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Research Article

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Rapid and sensitive spectrophotometric estimation of anionic surfactant in waste water with cationic dye Azure A in region Bilaspur, Chhattisgarh, India

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ABSTRACT

On the basis of change in absorption spectra of Azure dye A, the simplified and improved method for determination of anionic surfactants is described. The method is based upon the formation of colored complex between the cationic dye azure A (AA) and anionic surfactant sodium dodecyl sulphate (SDS). The ionic complex is extractable in chloroform. This procedure is consists of a rapid single extraction of the acidified aqueous test sample with chloroform. Under the optimal experimental conditions, absorbance of extract obeyed the Lamberts & Beer's law .Depending upon the pH of the solution, the excitation of Azure A leads to formation of absorbance peak in the range of (ʎ max.) at 555 nm, concentration range of 0.1 – 6.5 ppm. The interference due to the ions Cl^-, F^-, Ca^{2+} and Mg^{2+} were examined as well as the effect of pH. The method is applicable to waste water analysis.

Keywords: Absorption spectra, anionic surfactant, ionic complex, waste water.

INTRODUCTION

Due to excessive use of synthetic detergent in daily life, the waste water discharged in to the environment deteriorate the quality of water and cause harm to aquatic life as well as animal and human being. Detergents have been extensively used for over 40 years with estimated consumption of 2.8 million tons in 1998 [1]. Synthetic surfactants are toxic pollutants in natural water. However, many micro organisms have shown to be severally inhibited by surfactants in aerobic or anaerobic degradation [2]. This may cause long term environmental and ecological disorder [3]. Therefore, the determination of the surfactants from waste water is important in reducing their environmental impact .Various dyes have been used for the determination of anionic surfactants. Methylene blue has been used as a standard method for determination of anionic surfactant [4]. The method is sensitive and often interfered by sample matrix. There are several other analytical approaches based Potentiometric titration [5], Potentiometric sensor [6], surfactant selective electrode [7], but proved to be poorly reproducible. Other more specific method using gas chromatography – mass spectrometry [8] requires intensive sample preparation and more sophisticated procedure. High performance liquid chromatography was successfully used in monitoring of surfactants in sewage effluents [9]. Spectrophotometric method are becoming of great interest in chemical analysis. The method is based on formation of ion associate complex formed between anionic surfactant and cationic dye Azure A. Azure A (Fig. 1) is an organic compound with the chemical formula $C_{14}H_{14}C_lN_3S$. It is a light blue to dark blue dye. Reaction is followed up spectrophotometrically and the rate of change of absorbance (ʎ max.) at 555 nm measured. This method is adopted after full investigation and understanding of the principle of the reaction.

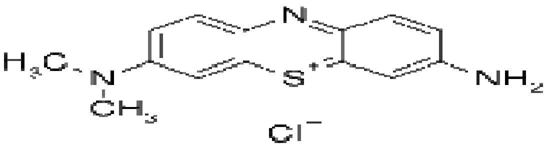

Fig. 1: Azure A (IUPAC Name - N', N'- dimethylphenothiazin-5-ium3, 7-diamine chloride)

The recently research has focused on low cost and easily available materials and does not require elaborate treatment and procedures, which are generally associated with other methods.

Study Area

Bilaspur is a City in Bilaspur District (Fig. 2) in the Indian state of Chhattisgarh, situated 111 km (69 mi) north of the state capital, Raipur. It is the second-largest city (after Raipur) in the state. Bilaspur city is situated on the banks of the rain-fed Arpa River, which originates from the high hills of the Maikal Range of central India.

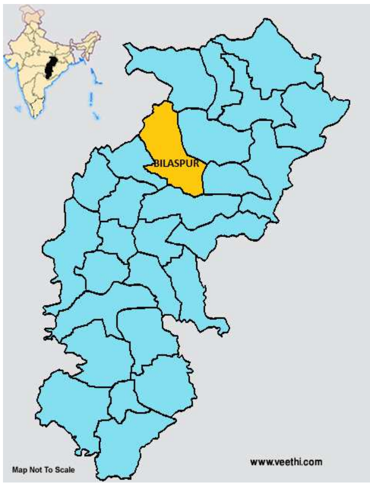

Fig. 2: Map of Bilaspur District in Chhattisgarh

EXPERIMENTAL SECTION

Material and Methods

The chemical and reagent were used for analysis were of Analytical reagent grade , Borosilicate glassware used, A digital Systronics pH meter and a combination electrode (pH range 0-14) with an accuracy of 0.01 pH unit were used or the measurement of pH., Systronic 9 parameter water analyzer.

