Oxygen in the laboratory

Oxygen is one of a small number of gases that is commonly used in schools and thus needs a more regular supply than might otherwise be the case. In this article, we look at some different methods of obtaining oxygen for use in the laboratory.

1. Cylinder/canister

This is the traditional method whereby you have a (usually large and heavy) cylinder of the compressed gas, (see Fig 1) often containing around 2,000 litres of gas, though there are smaller cylinders available. The cylinder is fitted with a regulator that allows the controlled release as required.

There is much to be said for the convenience of this method but there are some disadvantages: the cylinders are heavy and unwieldy and proper procedures need to be followed for safe storage and use[1]. The cylinders are leased rather than bought, though that is probably an advantage, the gas is refilled as required and the regulators need to be replaced every 5 years at a cost of around £80. For a 2,000 litre cylinder, BOC currently quotes rental of ~£30 per month and a refill charge of ~£15.

A variation on this is to use smaller, disposable canisters. These are commonly available for hydrogen but harder to track down for oxygen. The gas is pressurised rather than liquified and they hold 110 litres. The canisters cost ~£120 and usually come with a small but perfectly usable valve. Once empty, they are simply disposed of and replaced. While the cost per litre of gas is significantly higher there are none of the rental costs so this should work out cheaper unless you have very high usage. Our rough calculations suggest canisters become more expensive if you are using more than 5 litres of oxygen per week, every week. This seems unlikely in a school context.

Figure 1: Oxygen Cylinder

2. Chemical generation

Oxygen can easily be generated using manganese dioxide to catalyse the decomposition of hydrogen peroxide. If you prepare your own 5 vol peroxide from 100 vol and can recover the manganese dioxide (straightforward if you use the granular form) then the cost in materials at least is vastly cheaper. However, it is significantly more time consuming and technician time is limited.

An alternative chemical method is to prepare gases in syringes on a microscale. The method is detailed in Bulletin 263[2].

[1] https://www.sserc.org.uk/health-safety/chemistry-health-safety/hazchem_database-2/gas-cylinders-2/
[2] https://sserc2.wpenginepowered.com/wp-content/uploads/Publications/Bulletins/263/SSERC-bulletin-263p8_9.pdf

3. Oxygen Concentrator

We have recently in SSERC been looking at these devices that are widely available on the market for domestic, clinical oxygen supply. They are electrically powered devices that produce a steady supply of oxygen from the air, using molecular sieves to remove the nitrogen. (See Fig 2)

The highest concentration available is 90% oxygen. Not suitable if you need 100% pure oxygen but we are not sure we can think of a situation where that would be essential. Once switched on, it will produce around 1 litre per minute indefinitely.

The devices cost £200 – £300 but other than the cost of electricity (not negligible these days) there is no other running cost so you will soon recoup your investment.

Figure 2: Oxygen Concentrator