Diala, Jour, Volume, 37, 2009

Detection of Water Turbidity and Measurement I of Particle size by He-Ne Laser

Asst.Instructor.Nadia Mohammed Jasim* Asst.Instructor.Ala Rihoom HadeAsst.Instructor.Jasim Mohammed Mansour*****

***Department of Physics , College of science , University of Diyala, lraq**
****Directorate of Water Resources , Baquba, Diyala, Iraq**
***** Department of Physics , College of science , University of dials, Iraq**

Abstract

The laser technique provides a measure and detect method for the turbidity in a wide water layer levels, and it is considered as one of the latest method for detecting tiny concentrations 1.0 Parts per billion that are difficult to be measured by conventional methods, the technique gives quick and direct result with a high accuracy. The laser beam scattering technique was employed for determining turbidity concentration. In the first part of the project we use three main units the proparation unit , the laser system and the electronic detection system for turbidity measurement while the second part of the project is to calculate the size parameter by measuring the diameter of silica particle using He-Ne laser, the measuring system consists of 5mw He- Ne laser at wavelength, 638,8 nm, and lenses to collect the laser Beam in addition to a screen.

Introduction

Turbidity is the term given to anything that is suspended in a water (1).it is found in most surface waters (2), but usually does exist In ground waters except in shallow wells and spring after heavy rains (3), Turbidity gives the water a cloudy appearance or shows up as dirty sediment. Un dissolved materials such as

sand, clay, silt or suspended iron contribute to turbidity [4-5]. Usually turbidity is measured in nephelometric turbidity unit, NTU (3,4,6).

Typical drinking water have a turbidity level of 0 to 1 NTU (4,7). Turbidity: also be measured in part per million and its size is measured in microns (5,7) Anetwork of stations for observation and measuring the degrees of water pollution

usually used in which take the many countries. In 1980, an automatic observer stations were used samples and analyze them continuously. The results are recorded on special tapes and they are sent to central station. They measured the turbidity, temperature, the dissolved oxygen and suspended materials (8). In 1998, waterman et al. measured emission spectrum of the bacterial living in water using IV spectrums. It was clarified that most of fleece use of the pollutants was in the rea of blue green from spectrum (9J.

In 2002, A1 abdden, measured the drop size generated in a baffled cylindrical tank f oil using laser beam. He compared his result with a conventional microphotography (10). In 2005, the effect of turbidity concentration on the Tapered light intensity was studied by A1 dienee (11).

In this research, We studied the effect of turbidity concentration on the scattered At intensity, and I am measured the diameter of particle size of silica which buses the turbidity and then I am calculate the particle size of silica.

perimental Details

Detection of water turbidity

A block diagram of the detection of turbidity by He - Ne laser is shown in fig (1).

consists of 2mw He - Ne laser, sample cell made of glass with diameter (to = 10.7m) and volume of 640 ml, detector and electronic detection system.

When a laser beam is incident on the sample cell, which contained a silica mixed with water at different concentrations, part of light is scattered by particles of aspersed phase (l2). The transmitted light are dependent on the particle size (13).

A photomultiplier detector was used for detecting the transmitted laser light and scattered laser light was detected using the electronic detection system and then transmitted laser light was recorded at different scattering angles from the accident beam. Relation between the scattered laser light intensity for every 12 ascends to obtain to pulse laser was plotted as a function of the scattering angle for ales, it can be estimated to have a Gaussian shape, its full width it half simile (F) is sensitive to the concentration of turbidity (c) in water and relation of the form (11) :

$FWHM = a \cdot e^{bc}$……(1)

Where a, b are constants depend on the concentration of turbidity.

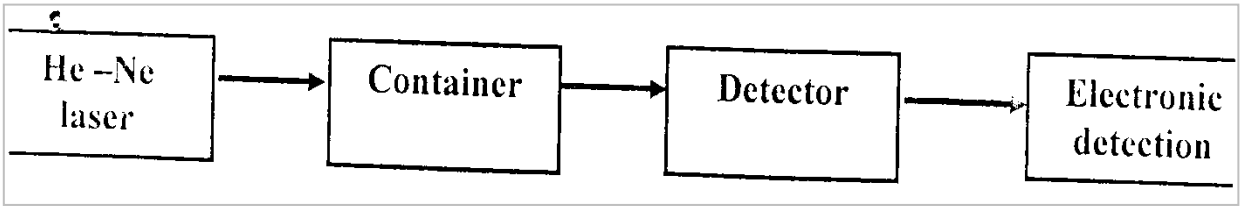


Fig.(1) a block diagram of the detection of turbidity unit by He-Ne laser

(2) - Measurement of Particle Size of Silica

The second part from the research is measuring the particle size of silica material, which causes a turbidity in water. A block diagram of measurement the diameter of silica material by He - Ne laser is shown in fig (2). It consists of 5mw He - Ne laser, slide which consists of particle of silica, lenses to collect the laser beam and screen.