General Procedure

In present investigation eight sampling station of sewage passed in Juna Bilaspur, Torwa, Sarkanda, Sirgitti, Gol Bazaar, Raj Kishore Nagar, Tifra, Uslapur were selected. Water sample were collected in the polyethylene bottle of 1.0 liters, filtered with 42 no. whatman filter paper and stored in a cooler.

Procedure

Sampling water (10 ml.) containing anionic surfactant sodium dodecyl sulphate (SDS), conc. Range 0.1 ppm- 6.0 ppm is taken in a separating funnel. A cationic dye Azure A (AA) and Hydrochloric Acid (10 ml. each) are added, followed by the addition of 5 ml of chloroform. The content are shaken for 2 minute and then allowed to settle for 3 min. The Chloroform layer is collected and 2.5 ml of this used directly for the absorbance maximum. The absorbance of the complex in Chloroform layer is measured at maximum wavelength (λ max.) at 555 nm.

RESULTS AND DISCUSSION

The absorption spectrum of these ion associates gives maximum absorptivity (λ max) in 555 nm. Respectively, where the absorbance of the reagent blank was very small and the calibration graph was constructed as shown in Fig. 4.

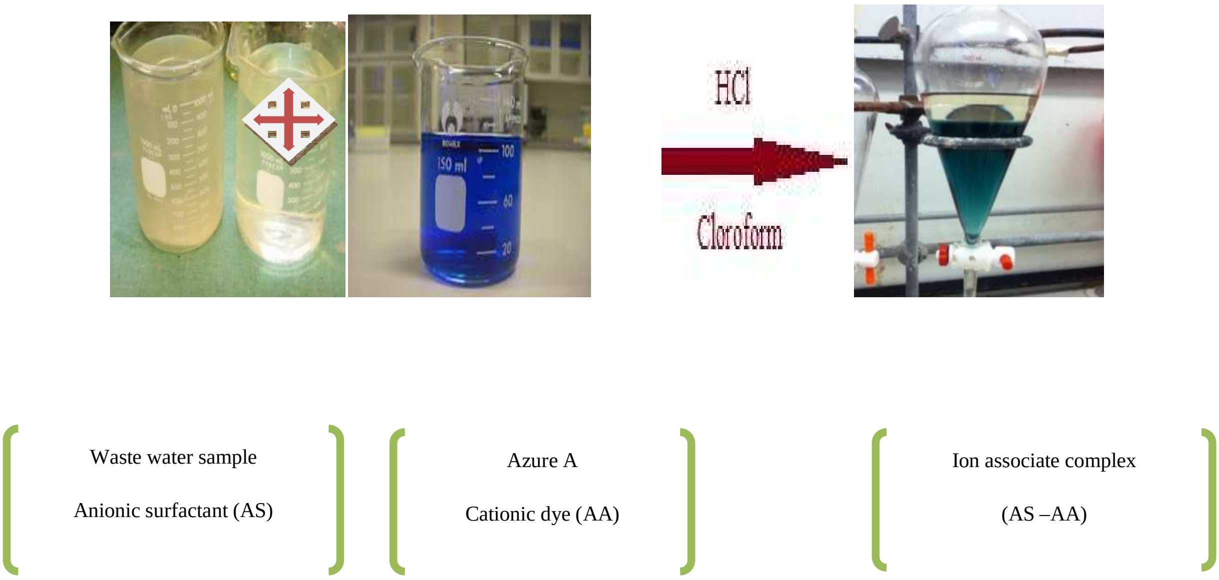

Fig. 3: Ion pair associated reaction of anionic surfactant and cationic dye Azure A.

It is found that ionic complex formed between sodium dodecyle sulphate (SDS) and Azure A could be extracted efficiently. There are many methods which require 50-80 min. for shaking and standing, but in the present method shaking time is 2 minute and retention time is 3 minute. The absorbance obtained remained constant with shaking for more than 5 min. It was found that a 0.001 M solution of Azure-A in the range of 2- 4 ml, 0.000035 M solution of SDS were achieve the maximum color intensity and gives the maximum absorbance and (λ max) is found at 555 nm (Fig. 5). However, the temperature and pH affect the maximum color development.

