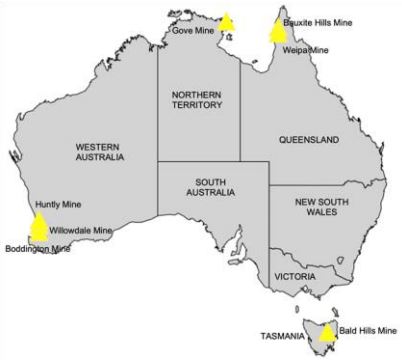
AUSTRALIAN EARTH SCIENCE EDUCATION

Sustainability of Aluminium Recycling Student Worksheet

Aluminium is a low density, non-toxic metal that resists corrosion and has high thermal conductivity. It is not particularly strong, so aluminium is alloyed with other metals for strength. Aluminium is used for many purposes including electrical transmission lines, construction, packaging, transportation, and reflective coatings.

Aluminium is the most abundant metal in Earth's crust and is found in silicate minerals such as bauxite and cryolite. Australia is the world's largest producer of bauxite and has the second largest reserves.



Bauxite mines in Australia
(HiStrawberryJam 2020, Creative Commons)

Energy needed to produce and recycle aluminium

Aluminium metal is extracted from bauxite using electrolysis – a process that demands large amounts of electricity and was responsible for 3% of global CO_2 production in 2009. The energy embodied in aluminium is 211.5 GJ/t*. This is nearly ten times as much energy as steel (22.7 GJ/t).

Aluminium is recycled by burning off any coatings and then melting. Recycling requires 17.5 GJ/t of energy. This is more energy intensive than steel recycling (9.7 GJ/t), but much less than producing metal from ore.

*GJ/t = Gigajoules (billion joules) per tonne

Aluminium cans ready for recycling (K Tucceri 2014, public domain)

Environmental impact of disposal and recycling

Aluminium is inert and does not decompose, so it does not contaminate the environment if disposed of in landfill. The environmental impact of recycling depends upon the source of energy used in the process (e.g., coal-fired versus solar power). Australian commercial and industrial waste streams sent 21 000 tonnes of aluminium to landfill and recycled 90 000 tonnes in the 2010-11 financial year.

The NSW Return and Earn drink container recycling scheme, which includes aluminium cans, reduced drink container litter by 40% between 2017 and 2020. More recent figures suggest that 3 out of 4 drink containers are recycled, which would include aluminium cans.

The International Aluminium Institute estimates that post-consumer recycling saves over 90 Mt of CO_2 and 100 000 GWh of electricity (= yearly power consumption of the Netherlands). It is estimated that 75% of the billion tonnes of aluminium ever extracted is still in productive use.

AUSTRALIAN EARTH SCIENCE EDUCATION

Sustainability of Aluminium Recycling
Student Worksheet

Facilities in New South Wales

Aluminium cans can be recycled at many Return and Earn locations across NSW. Cans and other aluminium products (such as foil) can also be recycled in household recycling bins provided by local councils. Scrap metal dealers collect aluminium (and other metals) from household appliances, construction and other sources. The metal is then sold to recyclers, most of which are located overseas.

Workers collect aluminium for recycling
(M Wolfe 2004, public domain)

Demand for recycled aluminium

Recycled plastic and paper are of a lesser quality than new materials. This is not the case for metals, so aluminium can be continually recycled without losing any quality. As consumers become more concerned about the source of materials, the demand for recycled aluminium is increasing. In 2019, Apple announced that its new iPads and watches would feature 100% recycled aluminium. Drink manufacturers are offering more beverages in aluminium rather than plastic containers. Thus, the demand for recycled aluminium is high and shows no sign of decreasing.

Questions

1. How much energy is saved by recycling aluminium rather than extracting it from bauxite?

2. Aside from energy savings, outline other advantages to aluminium recycling versus mining.

3. Evaluate the environmental impact of aluminium recycling using data and examples.

4. Outline the local options for people wishing to recycle aluminium waste.

_____

_____

_____

5. Is there likely to be a demand for recycled aluminium in the future? Justify your answer with examples of products and/or uses. _____

_____

_____

_____

References:

Department of Sustainability, Environment, Water, Population and Communities (2012). A study into commercial and industrial (C&I) waste and recycling in Australia by industry division. https://www.environment.gov.au/system/files/resources/91b2180c-b805-44c5-adf7-adbf27a2847e/files/commercial-industrial-waste.pdf

International Aluminium Institute (2018). Sustainability. https://recycling.world-aluminium.org/review/sustainability/

Rankin J (2012). Energy use in metal production. *High Temperature Processing Symposium*: 7-9 https://publications.csiro.au/rpr/download?pid=csiro:EP12183&dsid=DS3

Return and Earn (2020). 4.5 billion containers recycled through Return and Earn. https://returnandearn.org.au/exc_news/4-5-billion-containers-recycled-through-return-and-earn/

Royal Society of Chemistry (n.d.). Aluminium. https://www.rsc.org/periodic-table/element/13/aluminium