Suspended Solid Measurement System with Two Frequency Four Beam Technique for Distillery Spent Wash

M.L.Dongare

Abstract- ***An attempt has been made to measure suspended particles in the effluent from Sugar factories and distilleries. Waste water generation and its subsequent treatment is major problem for distillery industry and society as well. The effluent is generated in large amount and therefore prior to treatment, the effluent need to be monitored so as to permit their discharge into the local water sources or in a land. The comparison of conventional method used in distillery for the measurement of suspended solid and outcome of experimental procedure used is discussed in this paper. Basically, the incident light source, detection angle of detector, and ratioing are the important aspects which affects on optimization, performance and consistency of the measurement system. These aspects are concentrated mainly for precise measurement. Intensity of light scattered by the sample under defined condition with the intensity of light transmitted by the standard reference suspension under the same condition is studied. The conventional suspended solid measurement requires 4-5 hours where this system may take 4-5 minute. This technique will offer the potential for reliable for distillery industrial process measurement, and to follow the standard environmental norms prescribed by regulatory authority before depriving from distillery column, which would otherwise require for the pretreatment and controlling in the said industry.***

Key Words-Spent Wash, Scattering, Modulated light, four beam , band pass and absorption.

I. INTRODUCTION

At present there are around 434 sugar factories and 319 distilleries, having sugar and alcohol production capacity of about 21.90 million MT of raw sugar and 3.25billion liter of alcohol (UPPAL20040.) [1]. The alcohol manufacturing in Indian distillery involve three main steps i.e. feed preparation, fermentation and distillation. In the distillation processes the bottom discharge is known as spent wash" or "vinasse. Which is 10 to 15 times that of alcohol produced. An enormous quantity of these effluents poses a problem of easy disposal. Distillery is recognized as one of the most polluting industry among the polluting commodities because of high volume & strength of byproduct stream. The spent wash is reddish brown colored which has caramel smell and is highly acidic in nature having pH 4 to 4.5,Suspended solids100000mg/l (TERI). It also contains high percentage of dissolved organic and inorganic matters [2].The distillery effluent coming from the bottom of distillation column has very high polluting effect. If it is let out into rivers and canals without treatment, the aquatic life will get destroyed due to high BOD and other toxic elements. The water becomes dark colored and acquires unpleasant smell. It also lowers the pH of stream water; increases organic load and affect photosynthetic reaction in water bodies [2]

The properly implemented sanitation program is essential component of a distillery quality control plan. Inspection, record keeping and reporting within acceptable level and tolerance may develop the wastewater disposal arrangement operation. If the survey is comprehensive, it should be helpful to plan an overall treatment program by investigating some parameters in situ on quality and quantity of effluent [3]. . The local studies are essential to determine the optimum loading rates in order to avoid the possibilities of reduction in crop yields Therefore, it is essential to know the total solids and polluting parameters in spent wash for treatment to assess the biological and physical treatment processes and for assessing compliance with regulatory agency for effluent limitations.

Turbidity is caused by the presence of suspended matter in a liquid. It is an expression of an optical property that causes light to be scattered and absorbed rather than transmitted in a straight line through the sample. The light intensity at a fixed angle basically orthogonal to the incident beam can be used as a quantitative measure of turbidity as shown in fig1

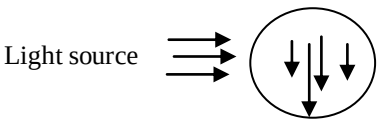

Fig1: Detector at orthogonal to incident beam

It is a very complex analytical measurement, which can be affected by many factors such as particle color, shape, angle of detection etc. There is no absolute difference between dissolved and un dissolved matters. The tiny particles may be termed as suspended solids and are measured in milligram per liter (mg/L) by filtering the spent wash and weighing the dried residue. The conventional gravimetric method for the measurement

Manuscript Received on November 2013.

M.L.Dongare, Department of Electronic Science, S.M.Joshi College Hadapsar Pune 28 India

of suspended solids is time consuming and manual error is quite possible. An irreversible change occurs due to different storage procedures used in different distilleries e.g. stored in large pond, tank unprotected from solar radiation, where fermentation and decomposition may also occur.