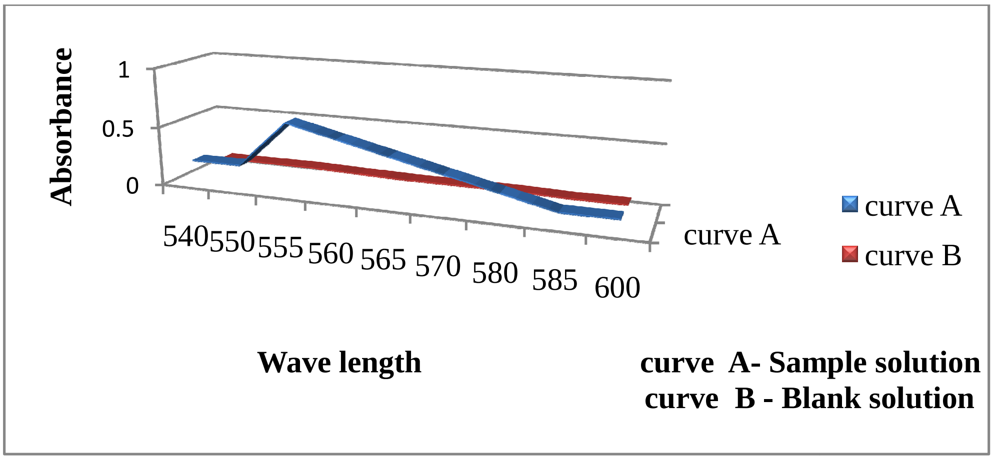

Fig. 4: Absorption spectrum of SDS and AA

Table: 1. Physico - chemical parameters of sampled waste waters containing surfactant.

Parameters	Sampling station (concentration in ppm.)							
	A1	**A2**	**A3**	**A4**	**A5**	**A6**	**A7**	**A8**
DO	3.4	3.7	3.2	3.4	3.7	3.9	3.9	3.1
Turbidity	0.41	0.46	0.50	0.47	0.35	0.37	0.40	0.55
Cl^-	151	155	141	167	164	141	146	159
F^-	0.44	0.41	0.71	0.48	0.56	0.52	0.68	0.69
Total Hardness	245	266	254	263	253	264	243	256
pH	8.2	7.1	7.8	7.3	7.2	7.6	7.8	7.5

The pH of these samples was ranged from 7.1 to 8.2. The pH values were found to highest in the location 1 showing the alkaline nature of the water. Moreover, Complex formation between SDS and AA is depending upon the pH of waste water and SDS gives maximum absorbtivity in acidic water, so during investigation pH is maintained.

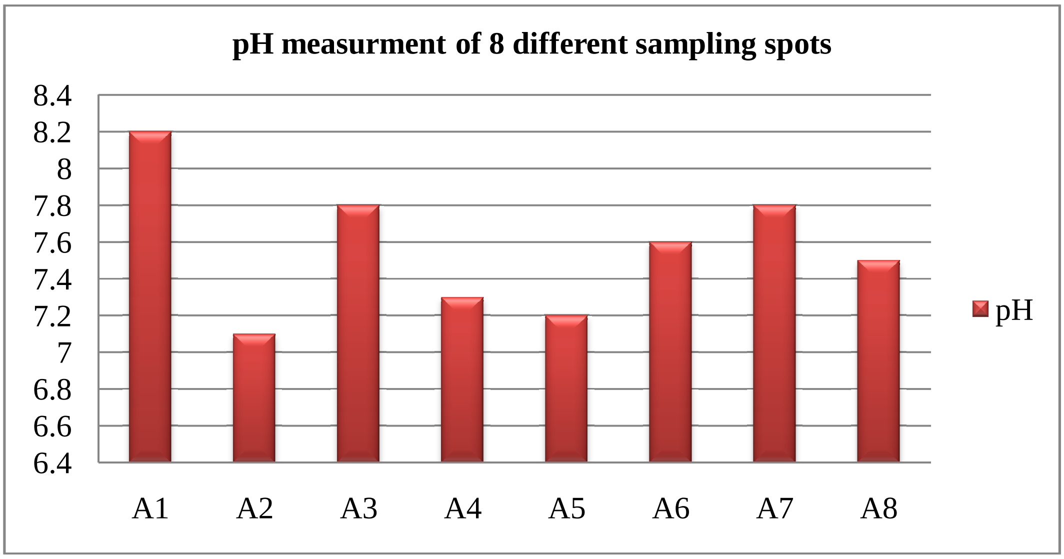

Fig. 5: pH analysis of waste water sample

The value of total hardness express the consuming capacity of soap, the Cl^- and F^- ions are corrosive element, affected the taste of water and degenerate the bones, the DO level and turbidity shows the extent of pollution (Table 1). The results of water parameters investigation shows that the water of the study area are contaminated due to presence of Ca^{2+} , Mg^{2+}, Cl^- and F^-. The concentration ratio of these ions to surfactant in waste water samples are usually within tolerance level and does not interfered in the formation of ion associate complex. Moreover, those ions which are of small size than the surfactant, interferes to form an ion association complex with Azure A.

