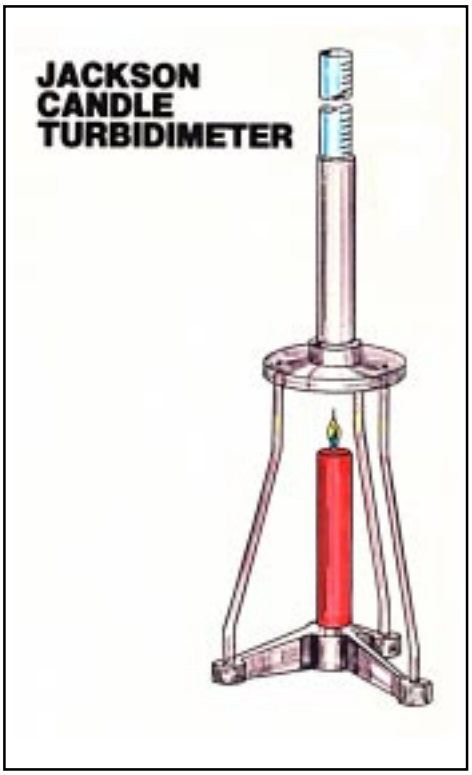
History of Turbidity

What is Turbidity? In simple terms, turbidity is “the absence of clarity in a liquid, due to suspended solids.” The first attempts to quantify turbidity date back to the turn of the century when Whipple and Jackson developed a standard suspension fluid using 1000 parts per million of diatomaceous earth in distilled water. Dilution of this reference suspension resulted in a series of standard suspensions used to derive a PPM, silica scale for calibrating contemporary turbidimeters.

Jackson applied the PPM, silica scale to an existing turbidimeter called a diaphanometer, creating what become known as the Jackson Candle Turbidimeter. Consisting of a special candle and a flat-bottomed glass tube, this turbidimeter was calibrated by Jackson in graduations equivalent to PPM of suspended silica. Measurement was made by slowly pouring a turbid sample into the tube until the visual image of the candle flame, viewed from the open top of the tube diffused to a uniform glow. Visual image extinction occurred when the intensity of the scattered light equaled that of transmitted light. The depth of the sample in the tube was read against the PPM silica scale, and turbidity was referred to in terms of Jackson Turbidity Units (JTU).



The discovery of formazin in 1926 by Kingsbury and Clark drastically improved the consistency in standards formulation and a new unit of measure was adopted called Formazin Turbidity Units (FTU).

Even though the consistency of formazin improved the accuracy of the turbidimeter, the Jackson Candle Turbidimeter was not able to measure very low turbidity samples containing fine solids. The light source being a candle, the incident light is in the yellow-red and longer wavelength end of the visible spectrum where wavelengths are not scattered effectively by small particles. For this reason the instrument is not sensitive to very fine particle suspensions.

Other problems with the Jackson Candle Turbidimeter is that it is a visual instrument. Measurements taken from any form of visual comparison are subjective to the differences in the way individuals see light. The development of photoelectric detectors that are very sensitive to small changes in light led to the development of turbidimeters that measured attenuated light much more precisely. However, these instruments were still limited in their ability to measure high or extremely low turbidities. At low scattering intensities, the change in transmitted light, viewed from a straight-on view, is so slight that it’s virtually undetectable by any means. At higher concentrations, multiple scattering interferes with direct scattering.

The solution was to measure the light scattered at an angle to the incident light beam and then relate this angle-scattered light to the sample’s actual turbidity. A 90 degree detection angle is considered to be the least sensitive to variations in particle size and has become the standard in design of today’s modern instruments. To distinguish these new instruments from the traditional instruments that measured absorbed light, they are called Nephelometers or Nephelometric turbidimeters.