We apply the following equation to calculate the particle size of silica (15)

$X = \pi d n / \lambda$……(2)

Where x is the particle size and d is diameter of the particle in micrometer n is the refractive index of water and λ is the wavelength of incident radiation in micrometer.

a parallel beam of laser light is passes through a slide which

contain the particle of silica, a laser beam is dispersed with different angles. We can apply the following equation to calculate the diameter of silica (16)

$\sin \theta \, d = n \lambda$ ..... (3)

$S \text{ in } \theta = \theta = n D$

$d r / D = n D = n \lambda D / r$

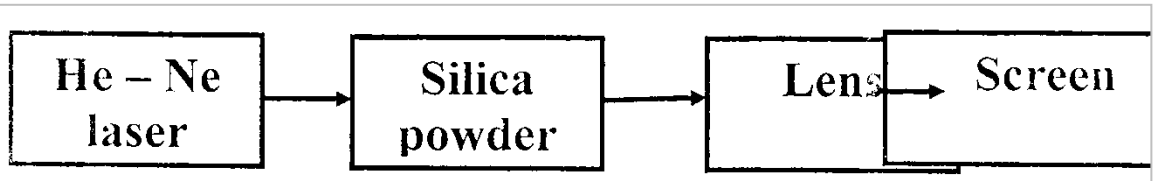
Where:

D = The distance between the screen and slide.

n = order ratio.

1, = diameter of fringe.

d = diameter of silica particle.



Fig(2) a block diagram of the measurement of diameter of silica

powder by He-Ne laser.

Results & Discussion

Detection of Water Turbidity:

The silica material was used with different concentrations (0, 3, 5, 7 and 12 NTU). The effect of turbidity on scattered laser intensity profile is shown in table (1).

Figure (1) explain the relation between scattered light intensity and scattering angles at different concentrations, and it shows half Gaussian shape distribution between intensity and scattering angle (I-θ) profile, the profile of distilled water showed higher intensity at zero and small angles. The intensity was increased at larger scattering angles with increasing of turbidity of was acreage concentration.

The dependence of full width at half maximum on water turbidity was found 'using RESOLUTION program. We can found full width at half maximum by using this program. The dependence of F on water turbidity concentrations is shown in table (2).

From Fig.(4) one can notice that the FWHM value is increasing

as the silica material concentration (C) increase. this dependence follows a simple relation of the form: be

$FWHM = a \cdot e^{bC}$

Where a and b are fitting parameters constants.

The parameter (a) represents the FWHM value at zero concentration turbidity, while (b) is the shape parameter.

(2) Measurement of Particle Size of Silica

The experimental measurement of diameter of silica particles using He - Ne laser was investigated using equation (3)

$\sin \theta \, d = n \lambda$

Where λ is the wavelength of He - Ne laser being 632.8 nm. and D = diameter of silica particles in micro meter.

The diameter of silica particles produced equal 25μm (d = 25 μm) then we can apply equation (1) to calculate the particle size of silica.

$X = \pi \, d \, n / \lambda$

Where

d = diameter of silica particles in micro meter calculated to be 25μm.

n = refractive index of water = 1.33.

λ= the wavelength of He - Ne laser = 632.8 nm.

X = 52.5μm

$X = \pi^*$ 25μm.* 1.33 / 632.8 nm and X = 52.5μm

Conclusions

l- the detection of turbidity using laser gives quick and direct result with a high accuracy. and provides ability to measure turbidity of water through a wide bottom layers.

2- the detection of turbidity by laser is considered as best method compare with other method.

3- the laser light intensity ship with scattering angle can be estimated to have a Gaussian shape. Its full width at half maximum (FWHM) is sensitive to the type and concentration of turbidity (C) in water. They obey the relatio

$FWHM = a \cdot e^{bc}$

Where a, b are constants depend on the type of turbidity.

4 - The results of diameter measurement by laser method are

more accurate than those obtained by conventional.

