



# **Estimating Turbidity (NTU) From Absorption Data**

Sensus Technical Note (SEN-TN-0010)

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**Kevin L. Goodner, Ph.D.**

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## **ABSTRACT**

This report focuses on how turbidity can be estimated from UV-VIS measurements. A model is presented to obtain turbidity information from the absorption of light at 750nm. Data is taken from QC logs and is shown at two different points in time and the slight change in the model as data points in the model increase from 80 to 196.

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## **INTRODUCTION**

Turbidity is the cloudiness or haziness of a fluid caused by individual particles (suspended solids) that are generally invisible to the naked eye. Typically a nephelometer is used to measure turbidity and is expressed as Nephelometric Turbidity Units or NTUs. A nephelometer measures turbidity by measuring the amount of light that is scattered by a light source. The turbidity can vary depending on the shape, color, and reflectivity of the suspended material meaning that two solutions could have a different NTU measurement at the same percentage of suspended material. When measuring absorbance in a UV-VIS spectrometer, the suspended particles block the photons and appear as absorbance and color and reflectivity have little effect. However, it should be possible to develop a model of UV-VIS absorption and turbidity NTU. A model was developed and reported here.

## **MATERIALS AND METHODS**

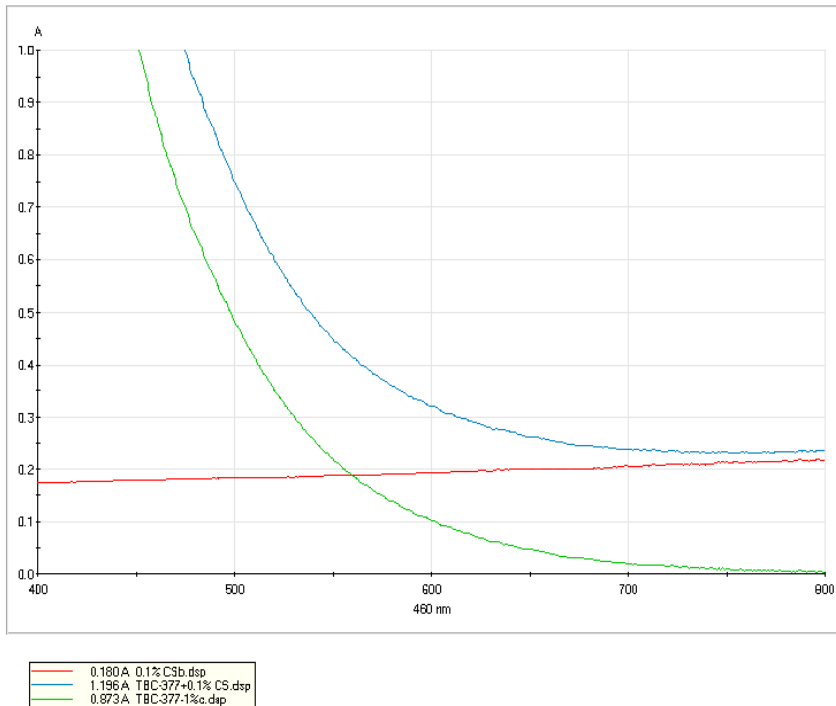
The absorbance at 750nm was determined using a ThermoElectron Genesys 6 UV-VIS Spectrophotometer (Minneapolis, MN). The turbidity of each tea sample was measured using Hach 2100P turbidimeter (Loveland, CO) at room temperature. This is an ongoing collection of data, the first in April of 2009 with approximately 80 data points, and the second in November of 2009, when approximately 120 data points were added for a total of almost 200 data points. Statistica version 8 was used for the plotting and confidence intervals.

## **RESULTS AND DISCUSSION**

Figure 1 is a plot of the spectra of a tea concentrate with and without cornstarch (from SEN-TN-0012) which shows that the majority of absorption at 750 nm is from particulates and not tea and could be used as a turbidity measurement.

