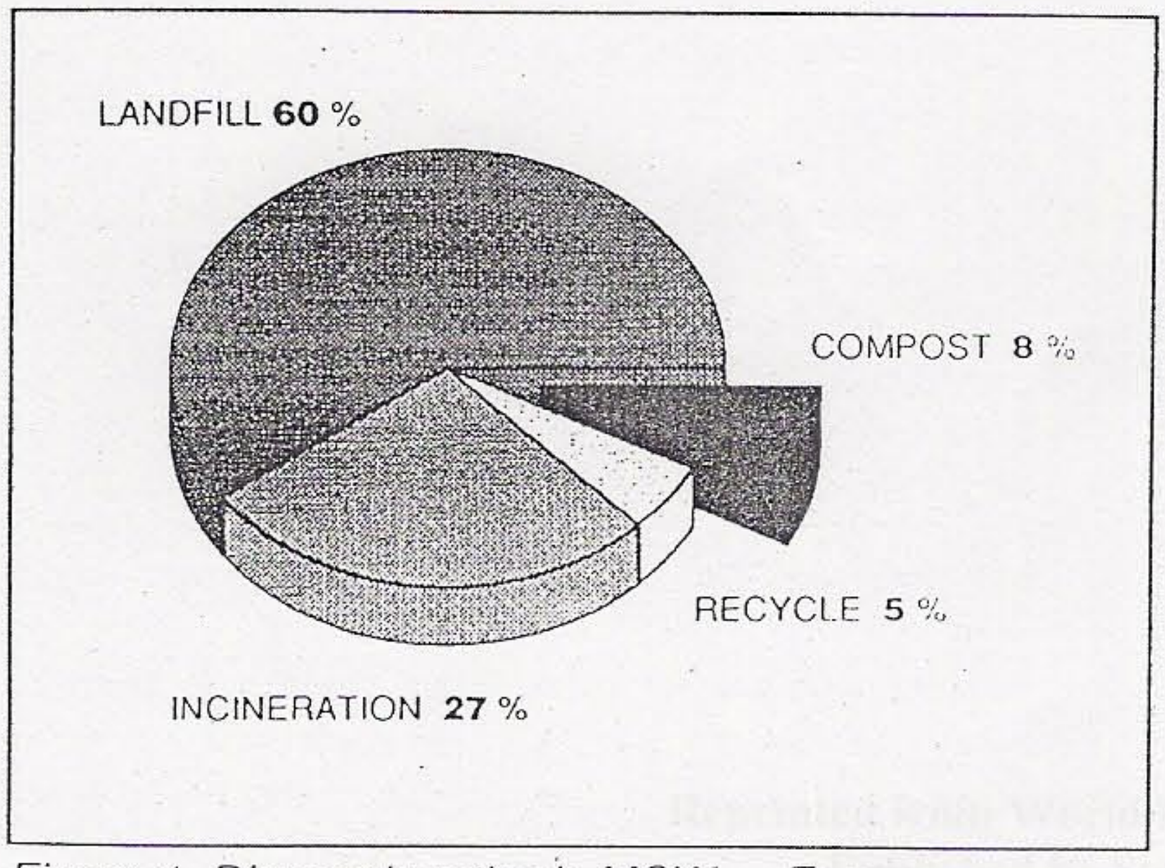

Figure 1. Disposal methods MSW – Europe

Our additives are tested by independent laboratories to ensure complete biodegradability under the desired disposal conditions. They will be metabolised to water and CO_2 by commonly occurring microbes in a timely fashion under aerobic conditions and to methane and water in anaerobic situations.

Some biodegradable polymer grades contain a small amount of common, natural minerals. These additives will have no negative impacts on compost quality or waste water treatment discharges and in some cases may be beneficial.

Part of our development work is participating in industry groups such as signing on to ORCA (Organic Reclamation and Composting Association) in Brussels to ensure the development of high standards for compost across Europe.

We are also actively participating in ISR efforts to ensure that laboratory tests for biodegradation can be related to real world conditions and time frames for biodegradation. With high quality standards, completely biodegradable polymers will become a humus that have a second life.

It has been demonstrated that high quality, marketable humus is generated through source-separated, clean organic composting. The humus generated had five times less lead, six times less chromium, and seven times less cadmium than mixed solid waste (MSW) compost.

We as an industry cannot afford to promote composting methods or standards that disregard the general public's attitudes against hazardous and contaminated waste.

Polymer application

Some of the best application opportunities for polymers are in plastic packaging mixed with food waste. Imagine the school cafeteria of the future. Your son or daughter is served a hamburger in a package made from completely degradable materials. They will eat soup with a biodegradable spoon, and drink from a paper cup with a biodegradable lid and through a biodegradable straw. When they are finished, they will throw it all in a bin with food scraps that will go to a local composting centre. After six months, it will have been transformed into humus, a valuable source of soil organics. This may be sold to a farmer who will use it to replenish his soil and ultimately grow the crops to make the starch to start all over again.

