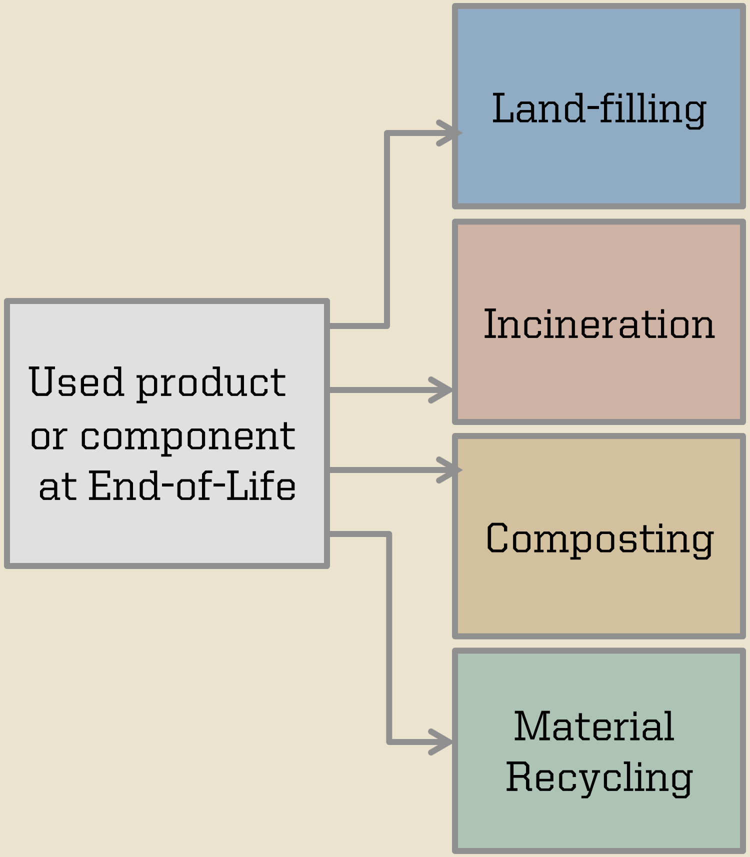
End-of-Life and Recycling

Okala Practitioner **Chapter 5**

End-of Life Treatment

This presentation explores treatment of products at end-of-life where upgrading or reuse of the product or components for extended life is not possible.

Products and product system components can take different paths at the end-of life of the product system.



Waste incineration

Incineration is one way to manage products at their end-of-life. Properly designed incinerators control temperatures and scrubbers filter hazardous exhaust gases.

Even the cleanest incinerators emit small quantities of toxic substances like dioxins and furans. Depending on the substances that are incinerated and the filtering systems that are employed, the process may also emit toxic metals such as mercury.

Autoclave

Waste incineration

Controlled incineration is common in Europe and Japan. Clean air laws prohibit the incineration of most waste in the North America. Medical waste, however, must be incinerated (or autoclaved) in North America.

In many low-income regions of the world, waste is burned in the open air. Open-air burning of chlorine-containing materials such as polyvinyl chloride (PVC) produces dioxins and furans, which are highly toxic.

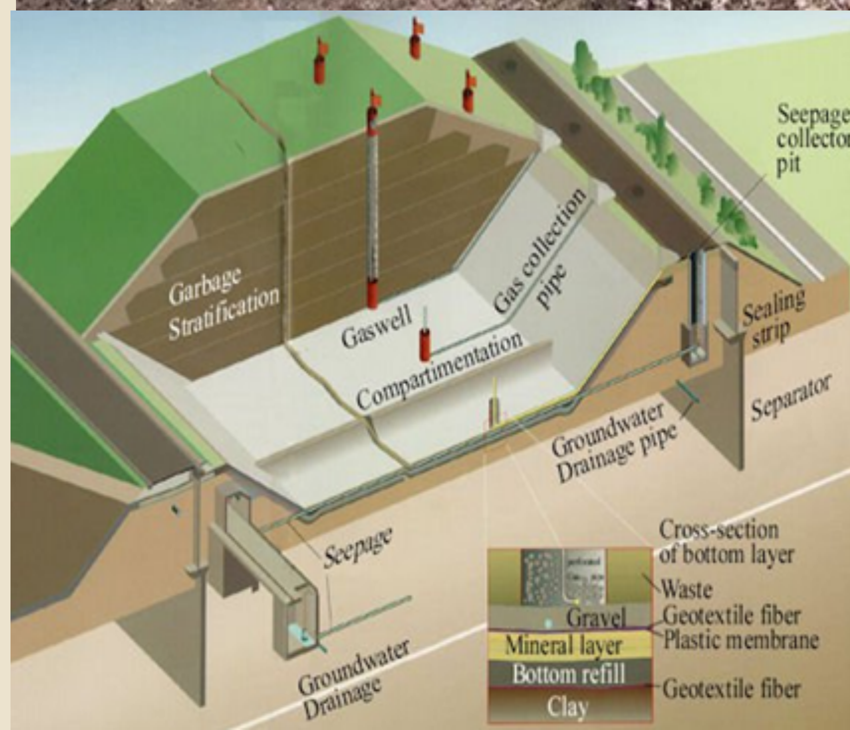
For products that will be burned in the open air, designers should avoid using materials, (such as PVC) that produce toxic emissions in uncontrolled burning.