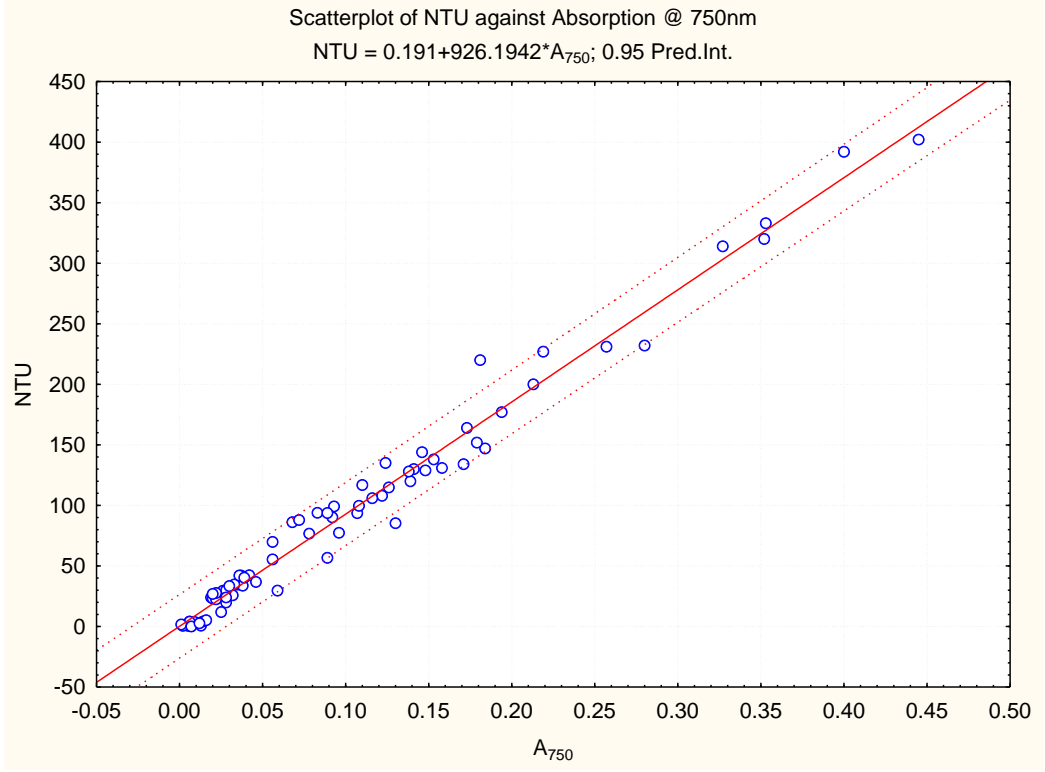
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Given this information, an examination of 80 data points of various Sensus products (tea, coffee, essences), the following chart was generated which can be seen that a linear relationship can be observed between turbidity (NTU) and absorbance at 750nm.

The model depicted below is simple linear model with  $r^2=0.98$  and 95% prediction probability lines drawn. The prediction probability lines are used to estimate the error. For example, if you measured the absorbance at 750nm to be 0.200 then the estimated NTU would be approximately 185NTU. The real value would be between 155 and 215 95% of the time.



Increasing the dataset size from 80 to 196 has little affect on the model. The slope changes slightly from 926.19 to 902.45. The example mentioned above would now be an NTU of about 183.

This report has several functions. First is to confirm that the use of 750nm as a correction factor for turbidity is a fairly valid method. Secondly, it allows for the estimation of NTU in the absence of a nephelometer. Lastly, it can be used to provide an indication that a sample is behaving abnormally and may require more attention if the value doesn't fall within the prediction lines.

Scatterplot of NTU against Absorption @ 750nm  
Spreadsheet8 in Turbidity.stw 10v\*200c  
NTU = 2.6346+902.446\*x; 0.95 Pred.Int.