II. EXPERIMENTAL PROCEDURE

The intensity of light source is modulated giving Vin an ac component, The light passing through the specimen is detected by a photo detectors which are geometrically oriented at 90^0 to each other. The modulated light sources are also oriented at 90^0 to each other. The color can be major interference in the measurement. Sample is diluted and wavelengths where the sample absorbs minimum light is determined by spectrum. The absorption spectrum of spent wash was obtained on spectrometer and it shows light in the range of 600 nm to 700nm can be used where transmission is about 100% and do not significantly absorb the light, and accordingly color of LEDs are selected. The signal-conditioned output is allowed to pass through a notch band pass filters, which is tuned at modulating frequency of the sources. The band selectable band pass filters are used. The output of notch band pass filter is fed to peak detector. This arrangement rejects any effect of ambient and stray variations and produces the output dependent on only light source

The system features low power consumption, solid compact design and easy operation that is housed in a single environmentally sealed enclosure, which can be used in a distillery with all necessary components for ambient stand-alone operation. In the light path sample is kept and scattering effect is observed with photo detector with spectral response measures voltage to a chopped light signal. Fig1.3 Shows the principle used for the measurement of suspended solids in the distillery effluent. This unique system uses combination modulated light sources that are geometrically oriented at 90^0angle to each other. The detector D1 and D_2 which responses to light sources which are modulated at specific frequency i.e. 1KHz and 10 KHz, are oriented at 90^0. In the specific interval of time, the sensor accomplishes two measurement phases. The two light sources are alternately pulsed. In the first phase of measurement a light source L_1 momentarily pulses a light beam directly in to D_1 scattered light at 90^0 viewing mode and D_1 measures transmitted light at 180^0viewing mode The two phases provides four independent measurements from two light sources when the light beam passes through the sample, the suspended solids scatter the light in all direction (360^0 spherically). Peripheral rays of scattered light beam are used for measurement of suspended solids [4] –[8]. In the 90^0 viewing mode, the excitation radiation passes through fairly long solution path so that there is upper concentration limit observed before attenuation of the exciting radiation. The experimental output voltages are compared with suspended solids measured by laboratory method. Optical Geometry for basic ratio system involving two detectors is shown in fig 2.1and fig 2.2

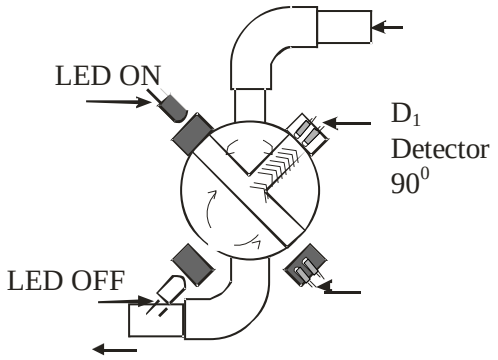

Fig.2.1: Optical Geometry for basic ratio system

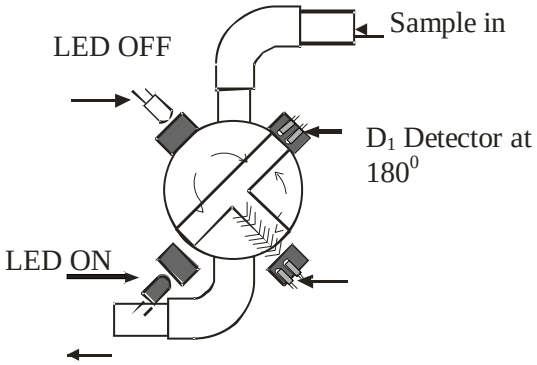

Fig.2.2: Optical Geometry for basic ratio system

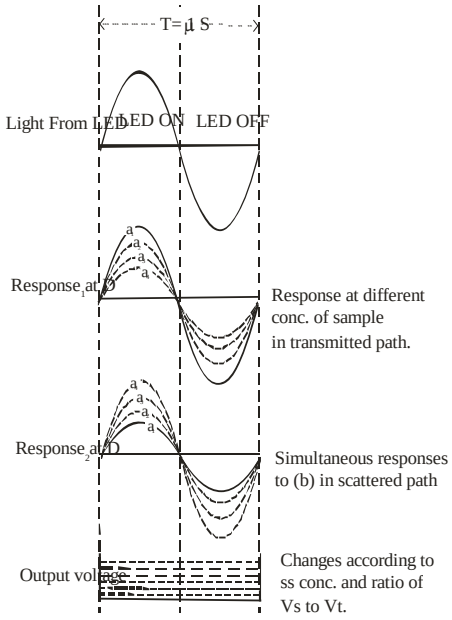

Fig 3 Signal and Process Control Waveform

In the second phase of measurement a light source L_2 momentarily pulses a light beam directly in to D_1 scattered light at 90^0 viewing mode and D_2 measures transmitted and scattered light at 90^0 and 180^0 iewing mode. Every time a light source is illuminated, it provides both an active signal and a reference