References

1- Davis, H.: Turbidity Water. Enviromnent Science 94, 63, 397- 401, 1980.
2- Montgomry, J.: Water Treatment Principles and Design, London 1985.
3- Robins, S.: Ground Water Pollution, Geological society special publications series Editor No.130. London 1998 4- Ayers, R.: Water quality for agriculture. Water pollutants.zg.
147. 1996.
5- Galen, W.: Instrumental Methods of Chemical Analysis. Fourth Edition 1985.
6- Minar, A.: Effect of High Concentration of Pollutants Element in Gaddisyia Water, M.SC. Thesis, University of Baghdad, 2001.
7- Iraqi Water Properties, Catalog No. 417. Ministry of Water Resources, Baghdad, Iraq, 1974.
8- Ajwad, H. Course in Environmental Engineering. Directorate ' Water of Resource, Diyala, 1997.
9- Raad, H.: Spectroscopic Study to Some Suspending in Iraqi Rizers Water by Raman Scattering. M.SC. Thesis, A1 Mustansiriyah University, 2001.
10- Ali, Z.: Drop Size Measurement Using Laser Technique. MSc,
Thesis. Institute of laser for postgraduate studies, University of Baghdad,
2002.
11- Nadia, M.: De
tection of Water Pollutants by Means of Lase Technique. MSC Thesis, Institute of laser for postgraduate studies, University of Baghdad, 2005.
12- Bayrel and ions.: Electromagnetic Scattering and it application, Applied Science Publishers, London, 1981
13- Jackson, T.: Performance Comjarision of Two Interferometric Droplet Sizing technique, SPIE, 573, 73, 1985.
14- Joseph, G.: Laser Remote Sensing, SPIE, 305, 130, 2000.

l 5- Laser Remote Sensing, John Wiley and Son, New York, 1994.
16- The diffraction Physics, maze's and Sami, London 1989.

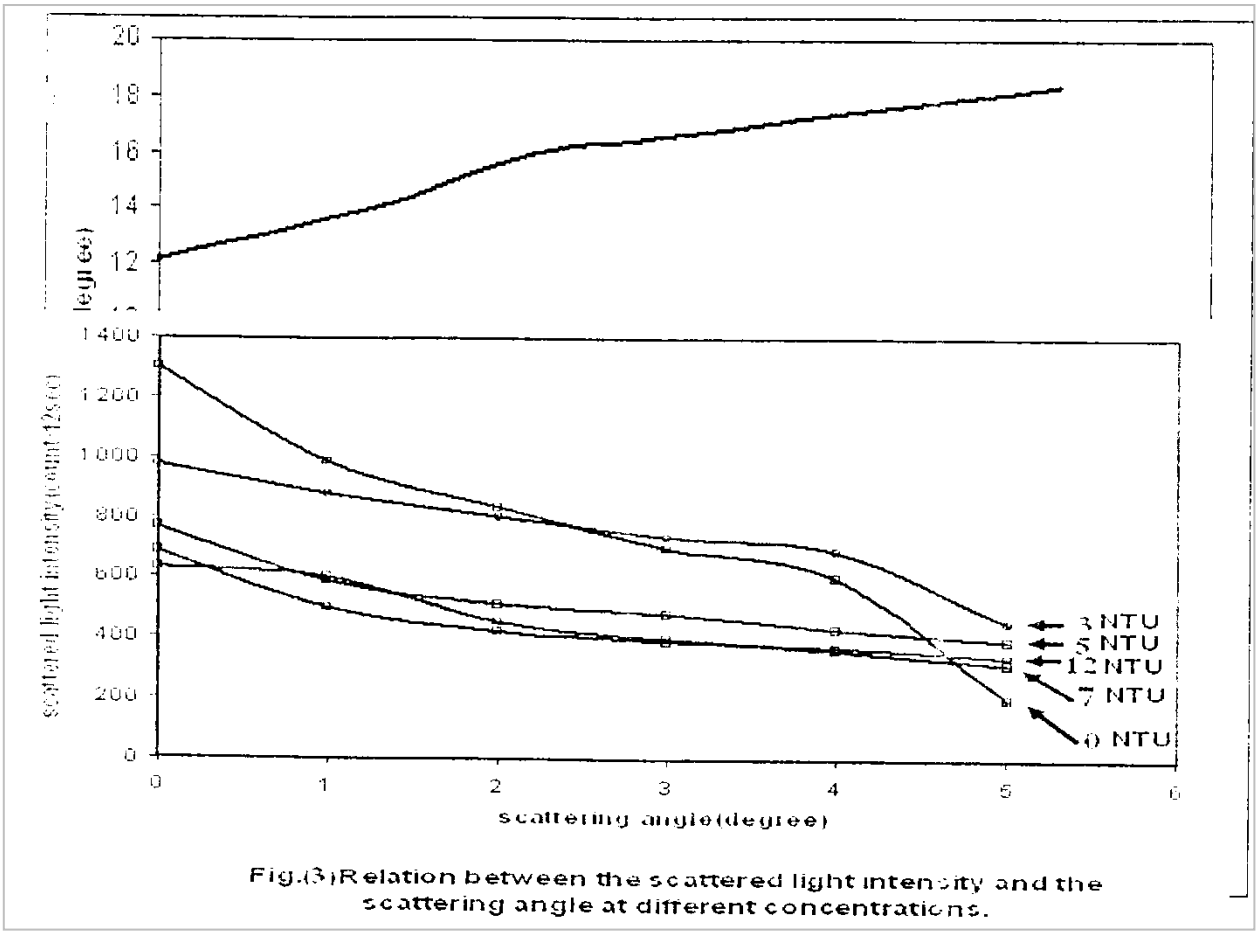


Fig.(3)Relation between the scattered light intensity and the scattering angle at different concentrations.

