

Determinand:

Biochemical Oxygen Demand (BOD).

Matrix:

Sample Type: Final effluents, trade discharge, crude sewage, raw water and surface water

Principle of Method:

The BOD is defined as the mass of dissolved oxygen required by a specific volume of liquid for the process of biochemical oxidation over a 5-day period at 20°C in the dark. The result is expressed as milligrams of oxygen per litre of sample.

Allyl thiourea (ATU) may be added to suppress nitrification during the course of the test. In this case the result is referred to as BOD (ATU).

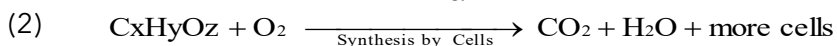
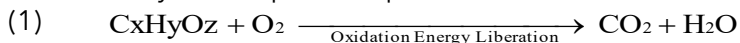
If the period of incubation is other than the standard 5 days this must be indicated by a suffix denoting the period in days e.g. BOD20.

The BOD test was originally envisaged by the Royal Commission on Sewage Disposal as a means of assessing the rate of biochemical oxidation that would occur in a stream to which a polluting effluent was discharged. However, predictions of the effects of such a discharge on a stream probably require consideration of many factors not involved in the determination of the BOD.

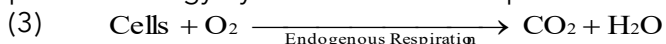
A number of substances and factors will influence the test. The activity of the micro-organisms may be inhibited by metals, free chlorine, high or low pH, cyanides, phenols, pesticides and by any other substances toxic to micro-organisms. Enhanced utilisation of oxygen may be caused by algae and nitrifying organisms.

Mechanism

Biochemical oxidation of organic matter is primarily brought about by the action of heterotrophic bacteria (bacteria which use the organic matter present to produce energy and for growth). These processes can be shown by the simplified equations:



The first phase of biochemical oxidation results in cell growth by depletion of the available organic matter. This is followed by a slower oxygen uptake known as endogenous respiration. During this the cells produce energy by self-oxidation. This process can be shown by the simplified equation:

**Sampling and Sample Preparation:**

Samples are normally received in a 1 litre PET. Samples are stored at $3 \pm 2^\circ\text{C}$ until ready for analysis.

There is no sample preservative used. Samples should be analysed as soon after receipt as possible.

Samples are stable for 2 days (EPA-600/4-79-020) from sampling.

Samples from Yorkshire Water requiring settled BOD should be pre-treated using method WWC4.

Other client samples requiring settled BOD should be pre-treated as described in section 7.3.5. Samples requiring filtered BOD should be pre-treated as described in section 7.3.6. Samples should be at 20°C prior to analysis.

Interferences

Free chlorine. Substances toxic to aerobic or to nitrifying bacteria. Ammonia and organic nitrogen compounds may enhance oxygen uptake by nitrification. Nitrification may be suppressed by specifically inhibiting the action of Nitromonas by addition of allyl thiourea. An immediate oxygen demand may be exerted by ferrous iron, sulphite, sulphide or aldehydes. Oily samples may coat the probes.

METHOD STATEMENT



Performance of Method:

Range of Application:

The range of the method is from <1.9mg/l upward
The normal reporting level is < 1.9mg/l.

Limit of Detection:

1.89mg/l as O

Recoveries of Compounds and Bias

	Final Effluent		Crude Sewage		Trade Discharge		Raw Surface	
Spike	Low	High	Low	High	Low	High	Low	High
Concentration mg/l as O	23.8	900.4	450.5	896.9	448.0	884.1	446.4	889.4
RSD %	5.52	4.73	4.40	3.98	6.20	4.20	4.56	5.78
% Recovery	99.77	99.39	102.7	100.8	95.12	98.62	99.65	98.66

	BOD Total AQC	BOD Filtered AQC
Mean	205.82mg/l O	206.45mg/l O
Precision	2.37%	2.94%
Bias	3.95%	4.27%

Uncertainty of measurement:

± 22.0%

References:

Water quality - Determination of biochemical oxygen demand after n days (BOD_n) - Part 1: Dilution and seeding method with allylthiourea addition. ISO 5815-1:2019
YSI Dissolved Oxygen Meter Operations Manual (Model 5100)
YSI BOD Probe Instruction Manual (Model 5010)
Labman Automation Biological Oxygen Demand Robot System Manual