

Simulation of CO₂ injection into a sedimentary reservoir

This experiment attempts to simulate gas being pumped into a sedimentary rock reservoir displacing the water or oil present in the pores of the rock.

Introduction

A sedimentary rock is composed of a grain framework and pores. The pores of the rock in a subsurface reservoir may be filled with water, oil or gas. In storing carbon dioxide or natural gas in a subsurface reservoir, the carbon dioxide or natural gas displaces the oil or water from the pores.

Equipment and Requirements

- 1 large 'Buchner' flask (which is a strengthened conical flask with a side arm socket)
- 1 rubber stopper to fit the flask mouth, with a hole bored through it
- 1 plastic or glass tube long enough to reach the bottom of the flask, and pass through the rubber stopper, and still stick out the top of the stopper. We used a glass tube to pass through the stopper and joined on a plastic tube to penetrate down into the flask.
- 2 pieces of plastic hose
- 1 bike pump with valve
- 1 small measuring jug (500ml)
- coarse sand, enough to fill the flask
- water
- tissues

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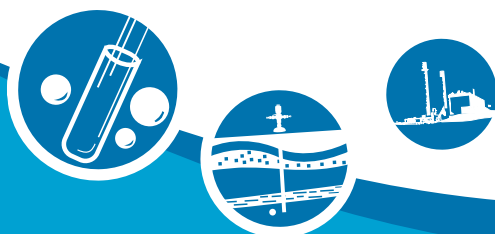




Figure 1. large 'Buchner' flask (2Litre)

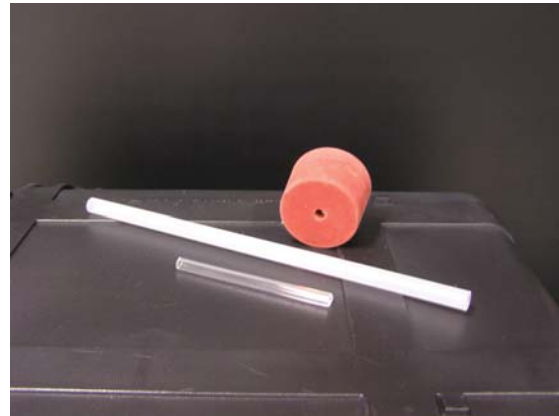


Figure 2. rubber stopper (with a hole bored through) to fit flask mouth, glass tube to pass through the hole in the stopper and a plastic tube long enough to reach the bottom of the flask.



Figure 3. stopper and tubes assembled ready to install into the flask



Figure 4. example of stopper and tubes installed in flask

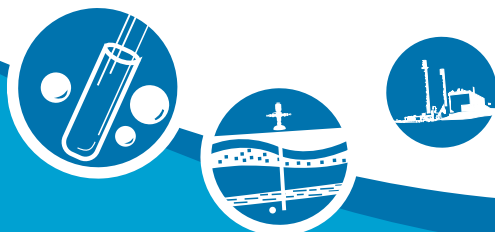




Figure 5. coarse grain sand



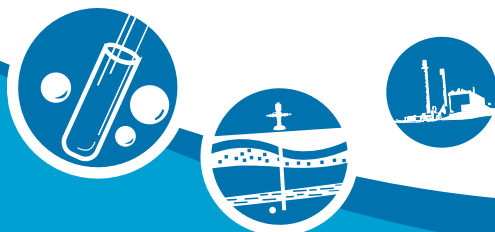
Figure 6. bike pump and valve, plastic tubes

Procedure

- 1 Select several small pebbles and poke them into the side arm of the flask from the inside. This will prevent the sand washing out of the side arm.



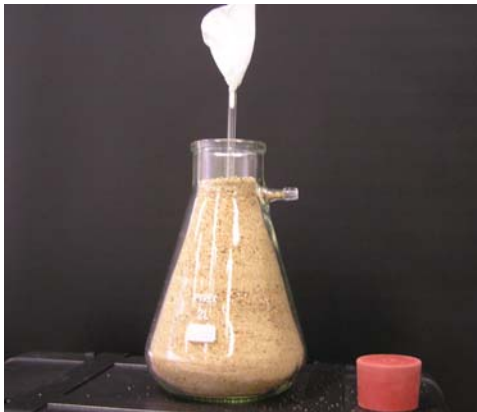
- 2 Place the plastic tube into the centre of the flask reaching all the way to the bottom. This tube will be used simulate a drilled bore hole (well).



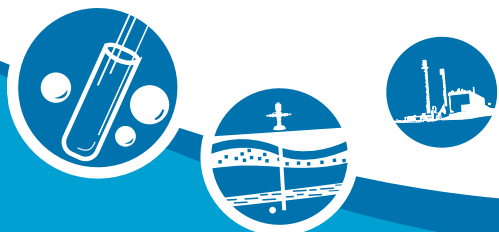
- 3 Plug the top of the tube with a paper tissue, to stop any sand filling up the tube.



- 4 Fill the flask with sand, while supporting the tube to keep it centred in the flask. Connect the glass tube into the top of the plastic tube and plug the top with a tissue.



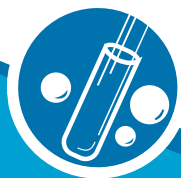
- 5 Remove the tissue from the tube.



- 6 Push the rubber stopper onto the top section of the tube.



- 7 Adjust the sand level in the flask to allow enough room at the top of the flask, for the stopper to be pressed into place. Test the stopper to see if it seals properly, but don't seal it firmly yet. You can use a few pebbles as weights to keep the sand packed down if you choose.



- 8 Attach a plastic hose to the side arm of the flask, place the measuring jug under the hose outlet.



- 9 Slowly add water to the sand filled flask, all the way up to the side arm. The water permeates down through the sand and the water level in the flask rises and reaches the side arm. The pebbles in the side arm will stop the sand escaping, but some water may flow out. Catch any overflow with the measuring jug.



- 10 Now slide the stopper down into the flask mouth to create a firm seal. Attach a plastic hose to the tube, above the stopper.



- 11 Connect the bike pump to the top hose. Empty any collected overflow water from the measuring jug then replace the jug under the plastic hose again.
- 12 Pump air into the tube, very slowly, using the bike pump.
- 13 Collect and measure the displaced water, with the measuring jug.



The experiment can easily be repeated multiple times. The stopper can be removed, the flask re-filled with water, and the volume of displaced water collected and measured.