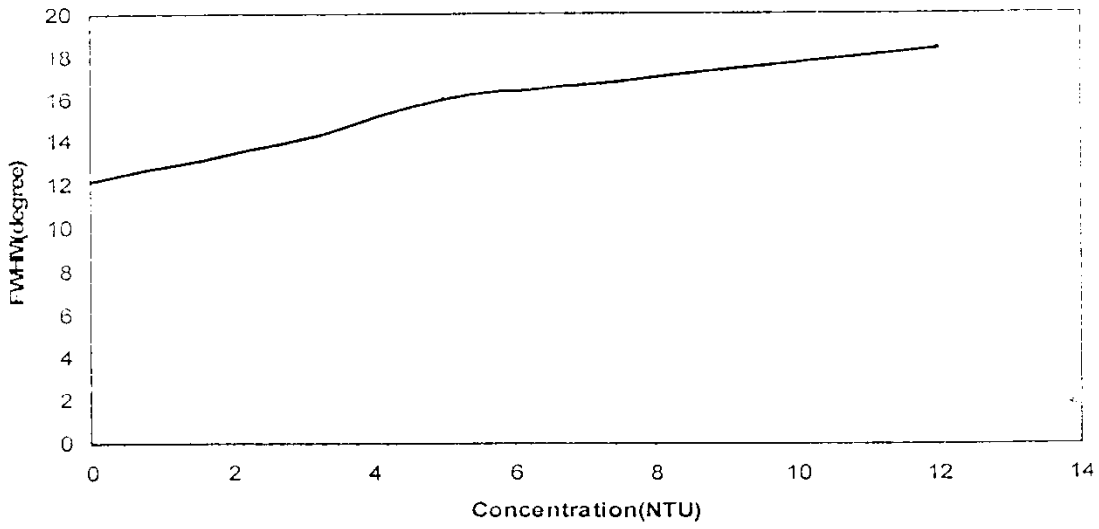


Fig.(2) Relation between the full width at half maximum and the concentrations of turbidity.

Table (1) The effect of turbidity on scattered laser intensity with different concentrations

0 (degree)	0 NTU	3 NTU	5 NTU	7 NTU	
0	1200	1070	991	795	
1	1156	1054	965	640	
2	1076	1007	884	603	
3	1000	935	793	592	
4	998	890	775	500	

5	907	887	698	478	

Table (2) The dependence of FWHM on water turbidity at different concentration

Concentration, NTU	FWHM Degree
0	12.13
3	12.50
5	12.98
7	13.1
12	17.24

Diala, Jour, Volume, 37, 2009

تحسس التعكر في الماء

وقياس الحجم الحبيبي للسليكا باستخدام ليزر الهليوم _ نيون

م.م.نادية محمد جاسم
قسم الفيزياء – كلية العلوم – جامعة ديالى – بعقوبة _ العراق
م.م.علاء رحوم هادي
مديرية ماء ديالى – بعقوبة – العراق
م.م.جاسم محمد منصور
قسم الفيزياء – كلية العلوم – جامعة ديالى – بعقوبة – العراق

الخلاصة

إن استخدام تقنيه الليزر توفر القدرة على قاس وكشف التعكر للماء ولأعماق مختلفة والتي تعتبر واحده من احدث الطرق للكشف عن تراكيز ضئيلة جدا (أجزاء بالمليون أو بالبليون)والتي يصعب قياسها بالطرق التقليدية ,حيث إن هذه التقنيه تعطي نتائج سريعة ومباشرة وبدقة عالة
استخدمت تقنية استطارة حزمه الليزر لتحديد تركيز التعكر للماء حيث تتكون منظومة الكشف عن التعكر باستخدام الليزر من ليزر الهليوم نيون ونظام الكشف عنها بقدرة 3 ملي واط ومنظومة التحضر ومنظومة الكشف ومنظومة العداد الالكتروني هذا بالنسبة للجزء الأول
في الجزء الثاني ثم حساب الحجم الحبيبي لمادة السليكا وذلك من خلا ل قياس قطر مادة السليكا باستخدام ليزر هليوم نيون بواسطة منظومة القياس تتكون من 5 ملي واط هليوم –نيون وشريحة تحتوي على حبيبات السليكا وعدسات لتجميع حزمة الليزر وشاشة مشاهدة .