Open-air burning

Waste land-filling

Most products in North America are disposed of by land-filling.

Legally designed landfills are constructed with impervious layers that contain liquids. Percolated liquids which often contain many toxic constituents are pumped out for the first thirty years. Thereafter the site is less chemically active because the biodegradation processes of the waste have largely been completed.



Waste land-filling

In low-income parts of the world, waste is often placed in uncontrolled piles and open pits. This consumes space that could be used as natural habitat, and presents serious risk of toxic chemical emission to water and soil.

Despite the physicality of solid waste, the toxic substances that they might emit and the volume of space that they consume, most environmentalists do not consider properly constructed landfills to be as important as other problems such as global warming and habitat loss.

Composting

A product or a component may be composed of a bio-degradable or compostable material. Composting coverts biotic materials (like paper or wood) into simpler organic substances that can be re-used by soil organisms and plants.

Materials can be composted at a backyard scale or a larger municipal or industrial scale. Although a material may have the capacity to decompose, if it does not reside in conditions between 40˚F - 150˚F and between 20% - 100% humidity, the compost process will not occur.

Toxic substances, especially toxic metals, should be avoided above a few parts per million in materials intended for composting. Claims about compostable plastics should be treated with skepticism. Processing plant fibers to have 'plastic' qualities can chemically convert them into materials that are not compostable.

Material recycling

Material recycling eliminates the impacts associated with the extraction and production of the original material. However, it still creates impacts in the transporting, separating, ~~and~~ cleaning, and reprocessing the material to manufacture a new product system. In most cases the net environmental impacts of recycled materials are lower than those of virgin materials.

Definitions:

Material Recycling

Recycling is the process of collecting one type of material from one product, cleaning and reprocessing it into a new product.

Material downcycling

Downcycling is the process of material recycling whereby the physical and mechanical properties of the recycled material are lower than the original material.

Some downcyling occurs due to structural loss during reprocessing, such as with paper. Exposure to harsh chemicals or UV light can also cause downcycling. It can also result from mixed or poorly sorted materials, or a material that has been contaminated, coated or contains fillers.

Material upcycling

Upcycling is the process of material recycling whereby the physical and mechanical properties of the recycled material are higher than the original material.

Materials can be upcycled only with the addition of other materials (such as other metals in a metal alloy).

Upcycling is NOT defined as having higher economic value than the original material.

Electronic product recycling

In the recycling process, hazardous components (containing lead, mercury, bismuth, beryllium, nickel, arsenic and cadmium) will be removed manually.

External housings may be manually removed, depending on the size of housings and ease of manual removal.

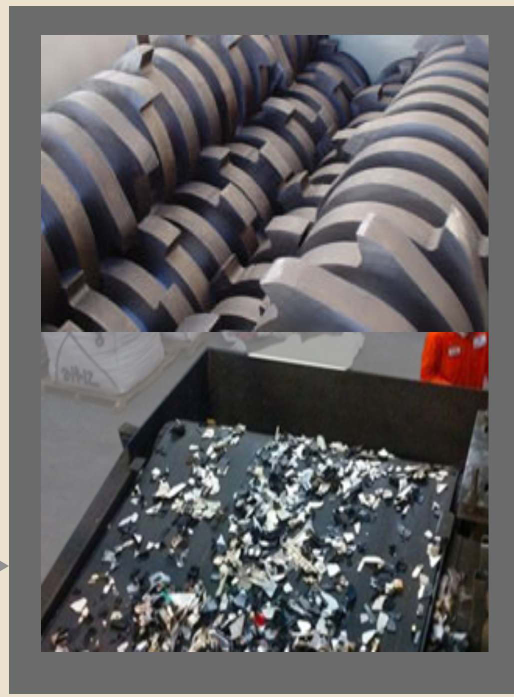
Alternately the entire item without hazardous components may be shredded.

Shredding of materials from electronic products

Shredded pieces can be sorted into specific material streams, often by automated material sorting machines. Shredded plastic from multiple plastic types is difficult to sort. It is often treated as waste that is land-filled or made into low-value mixed plastic products.

