

4.10 Using Resources

Humans use the Earth's resources to provide warmth, shelter, food and transport.

Natural resources, supplemented by agriculture, provide food, timber, clothing and fuels.
Finite resources from the Earth, oceans and atmosphere are processed to provide energy and materials.

Chemistry plays an important role in improving agricultural and industrial processes to provide new products and in sustainable development, which is development that **meets the needs of current generations** without compromising the **ability of future generations** to meet their own needs.

Water

Water of the correct quality is essential for life. For humans, drinking water should have sufficiently low levels of dissolved salts and microbes

The methods used to produce potable water depend on available supplies of water and local conditions.

Water that is safe to drink is called **potable water**. Potable water is not **pure water** in the chemical sense because it contains **dissolved solid** substances.
Pure water would contain no dissolved solids.

Turning fresh water into drinking water

In the UK, rain provides water with low levels of dissolved substances (fresh water) that collects in the ground and in lakes and rivers and most potable water is produced by:

- choosing an appropriate source of fresh water
- passing the water through **filter beds** to remove any **solids**
- **sterilising** to kill **microbes**.

Sterilising agents

Sterilising agents used for potable water include **chlorine, ozone or ultra-violet light**.

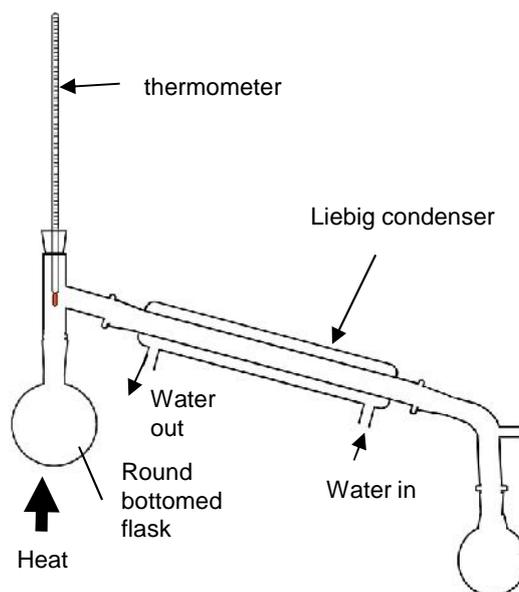
- *Chlorine is a toxic gas so the amount added to water has to be carefully monitored.*
- *Using ultraviolet light to kill microbes avoids adding chemicals to the water but is more expensive.*

Turning sea water into drinking water

If supplies of fresh water are limited, desalination of salty water or sea water may be required. Desalination can be done by **distillation** or by processes that use membranes such as **reverse osmosis**. These processes require large amounts of energy.

Reverse Osmosis

Sea water is passed through a membrane that only allows through the water molecules. It needs high pressure to push the water through the membrane. The high pressure requires a lot of energy to produce.



Distillation has high energy costs because it requires heat to boil the water

Waste Water treatment

- Urban lifestyles and industrial processes produce large amounts of waste water that require treatment before being released into the environment.
- **Sewage and agricultural waste** water require removal of **organic matter** and **harmful microbes**.
- **Industrial waste** water may require removal of **organic matter** and **harmful chemicals**.

Sewage treatment includes:

- screening and grit removal
- sedimentation to produce sewage sludge and effluent
- anaerobic digestion of sewage sludge
- aerobic biological treatment of effluent

Extracting Copper

The Earth's resources of metal ores are limited. Copper ores are becoming scarce

New ways of extracting copper from low-grade ores include **phytomining**, and **bioleaching** can be used.

Phytomining uses plants to absorb metal compounds from the soil. The plants are harvested and then burned to produce ash that contains the metal compounds.

Bioleaching uses bacteria to produce leachate solutions that contain metal compounds.

The metal compounds formed in phytomining and bioleaching can be processed to obtain the metal. For example, copper can be obtained from solutions of copper compounds by displacement using scrap iron or by electrolysis

Equation for Displacement reaction using scrap iron: $\text{Fe} + \text{CuSO}_4 \rightarrow \text{Cu} + \text{FeSO}_4$

Advantages of these methods

- need less energy than traditional methods
- can extract from low grade/ concentration ores
- mining not required
- avoid the disadvantages of traditional mining methods of digging, moving and disposing of large amounts of rock.

Disadvantages of these methods

Reactions slow to carry out.
Will produce small amounts of metal

Life Cycle Assessments (LCAs)

Life Cycle Assessments (LCAs) are carried out to assess the environmental impact of products in each of these stages:

- extracting and processing raw materials
- manufacturing and packaging
- use and operation during its lifetime
- disposal at the end of its useful life, including transport and distribution at each stage.

Energy, water, resource consumption and production of some wastes can be fairly easily quantified.

Allocating numerical values to pollutant effects is less straightforward and requires value judgements, so LCA is not a purely objective process.

Selective or abbreviated LCAs can be devised to evaluate a product but these can be misused to reach pre-determined conclusions, e.g. in support of claims for advertising purposes

Ways of reducing the use of resources

The reduction in use, reuse and recycling of materials by end users reduces the use of limited resources, energy consumption, waste and environmental impacts.

Metals, glass, building materials, clay ceramics and most plastics are produced from limited raw materials. Much of the energy used in the processes comes from limited resources. Obtaining raw materials from the Earth by quarrying and mining causes environmental impacts.

Questions on LCAs will generally involve using data given in a table. Use the data given and combine with your knowledge about areas like pollution and waste

Reusing or recycling?

Some products, such as glass bottles, can be reused.

Other products cannot be reused and so are recycled for a different use. Glass bottles can be crushed and melted to make different glass products.

Metals can be recycled by melting and recasting or reforming into different products.

The amount of separation required for recycling depends on the material and the properties required of the final product. For example, some scrap steel can be added to iron from a blast furnace to reduce the amount of iron that needs to be extracted from iron ore.

Advantages of recycling:

- less acid rain (pollution)
- metal ore reserves last longer / conserved
- energy for extraction saved
- less mining / quarrying
- less waste
- less landfill
- creates local employment

Disadvantages of recycling

- collection problems
- transport problems/ cost of transport
- difficult to separate metal from appliances/sort