

**Most industries and municipalities produce waste or emissions of one kind or another. Mining and mineral processing, energy and petrochemicals, manufacturing, food processing, iron and steelmaking all generate waste streams after they have extracted the economically valuable products from raw materials.**

Sometimes these waste streams contain contaminants which may be toxic and harmful either to human health or to the environment. It is in the nature of processing that, by removing desirable substances from the raw material this may concentrate harmful or undesirable ones in what is left over. Disposing of these safely, permanently and economically is a challenge and a cost for every major production industry.

Today, many contaminated sites consist of old waste dumps which, long ago, nobody thought would be occupied, but with the growth of cities, populations and business activity have become valuable land. In the past, people were not as aware as they are today of the long-lasting and toxic nature of some of the things they threw away.

Sometimes waste streams can be very large – for example Australia's power stations between them produce 13 million tonnes of fly ash every year from burning coal. The alumina industry generates 30 million tonnes of a by-product from bauxite processing called red mud. Steelmaking and other metals industries produce millions of tonnes of slag.

Scientists research what can be done to turn these wastes into safe, economically valuable products and to prevent them from posing an environmental or health risk in the future is highly desirable. This has led to a concept known as "zero waste".

### **Zero waste**

At present, zero waste is an ideal rather than a reality. It represents a goal worth striving for by industry, government and society as a whole. Several Australian governments have already adopted it as a target for domestic waste and are advising both industry and consumers on promising ways to achieve it.

The main approaches include:

- reducing the amount of raw material being processed and improving the yield of valuable substances from raw materials
- analysing the resulting left-over 'waste stream' for substances of potential value to other industries or uses
- analysing the waste stream for potential contaminants with a view to making them harmless
- recycling the product stream so as to reduce demand for the original raw material (and the waste that comes with it)
- analyse the entire life-cycle of the product to identify opportunities to reduce waste, increase efficiency, generate useful by-products and lower costs all along the chain
- combine different forms of waste to neutralize hazardous elements and produce economically beneficial new products.

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Examples of industries which now have a strong focus on waste minimisation – especially through recycling – include aluminium, glass, plastics and building materials. Organic material from food processing or garden waste is increasingly being recycled as soils, composts and soil improvers.

### Contaminated waste

Waste streams may be contaminated with inorganic substances – like heavy metals – or organic compounds. The challenge lies in finding economic ways to remove or neutralise these.

In the case of heavy metals, CRC CARE is exploring two main approaches:

1. Increasing the pH, or alkalinity, of the waste immobilises heavy metals so they can no longer be taken up by plants and reach people or animals.
2. Heavy metals can also be immobilised by adding an adsorbent such as clay, to which they are bound.

Some wastes like red mud, fly ash and slag contain adsorbents, which can bind to heavy metals. They may be quite alkaline, which further immobilises the heavy metals.

By combining two waste streams which would otherwise be problematic to dispose of, it is possible to create a product which is both safe and has value in fields such as agriculture, construction or as a filler. Some wastes are already being treated in this way to create safe, useful products – but there remain a great many opportunities still to be explored.

For example, adding an organic waste such as chicken manure or sewage solids to a waste stream created by mineral processing may also help to lock up the heavy metals, yielding a product useful as a soil improver.

Not all heavy metals are bad. Some, such as zinc and copper are essential micronutrients for plant growth, and wastes containing traces of these can readily be used as ingredients to make fertilisers or soil improvers.

Organic wastes are readily recycled if they are free of contaminants, but where they contain either disease-causing microbes or heavy metals they require further treatment. For this reason it would be better if urban waste streams no longer contained industrial effluent with toxic elements. This would make it much easier to recycle organic matter in sewage into productive uses, and also to concentrate and deal with toxic by-products of industry.

### Our role

CRC CARE is at the forefront in developing new technologies and partnerships for eliminating and reducing waste.

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CRC CARE is a partnership of organisations providing research, technologies and knowledge in assessing, preventing and remediating contamination of soil, water and air.

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