Dissolved oxygen (DO) is essential for the maintenance of healthy lakes and rivers. The presence of oxygen in water is a good sign. The lack of oxygen is a signal of severe pollution. Rivers range from high to very low levels of dissolved oxygen. Sometimes the level gets so low that there is little aquatic life.

Most aquatic plants and animals need oxygen to survive. Fish and some aquatic insects have gills to collect oxygen from the water. Some aquatic organisms, like pike and trout, require medium-to-high levels of dissolved oxygen to live. Other animals, like carp and catfish, flourish in waters of low dissolved oxygen. Waters of consistently high dissolved oxygen are usually considered healthy and stable ecosystems capable of supporting many different kinds of aquatic organisms.

**Where Does the Oxygen Come From?**

Much of the dissolved oxygen in water comes from the air. Oxygen can also be mixed into the water by waves on lakes or the tumbling of water on fast-moving rivers. Algae and rooted aquatic plants also deliver oxygen to water through photosynthesis.

In general, rooted aquatic plants are more abundant in lakes and slow-moving rivers. In bodies of water with lots of plants, there will a large daily fluctuation in dissolved oxygen. Dissolved oxygen levels rise from morning through the afternoon as a result of photosynthesis, reaching a peak in late afternoon. Photosynthesis stops at night, but plants and animals continue to respire and consume oxygen. As a result, dissolved oxygen levels fall to a low point just before dawn. Dissolved oxygen levels may dip below 4 mg/liter in such waters- the minimum amount needed to sustain warm water fish like bluegill, bass, and pike.

**Physical Influences on Dissolved Oxygen**

Water temperature and the volume of water moving down a river (discharge) affect dissolved oxygen levels. Gases, like oxygen, dissolve more easily in cooler water than in warmer water. In temperate areas, rivers respond to changes in air temperature by cooling or warming.

River discharge is related to the climate of an area. During dry periods, flow may be severely reduced, and air and water temperatures are often higher. Both of these factors tend to reduce dissolved oxygen levels. Wet weather or melting snows increase flow, with a resulting greater mixing of atmospheric oxygen.

**Human-Caused Changes in Dissolved Oxygen**

The main factor contributing to changes in dissolved oxygen levels is the build- up of organic wastes. Organic wastes consist of anything that was once part of a living plant or animal, including food, leaves, feces, etc. Organic waste can enter rivers in many ways, such as in sewage, urban and agricultural runoff, or in the discharge of food processing plants, meat packing houses, dairies, and other industrial sources.

A significant ingredient in urban and agricultural runoff are fertilizers that stimulate the growth of algae and other aquatic plants. (See the sections in this chapter on biochemical oxygen demand, nitrate, and total phosphate for more information.) As plants die, aerobic bacteria consume oxygen in the process of decomposition. Many kinds of bacteria also consume oxygen while decomposing sewage and other organic material in the river.

**Changes in Aquatic Life**

Depletions in dissolved oxygen can cause major shifts in the kinds of aquatic organisms found in water bodies. Species that cannot tolerate low levels of dissolved oxygen-mayfly nymphs, stonefly nymphs, caddisfly larvae, and beetle larvae-will be replaced by a few kinds of pollution-tolerant organisms, such as worms and fly larvae. Nuisance algae and anaerobic organisms (that live without oxygen) may also become abundant in waters with low levels of dissolved oxygen.

**Calculating Percent Saturation**

The percent saturation of water with dissolved oxygen at a given temperature is determined by pairing temperature of the water with the dissolved oxygen value, after first correcting your dissolved oxygen measurement for the effects of atmospheric pressure. This is done with the use of the correction table and the percent saturation chart.

Rivers that consistently have a dissolved oxygen value of 90 percent or higher are considered healthy, unless the waters are supersaturated due to cultural eutrophication. Rivers below 90 percent saturation may have large amounts of oxygen-demanding materials, i.e. organic wastes.

To calculate percent saturation, first correct your dissolved oxygen value (milligrams of oxygen per liter) for atmospheric pressure. Look at the correction chart. Using either your atmospheric pressure (as read from a barometer) or your local altitude (if a barometer is not available), read across to the right hand column to find the correction factor. Multiply your dissolved oxygen measurement by this factor to obtain a corrected value.

**Correction Table for Dissolved Oxygen Measurements**

|  |  |  |
| --- | --- | --- |
| **Atmospheric Pressure (mmHg)** | **Equivalent Altitude (ft.)** | **Correction Factor** |
| 775 | -540  | 1.02  |
| 760 | 0 | 1.00 |
| 745 | 542  | .98 |
| 730  | 1094 | .96 |
| 714 | 1688 | .94 |
| 699 | 2274 | .92 |
| 684 | 2864 | .90 |
| 669 | 3466 | .88 |
| 654 | 4082 | .86 |
| 638 | 4756 | .84 |
| 623 | 5403 | .82 |
| 608 | 6065 | .80 |
| 593 | 6744 | .78 |
| 578 | 7440  | .76 |
| 562 | 8204 | .74 |
| 547 | 8939  | .72 |
| 532 | 9694 | .70 |
| 517 | 10,472  | .68 |


Level of Oxygen Saturation Chart

Now look at the percent saturation chart. Draw a straight line between the water temperature at the test site and the corrected dissolved oxygen measurement, and read the saturation percentage at the intercept on the sloping scale.

|  |
| --- |
| **Example:**Let's say that your dissolved oxygen value was 10 mg/L, the measured water temperature was 15'C, and the atmospheric pressure at the time of sampling was 608 mmHg. From the table in Figure 8, the correction factor is 80 percent, which multiplied by 1 0 mg/L gives a corrected dissolved oxygen value of 8 mg/L. Drawing a straight line between this value and 15’C gives a percent saturation of about 80 percent.How might you interpret these results? At the relatively cool temperature of 15'C, one would expect a river to have a dissolved oxygen value higher than 80 percent. It would appear that something is using up oxygen in the water. |

**Sampling Procedures**

Because DO levels vary so much according to time, weather, and temperature, this test should be run during the same period (week and time of day) if yearly comparisons are to be made. In rivers, there is usually adequate mixing of water from the surface to the river bottom. However, in impounded river reaches or in very large deep rivers there may be little mixing of the water. This could cause differences in DO measurements from the surface to the river bottom.

It is best to sample away from shore and below the water surface. In free- flowing rivers with good mixing, samples taken beneath the surface and in the current will probably be representative samples. In slow-moving river reaches and in impounded river areas with little mixing, it is very important to sample away from shore and to sample at various depths. Shore sampling will probably not provide a representative sample in these waters. Nor will a sample taken from only one depth, since aquatic vegetation produces oxygen near the surface, while decaying vegetation on the bottom consumes oxygen through the respiration of aerobic (oxygen-dependent) bacteria.