Extracting and Recycling - KS4

Lesson Plan

Overview	Pupils will be able to discuss how aluminium is extracted from the earth. They will compare this process with the recycling of aluminium and the impact each of these processes has on the environment.
Age Group	KS4
Subject	Science
Learning Objectives	• **Some:** I know and can confidently name all the processes involved in the extraction of aluminium and recycling aluminium. • **Most:** I can describe the processes involved in extracting aluminium from the earth and how aluminium is recycled. • **All:** I know aluminium is extracted from the ground. I understand that aluminium can be recycled.
National Curriculum	**Chemistry** **Chemical and allied industries** • Life cycle assessment and recycling to assess environmental impacts associated with all the stages of a product's life. • The viability of recycling of certain materials.
Resources	'Making aluminium' PowerPoint Aluminium can recycling video Environmental mangers audio clip

Lesson structure	**Introduction** Open the 'Making aluminium' PowerPoint. Work through the PowerPoint discussing each slide. Encourage pupils to make notes. Stop at slide 5. Add more information to this slide. Describe in more detail where the aluminium comes from and how it is extracted from the earth. Continue with PowerPoint slide. As a class, watch aluminium can recycling video and listen to the environmental mangers audio clip. **Task** Divide class into two groups. Using the ThinkCans website as a key resource, groups will create presentations about recycling aluminium and the extraction of aluminium from the earth. Group 1 will create a presentation to show the stages involved in extracting aluminium from the ground and changing into a usable material. Group 2 will create a presentation to show the stages involved in the recycling of aluminium. Pupils can work in pairs or small groups. Their presentations will take the form of a poster. Pupils should ensure detailed explanations and labels follow all images/diagrams used and that technical and scientific language is used whenever possible. **Plenary** Select pupils from each group to share their presentations.

Teacher Information

Recycling

No other material offers the versatility and environmental benefits of aluminium.

Aluminium is infinitely recyclable making it the material of choice for balancing the demand of a growing economy with the need to preserve the environment.

Since the first industrial production of aluminum in the 1880s, 75% of all material produced is still in use today.

Aluminium recycling provides significant energy savings in multiple sectors:

- Recycling aluminum requires 95% less energy, and produces 95% fewer greenhouse gas emissions (GHG) than manufacturing primary aluminum. That is a GHG saving equivalent to taking 900,000 cars off the road for 12 months.
- Today, the global aluminium recycling industry prevents close to 170 million tonnes of GHG from entering the environment every year.
- Recycling 1 tonne of aluminium avoids the emission of about 9 tonnes of CO2 emissions – just 1 tonne of CO2 is equivalent to driving nearly 3,000 miles.
- Recycling aluminium reduces the use of natural resources and chemicals (caustic soda, aluminum fluoride and lime) and eliminates the need for bauxite ore to be mined.

The aluminium beverage can is the world's most recycled packaging container.

Eight billion aluminium beverage cans are sold in the UK every year, and each one could be recycled over and over again, saving energy, raw materials and waste.

A used aluminium beverage can be recycled, reprocessed, remade and ready for re-sale in around 60 days.

In a whole year, that one can could be recycled eight times, saving enough energy to make 160 new cans.

Making one aluminium beverage can from raw materials uses the same amount of energy that it takes to recycle 20. And if you want to put this into an everyday context – recycling just one aluminium beverage can saves enough energy to power a television for three hours.

The future

Globally, close to 70% of all aluminium beverage cans are recycled, making it the world's most recycled packaging product. Because aluminium is infinitely recyclable, it can be reused in applications vastly different from its previous purpose, and it can also be recast into its original form.

These properties make aluminium an ideal material for use in premium applications, even after being recycled many times. For example, a 50-year-old building facade can be recycled into the aluminum needed for the engine block of a new car with no degradation in quality.

Nearly 90% of the beverage cans sold in the UK are made of aluminium and the current recycling rate (2015) for beverage cans stands at 69% so there's still plenty out there to collect and recycle.

Extraction

Aluminium is the most abundant (found in large quantities) metal on Earth. However, the way that it is extracted from the earth, using lots of electricity, makes it expensive to do so.

Aluminium is found in an ore called bauxite. When it is purified, bauxite yields a white powder – aluminium oxide – that aluminium can be extracted from.

To extract it, electrolysis is used. The aluminium oxide must first be melted to enable electricity to pass through.

Simply melting the aluminium oxide would be very expensive, as it has a melting point of over 2000°C. To get around this the powder is first dissolved in molten cryolite, which is an aluminium compound with a lower melting point. The use of cryolite reduces some of the energy costs involved in extracting aluminium.

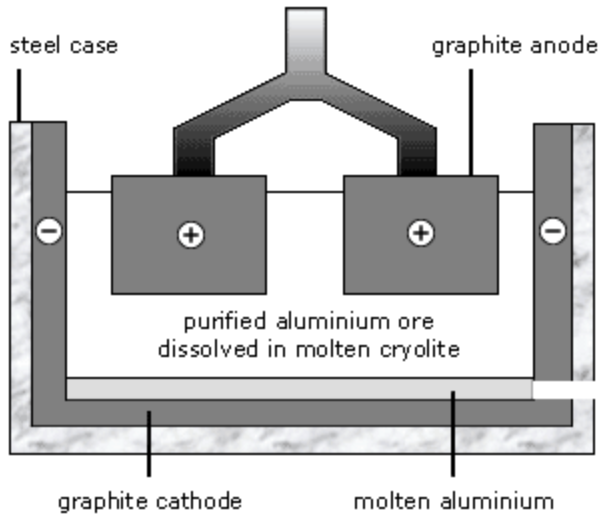

Diagram showing cell for aluminium extraction

The diagram above shows an aluminium oxide electrolysis tank. Both the negative electrode (cathode) and positive electrode (anode) are made of graphite, a form of carbon.

Aluminium metal forms at the negative electrode and sinks to the bottom of the tank, where it is tapped off.

Oxygen forms at the positive electrodes. This oxygen reacts with the carbon of the positive electrodes, forming carbon dioxide, and they gradually burn away.

This means that the positive electrodes have to be replaced frequently, adding to the cost of the process.