

TUNNELWORKS

A2 CHEMISTRY

STUDENT SHEET 1

Oxygen detectives – Winkler Test

Winkler Test kits allow dissolved oxygen to be sampled at the river's edge. Your task is to find out which of a range of Winkler Test kits is most accurate. Each kit has been used on the same water sample, which has also been tested using an electrode-based testing system in a laboratory. This benchmark result gives a dissolved oxygen level of $7.8 \text{ O}_2\text{l}^{-1}$. That's a good result showing high levels of dissolved oxygen.

The Winkler test kits should give a dissolved oxygen level to within $0.1 \text{ mg O}_2\text{l}^{-1}$ of the electrodebased laboratory test.

Which kits are suitably accurate?

Kit	Sample volume	Sodium thiosulphate concentration (M)	Titration volume (ml)
A	300	0.025	11.7
B	250	0.05	4.8
C	400	0.025	15.6
D	300	0.04	7.6
E	150	0.1	1.5

1. Calculate the dissolved oxygen level in mg O_2 per litre indicated by each titration.
2. Calculate the titration's variance from the electrode-based result.
3. Identify which kit(s) are suitably reliable.

How will the Thames Tideway Tunnel help dissolved oxygen levels in the River Thames?

London's Victorian sewerage system was designed to overflow into the River Thames. In an average year 39 million tonnes of untreated sewage combined with rainwater overflows into the River Thames each year.

The Thames Tideway Tunnel project will address these sewage overflows, either by directly connecting them to the tunnel, or by making other alterations to the sewerage system, which will make more effective use of the existing capacity. The flows diverted into the tunnel will be stored and pumped out for treatment at Beckton Sewage Treatment Works.

Dissolved oxygen is one of the most important indicators of river health. When untreated sewage enters a river the high nutrient levels in the sewage can cause rapid increases in aerobic bacteria that feed on the sewage. These bacteria use up dissolved oxygen as they multiply. This biological oxygen demand (BOD) can reduce the level of dissolved oxygen in the river to a point that may cause harm to fish, other wildlife and ecosystems.

Computer modelling shows that the Tidal Thames (which covers a region from Teddington Lock out into the Thames Estuary) currently fails the four dissolved oxygen standards set for the Tidal Thames. This is due to the combined effect of discharges of untreated sewage from CSOs as well as continuous effluent and intermittent storm discharges from five major sewage treatment works along the Tidal Thames.

By diverting untreated sewage from CSOs away from the Tidal Thames via the Thames Tideway Tunnel, natural levels of dissolved oxygen will be maintained ensuring a healthy river ecosystem.