DISSOLVED OXYGEN CONCENTRATION

CASE STUDY BUBBLE BARRIER AMSTERDAM

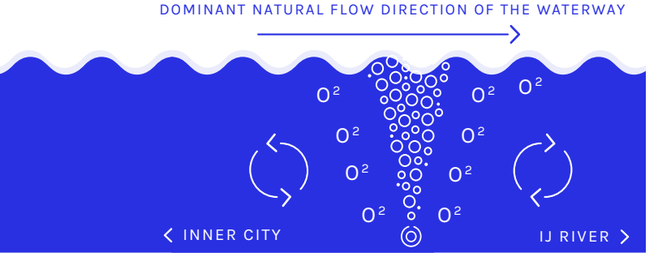


Figure 1: Hypothesis for oxygenation dynamics around Bubble Barrier Amsterdam, in Westerdok canal.[1]

Bubble Barriers do not only catch plastic waste in waterways, they also affect dissolved oxygen levels (DO) in their adjacent waters. This conclusion is based on a case study done on the effects of Bubble Barrier Amsterdam, in the Westerdok canal, on dissolved oxygen.

METHODS

In this case study, a total of 48 measurement locations were covered creating horizontal and vertical cross-sectional views in order The aim was to visualise the concentrations of dissolved oxygen (DO) in the Westerdok canal. The sampling locations shown in Figure 2 were measured under two conditions: firstly, when the Bubble Barrier was turned on; and secondly, after the Bubble Barrier had been turned off for three days.

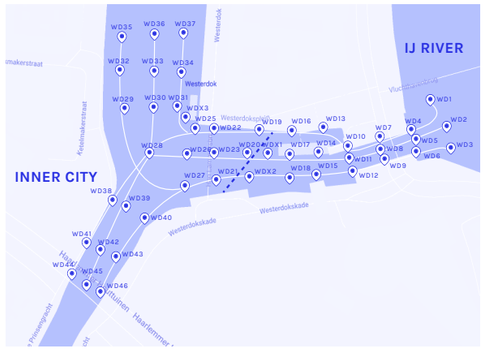


Figure 2: Visualisation of all 48 measurement locations around the Westerdok, with white lines indicating horizontal cross-sectional paths. The respective location of the Bubble Barrier is indicated by a blue dotted line.

RESULTS

When the Bubble Barrier is turned off, there is a noticeable difference in the levels of dissolved oxygen between the shallow and deep water layers at Westerdok. The deeper layers have lower oxygen levels than the shallower ones. However, when the Bubble Barrier is turned on, the whole water column in the vicinity of the bubble curtain has similar levels of dissolved oxygen at all depths. This effect spreads about 75 meters upstream and downstream of the curtain.

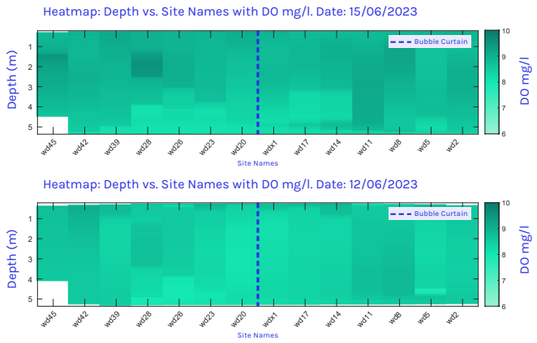


Figure 3: Bubble Barrier off (top), Bubble Barrier on (bottom). Colour coded changes of DO in mg/l over depth in m, where dark green indicates higher DO concentrations and light green lower DO concentrations. The respective location of the Bubble Barrier is indicated by a blue dotted line.

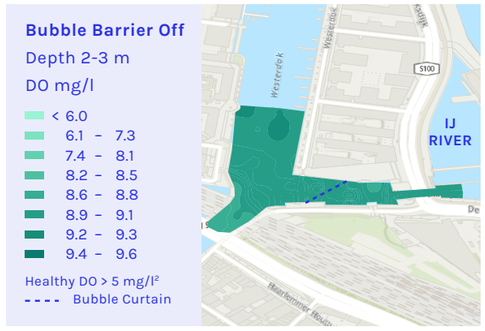


Figure 4: DO environment in Westerdok as measured on 15/6/2023 from 8:33-10:23. Light green indicates lower DO concentrations, dark green indicates higher DO concentrations. Note that the Bubble Barrier had been turned off for approximately three days.

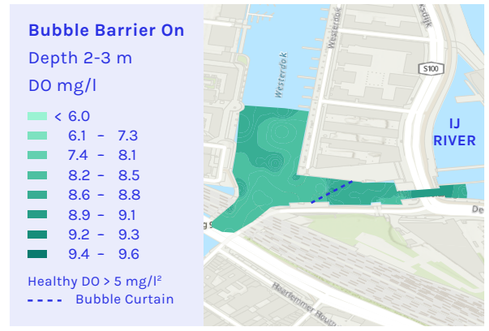


Figure 5: DO environment in Westerdok as measured on 12/6/2023 from 9:13-12:05. Light green indicates lower DO concentrations, dark green indicates higher DO concentrations. Note that the Bubble Barrier was still turned on here.

It appears that the values of dissolved oxygen (DO) were higher within the 0 to 1 meter depth surface layer on the day when the Bubble Barrier was turned off as compared to when it was turned on. However, both settings exhibit healthy DO levels far above 5.0 mg/l.

Downstream surface waters seem to be impacted by the Bubble Barrier as dissolved oxygen levels increase within a distance of around 100 metres. Overall values are slightly lower (+- 0.3mg/l) yet still within the same healthy DO range as when the curtain is off. Changes in surface DO may be due to an increased amount of phytoplankton within the surface layer which are being pushed to layers with more suitable conditions because of higher salinity values within the lower waters.

CONCLUSIONS

In general, across all graphs, a clear trend can be seen: there are healthy dissolved oxygen (DO) concentrations both during times when the Bubble Barrier is on and off. Overall, one can observe that the water around the Bubble Barrier is being mixed, which leads to similar levels of DO throughout the entire water column. Additionally, there is some increase in DO in the downstream area of the Bubble Barrier, but the effect is minimal and hyperlocal, meaning that it is only noticeable in a small area. Since DO concentrations are influenced by various environmental factors that vary over time and space, it is challenging to draw a definite conclusion based on only two measurements. Therefore, we can conclude that the Bubble Barrier merely has a mixing effect on adjacent waters.

IMPLICATIONS

Creating stable and healthy DO concentrations can improve certain environmental factors. This secondary benefit of the Bubble Barrier could contribute to solving these issues. An example is:

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Living conditions vary for different species, and the level of dissolved oxygen in an environment is one of the factors that affect this. Low DO concentrations can pose threats to local flora and fauna, particularly to species that are accustomed to small changes in DO concentration. Levels below 5.0mg/l put stress on aquatic flora and fauna. Increases in salinity specifically lead to a decrease in dissolved oxygen, making the very saline lower water layers even less liveable for species within the canal.[3]

1. Srithongouthai et al. (2006). *Control of dissolved oxygen levels of water in net pens;*
2. USEPA (2023). *Indicators: Dissolved Oxygen*
3. Kramer, D.L. (1987). *Dissolved oxygen and fish behavior.*