First remove circuits and large mono-material (one type of plastic or metal) pieces

Post-disassembly remainder



Shredding and automated sorting

Pure thermoplastic

Plastic for new part

Pure aluminum or steel

Metal for new part

Mixed plastic

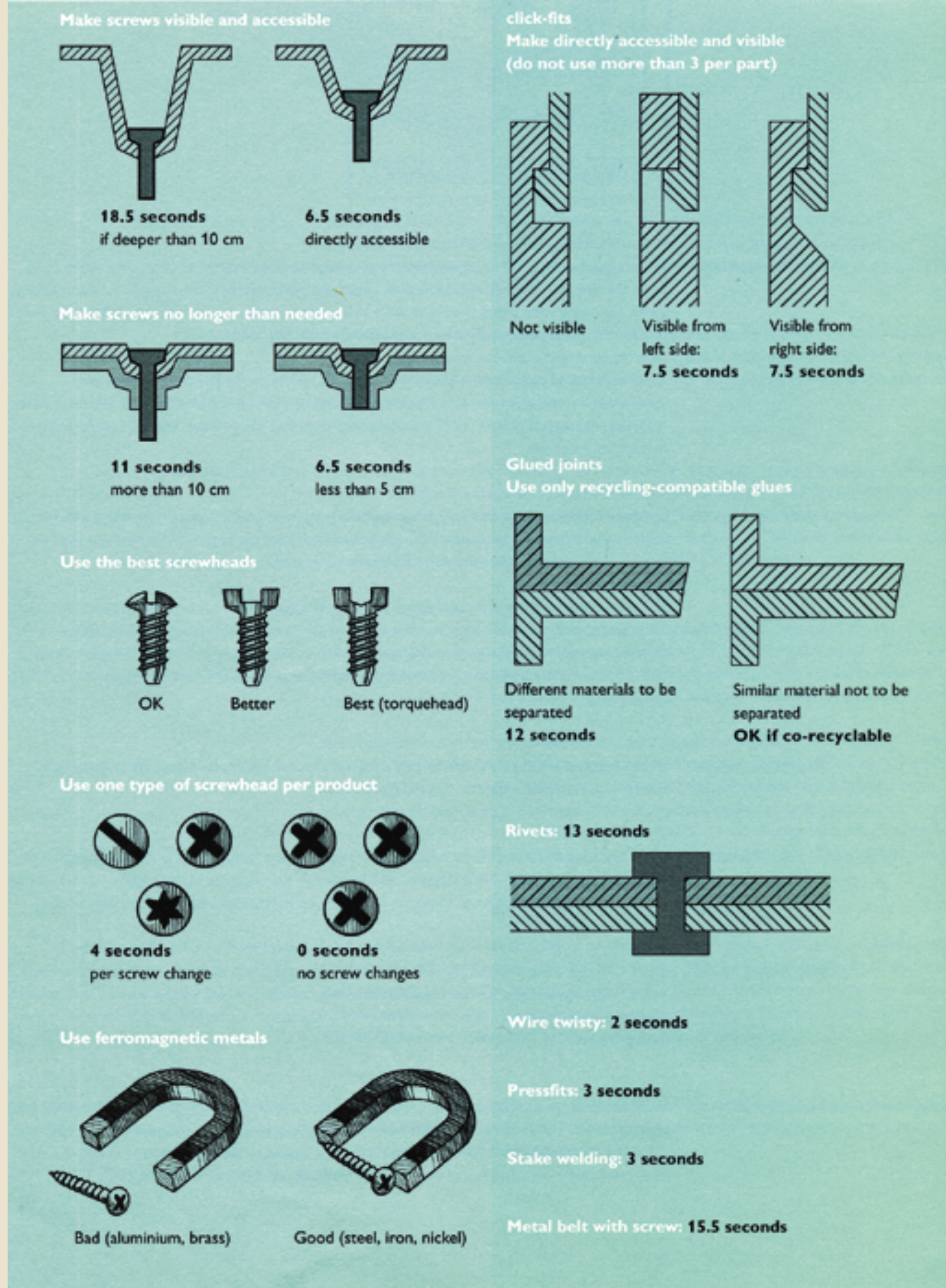
Down-graded application or landfill

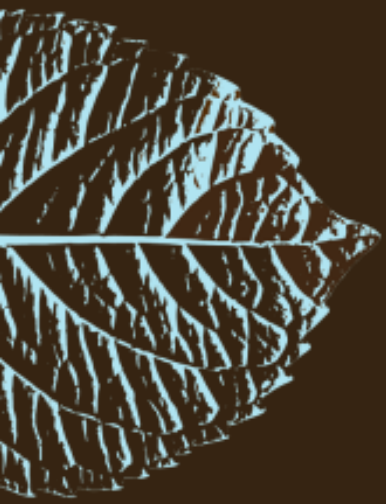
Design for Disassembly & Recycling Guidelines

Reference pages 19-20 in *Okala Practitioner.*

Connections that will be manually disassembled should be designed to take a minimum of time to separate.

What questions do you have about these guidelines?





Okala Practitioner

Integrating Ecological Design

This presentation is part of an educational presentation series that supports teaching from the *Okala Practitioner* guide.

Okala Practitioner and these presentations were created by the Okala Team to disseminate fact-based knowledge about ecological design to the design disciplines and business.

Unless provided in the presentations, Information sources are found in the *Okala Practitione*r guide.

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The Okala Team initiated the collaboration with the US EPA and the Industrial Designers Society of America (IDSA) in 2003. The team developed Okala Practitioner with support from Autodesk, IBM, Eastman Chemical and the IDSA Ecodesign Section.

Okala Practitioner is available through amazon.com.

More information and the free Okala Ecodesign Strategy App are found at Okala.net.