QER for Schools

QER Science Lesson – Year 10

Chemistry of extracting oil from oil shale

NOTES

Hydrocarbons have been recovered from shale containing an organic material called kerogen for at least 600 years. In northwest Colorado, Ute Indian legends told of warriors who saw lightning ignite certain rock formations, causing them to burn. Cowboys and rangers burned the dark rock in their fires like coal. It's said that a Parachute area rancher and frontiersman named Mike Callihan discovered the phenomenon in spectacular style. Unknowingly building his fireplace of oil shale, upon lighting his first fire he experienced the ultimate in housewarmings, with both fireplace and cabin going up in flames!

From such experiences came the knowledge of this unlikely oil source. With a rising demand for fuel today, perhaps we are yet to see the most spectacular performance of the rock that burns? QER's New Fuels Development Centre and oil shale mine at Yarwun near Gladstone has been created to demonstrate just what this astonishing rock might do for Australia's energy future. In this lesson, you'll discover how.

In this lesson, students will:

- identify physical changes and chemical reactions in the process of extracting oil from oil shale
- articulate the role of heat and catalysts in increasing the rate of chemical reactions

LESSON-LEVEL CONTENT DESCRIPTIONS

The Australian Curriculum: Year 10

Science Understanding

Chemical sciences: Different types of chemical reactions are used to produce a range of products and can occur at different rates (ACSSU187).

Elaborations:

- investigating how chemistry can be used to produce a range of useful substances such as fuels, metals and pharmaceuticals
- investigating the effect of a range of factors, such as temperature and catalysts, on the rate of chemical reactions

Year 10 achievement standard

By the end of year 10 students develop questions and hypotheses and independently design and carry out appropriate methods of investigation. Students use knowledge of chemical change to predict the products of chemical reactions They explain and predict how change, including that caused by human activity, affects the sustainability of systems at a local and global level. They describe factors that have guided scientific developments, predict how future applications of science and technology may affect people's lives, and evaluate information from a scientific perspective.

LESSON OUTCOMES

The assessment focus of this lesson is formative: The classroom activities provide an opportunity for students to generate evidence with which the teacher can establish the student's progress towards understanding the concepts that are being developed in this lesson.

Science Outcomes	Literacy Outcomes	Numeracy Outcomes
Students may/should be able to:		
• distinguish between physical changes and chemical reactions • articulate the effect of temperature and catalysts on reaction rate	• listen • read • view • write • speak • create print materials • discuss scientific phenomena • document scientific phenomena • use technical terms in a scientific context	• collect qualitative data

BACKGROUND INFORMATION

The process of extracting oil from oil shale is complex, so this lesson presents the option of two short video snippets or a more involved video presentation. View both and determine which is best suited to the understanding of your class.

PREPARATION LIST

- QER 3D animation video
- two short videos from the QER web site, www.qervisitorcentre.com.au –> QER and sustainability ––> Resource and development –> The Paraho II technology and The Paraho II retort

ACTIVITY SEQUENCE

1. Introduce the lesson by reading the introduction to the rock that burns from the beginning of this lesson plan.

2. Introduce to students that the will be compiling a list of the changes that take place in the shale and the extracted oil at each stage in the process.

3. View the full 3D animation video OR the two short videos from the QER web site, www.qervisitorcentre.com.au –> QER and sustainability –> Resource and development –> The Paraho II technology and The Paraho II retort. As they watch, students should write a list of the changes that take place in the shale and the extracted oil at each stage in the process.

4. Divide students into groups of 3-4. Have each group compile a group list of the changes that take place in the shale and the extracted oil at each stage in the process.

5. Classify each of the changes that you have written down as either a "physical change" or a "chemical reaction." For instance, heating the shale is simply a physical change to release moisture and other gases. Chemical reactions occur when the organic matter in the shale ('kerogen') is broken down into hydrogen and hydrocarbon compounds in the retort.

6. As a class, discuss the various means of increasing the rate of chemical reactions, including heating and introducing a catalyst.

7. Have students identify examples of chemical reactions in the oil shale extraction process which use heat or a catalyst to increase the reaction rate.

NOTES

OPPORTUNITIES FOR CONDUCTING FORMATIVE ASSESSMENT

- Observations from students' verbal responses, group participation and written answers to questions

LINKS TO OTHER LEARNING AREAS

The following suggested activities may be used to provide a link between the content of this unit and that of other learning areas, in particular those related to Mathematics, English and ICT.

- this lesson could lead into a practical experiment in which rates of reaction are measured at different temperatures and with and without catalysts, with a mathematical consideration of rates of change

ADDITIONAL RESOURCES

- www.qervisitorcentre.com.au – Extensive overview of QER New Fuels Development Centre, including video snippets, animations, graphs, maps and explanations relating to:
  - Australia's fuel challenge
  - QER and sustainability
  - benefits for Australians
  - turning oil shale into fuel
- Oil Shale fact sheet www.oresomeresources.com/resources_view/resource/fact_sheet_oil_shale

NOTES