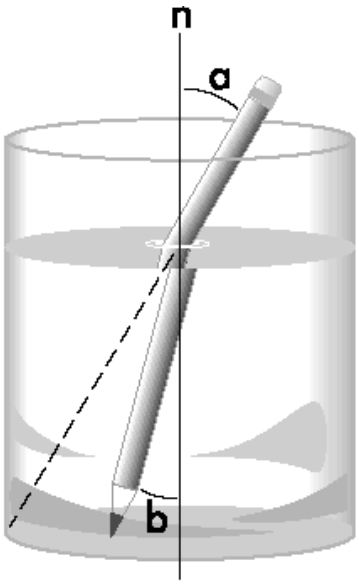
Refractometers

Introduction

Refractometers are used to determine a concentration of a particular substance within a given solution. They operate based on the principle of refraction. When rays of light pass from one medium into another, they are bent—either toward or away from a normal line—between the two media. The angle between the normal ray and the incident ray is called the angle of incidence. The angle between the normal ray and the refracted ray is called the angle of refraction. The Figure below demonstrates this using a pencil resting in a container of water. As you can see, the light ray passes from the air into the water and is bent toward the normal ray or, the angle of incidence.



(a) Angle of incidence

(b) Angle of refraction

(n) Normal line

The angle of refraction is related to an index value called the index of refraction. Each compound has a specific index of refraction. The angle of refraction is dependent on the composition of the media and on the temperature—this composition dependency is what makes refractometers so useful. As the concentration of a particular compound in a solution increases, so does the degree to which the light is bent. Also, it is important to determine the temperature of the testing environment since temperature affects the angle of refraction.

Let's say we want to determine the salinity (NaCl concentration) in a brine solution. For each percent salinity value there is a corresponding angle of refraction. First, we determine the angle of refraction. Then, we convert the angle of refraction to percent salinity. This percentage is the concentration of NaCl in our brine solution. To make the conversion easier, refractometers are available with scales that are calibrated to read the desired value directly—in this case, percent salinity.

Refractometers are available with a variety of scales:

- **Salinity:** Mentioned above.
- **Brix:** Measures percent sucrose. Used in the food and beverage industry for quality control.
- **Coolant:** Freezing Point: Determines the effectiveness of ethylene glycol and propylene glycol coolants.
- **Clinical:** Measures Serum albumen and Urine specific gravity (e.g. to test for urine drug sample tampering).

- **Serum Protein**
- **Specific Gravity**

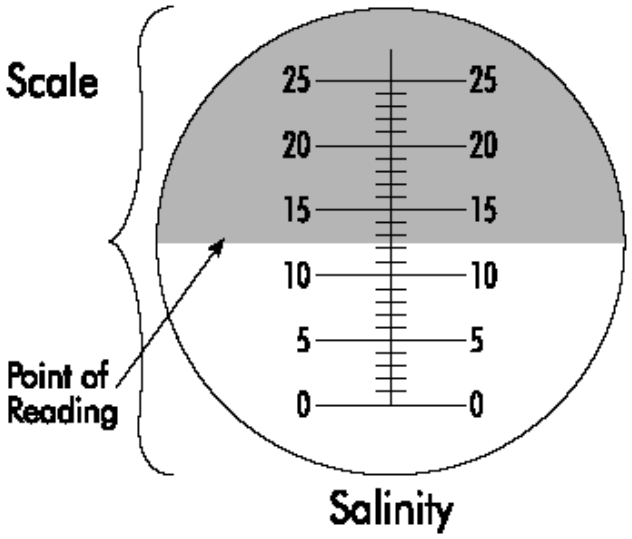
Calibration and Use

1. Calibrate the refractometer with a standard solution before use. Since the reading will be affected by temperature changes, it is best to calibrate at the temperature of the test environment. If this is not possible, correction charts may be used to correct for this effect. Some refractometers have automatic temperature correction (ATC), a feature that allows the instrument to automatically correct for temperature differences.

2. Place a small amount of liquid (usually 2-5 drops) on the prism and secure the cover plate—this will evenly distribute the liquid on the prism.

3. Point the prism end of the refractometer toward a light source and focus the eyepiece until the scale is clearly visible.

4. Read the scale value at the point where the dark and light portions meet. Below is an example of a salinity scale as seen through the eyepiece:



Commonly Asked Questions

Q. I need to test the concentration of a lubricating oil but I have a Brix refractometer. Can I use it?

A. Yes, you can use it if the refractive range is similar. In this case, you need to prepare known samples of the lubricating oil and determine the corresponding Brix values. From this data, a chart can be created to convert from the Brix value to the percent oil value.

Q. How do I maintain a refractometer?

A. Refractometers require very little maintenance. When the measurement is complete, wipe the prism with a soft lens tissue. When the instrument is not in use, keep the cover closed to avoid scratching the prism.