signal., likewise, the two photo detectors alternate in reading either the active signal or reference signal. Signal and Process Control Waveform fig3

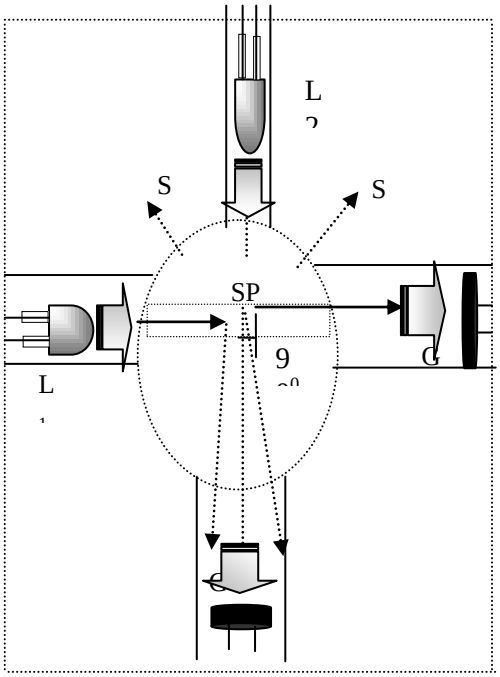

Fig. 4 Experimental set-up for measurement of suspended solids

Better performance may be possible using multiple sources and detectors. With this approach most of the permutation of detector/source path transmission are measured. Means that error effect appears both in the numerator and denominator are cancelled. Other sources of noise are such as flicker from radiation due to incandescent lamp or tube light etc. The ambient light, which tends to inconsistency in the measurement and causes inaccuracy in the inspection of results, may be suppressed. The modulated light source is effectively immune any electromagnetic interference (EMI)in the ambient light[9]. The modulated light source is not affected by these incoherent error sources. The detector only responses to optical radiation of 1 KHz. And 10 KHz alternatively

The voltage across detector due to scattering changes and pass through unity gain follower to notch band pass filter with cutoff frequency i.e. chopper frequency is 1 KHz. The resulting processed signal at the TTL level is ready for digitization by 8-bit ADC. The signal is routed to one of the available I/O port. The four-beam method with modulated source cancels error term derived from aging or fouling of components, and reduces errors due to color factors. measured by using standard gravimetric method, with voltage V across detector D_1 and D_2. The attenuated light due to sample is detected by detector D_2 and D_1. modulated at specific frequency. fig. 4 Experimental set-up for measurement of suspended solids and fig 5 Block diagram of the experimental set-up used for determining Suspended solidL_1, L_2 Light Sources of different color which striking the sample,D_1 and D_2 Photo transistors G_1/G_2=Peripheral rays of the scattered light beam used for measurement SPW= Spent wash sample .S= Scattered light

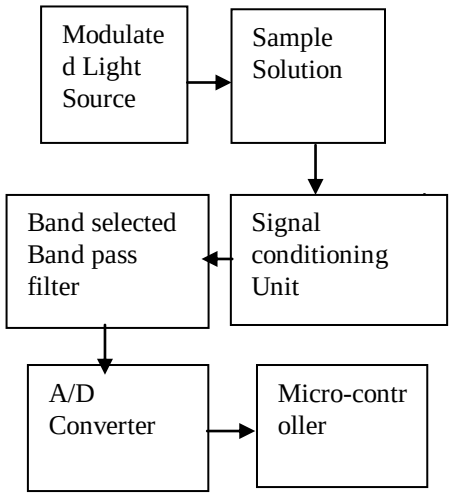

Fig 5 Block diagram of the experimental set-up used for determining Suspended solid

The intensity of light source is modulated and phototransistor is used as a detector. It gives consistency in the measurement and improves response. Figure 6. Response of suspended solids (mg/L) with voltage ratio is showing very good correlation. This shows that the problems of the conventional gravimetric technique for suspended solid measurement can be solved with this fast and accurate technique, and can be used in the monitoring and process controlling in fermented industry.