Imagine a fully degradable baby diaper without plastic fragments decomposing into a high quality humus that can be easily marketed to homeowners, nurseries or farmers; imagine a tampon applicator that will decompose in a sewage treatment plant so that your kids won't discover them as litter on the beach; packaging foam material that disintegrates completely with water and becomes food for soil; or imagine health care packaging used in sanitary applications which are undesiderable to recycle or even incinerate. Examples

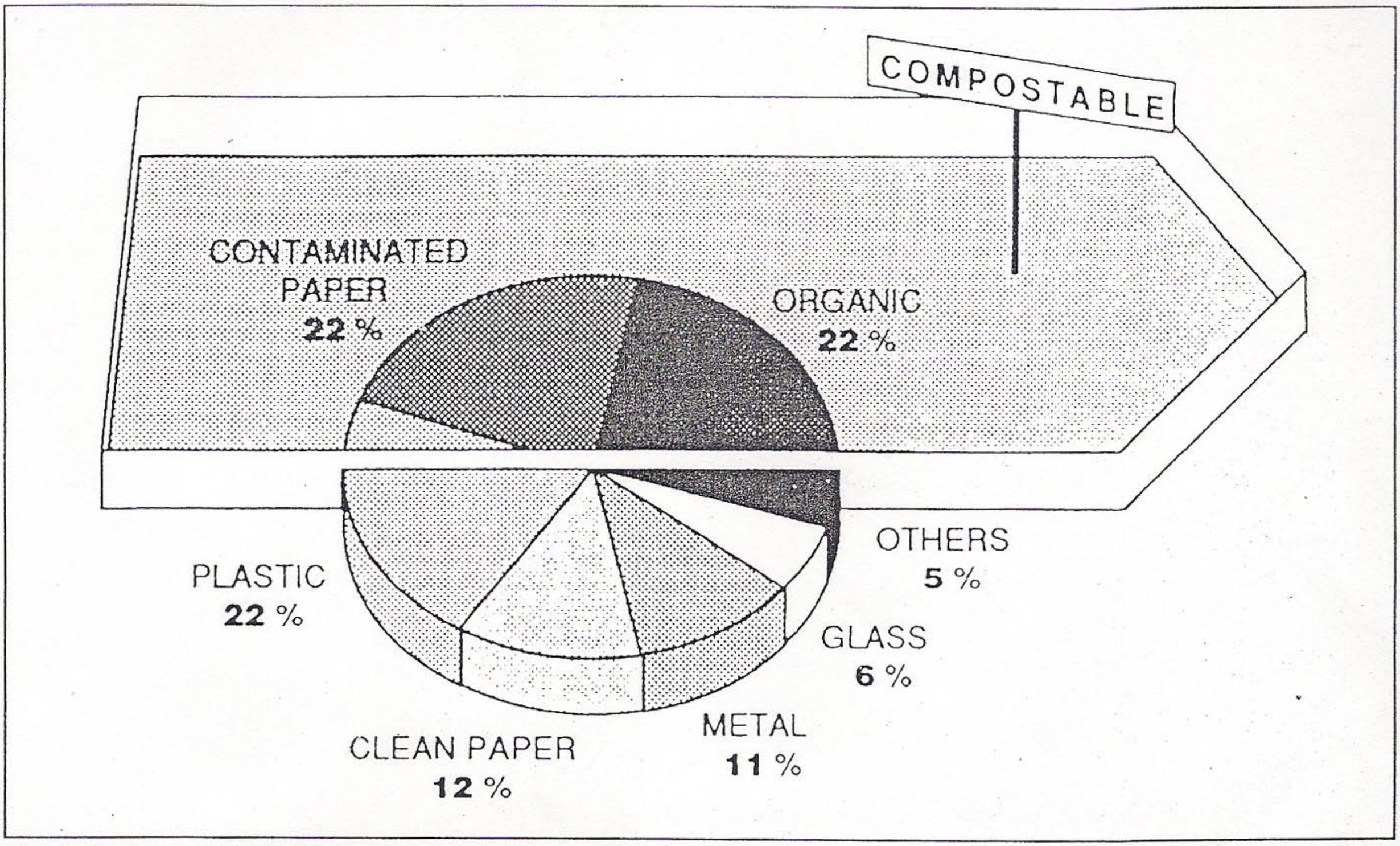

Figure 2. Potential MSW for compost

include diagnostic medical products.

In certain applications, biodegradable polymers might be used in support of recycling of multi-layer packages. Because these polymers disintegrate and flush away in the high-temperature washing process used in recycling systems, they could be used as the tie-layer. This would enable the recovery of uncontaminated layers of plastic, paper and aluminium for subsequent recycling.

Biodegradable polymers are not for every packaging application; there are technical limits in a starch-based material such as high water-vapour transmission rates.

Through close work with manufacturers, environmentalists and legislators, and continuous research, our goal is to develop polymers that decompose completely after appropriate disposal methods to help our customers make products that are safe for the environment. □

George Hanna is associate director, market development for Novon polymers in Europe located in Arlesheim, Switzerland. In 1981, he started with Dow Chemical where he held several jobs in research, application development and commercial areas, both in Holland and Switzerland. During that time, Mr Hanna has worked for the packaging, electronics, and automotive markets with commodity and engineering thermoplastics and thermoset resins.