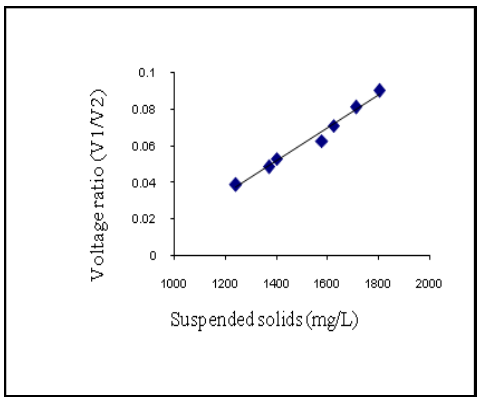

Figure 6. Response of suspended solids (mg/L) with voltage ratio

III. RESULTS AND CONCLUSION

Suspended solid measurement in fermented wash is very sensitive because of its chemical, physical and Biological characteristics. Technologies based on scientific experimentation are needed for effectively utilizing in agro based industries for the

good health of environment, by analyzing and by making the possible treatment processes on the polluting elements like molasses spent wash etc. Response of suspended solids (mg/L) with voltage ratio is shown in fig 6.

The graph of output voltage across the sensor has been plotted against suspended solids obtained from laboratory measurement. The sample was prepared for different dilution in water. It shows good linear relationship between suspended solids measured by conventional method and experimental results

This approach can be used in four-beam turbidity measurement in which all permutations of source/detector path transmission. The combination of the two phases provides a turbidity measurement that is corrected for color absorption, fouling of the optics, and any optical changes that can occur.[4].

The experimental set-up can be effectively used for detection and measurement of suspended solids. It is hope that the technique will help in process control and regulatory instrumentation in a distillery industry. The device is of low cost and easy to fabricate. Reasonable relationship between turbidity and suspended solid for the effluent from activated sludge process may be carried out. At lower concentration, the accuracy of measurement observed is more.

ACKNOWLEDGMENT

The author expresses sincere thanks to Principal, Rayat Shikshan's S.M Joshi college, Hadapsar Pune -28 and Principal ,Abasaheb Garware College Pune. for continuous encouragement to promote the research activity.

REFERENCES

1. Dr Y.S.Nerkar,VSI,Manjari(BK) Pune,)International level short term training programme for Distillery personal from Colombia south America412307.
2. Uppal J2004 water utilization and effluent treatment in the Indian alcohol industry –an overview(Indo EU workshop on promiting Efficient water use in agro-based industries, New Delhi15-16Jan2004.
3. Questionnaire survey of Indian distilleries conducted by TERI(The Energy and Resources institute)and AIDA(all India Distillery association
4. Manohar Rao,P.J.Energy conservation and alternative sources of energy .pp561 to 563.
5. Hobart H.Willard,Lynne.L.Merritt Jr,John.A.Dean,Frank.A.Settle Jury Instrumental Methods of analysis., CBS publishers and distributors ,Delhi. Sixth edition$_{pp}$90 to 94. ,(1986),
6. M.Sadar,Turbidimeter Instrumentation Comparision:Low level sample Measurements,Hach company Techenical information series, Loveland ,Colorado. 1999.
7. N.C.Varma,System of Technical control for cane sugar factories in India, Publish by The sugar Technologist Assosiation Of India Kanpur India (1988) pp88,89.
8. Arnold .E. Greenberg, Lenore. S. Clesceri, American Publisc Health association (APHA), Standrad Methods For Examination of Water &Waste water American Waterwork association (AWWA), Water Environment Federation (WEF).physical and aggregate properties),approved by standard methode comittee.(1988),2130A to 2540G. (2000) Allan Whitaker, Stephen.J.Hall Principles of fermentation Technology Peter F.Stanbury (U.K), University of Hertfordshire.pp313-326.
9. K.Jacques,T.P.Iyons,Dr.Kelsa The Alcohol Text book 3rd Edition A reference for beverage fuel & Industrial alcohol Industries, ll310-311.
10. Ramakant Gaikwad(1993) OpAmps and linear Integrated circuits 3rd edition PHI