Table: 2. Comparative SDS concentration (in ppm) at source, flow and dumping site of 8 major sewage sampling spots flowing across the Bilaspur city in the month November 2012.

Sampling spots (A)	Near starting source	At flowing region	At dumping site
A1	**1.96**	**0.73**	**2.13**
A2	**2.11**	**1.76**	**2.94**
A3	**1.75**	**1.33**	**2.99**
A4	**1.93**	**1.92**	**2.74**
A5	**2.03**	**0.66**	**3.01**
A6	**1.90**	**1.00**	**3.82**
A7	**1.27**	**0.82**	**4.27**
A8	**2.97**	**0.95**	**3.41**

The concentration percentage of AS under study indicates their concentration orders in various environmental systems. This order of SDS concentration in eight sampling spots in month November 2012 showed a wide degree of variation (Table 2). A higher sedimentation rate of SDS shows high concentration after dumping rather than during flow, it indicates the increased probability for enhancing the surfactant value in the nearby ground water sources (fig. 6).

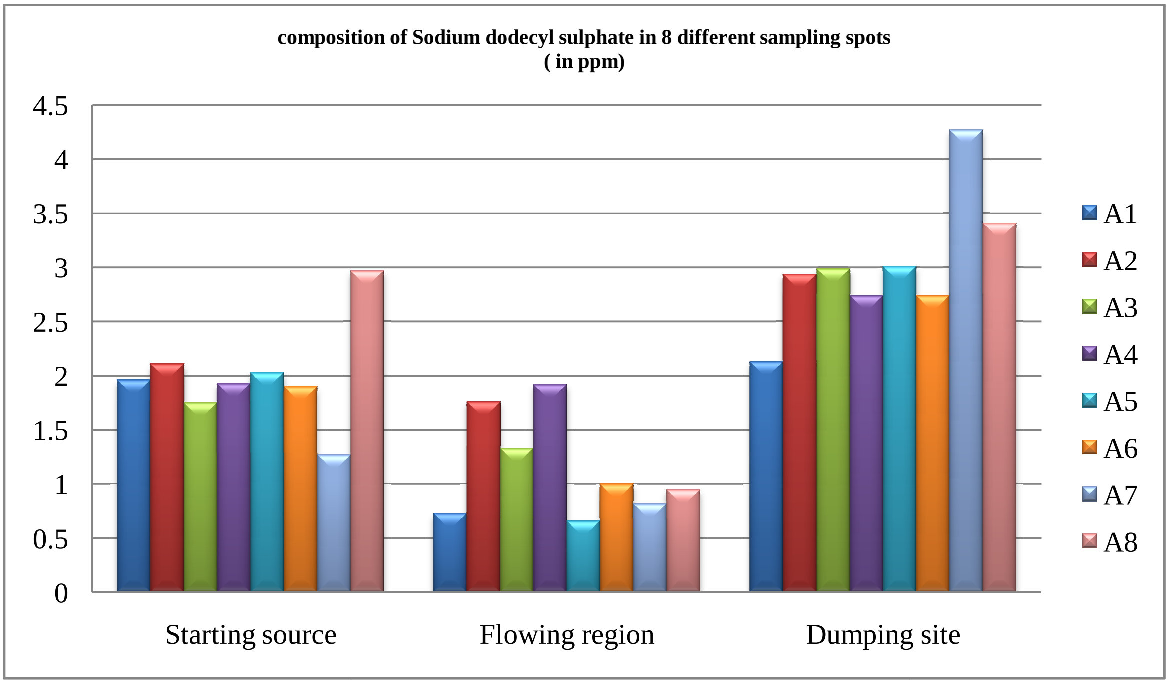

Fig. 6: composition of Sodium dodecyl sulphate in different sampling spots

CONCLUSION

The proposed spectrophotometric method is simple, sensitive, reliable and rapid for the determination of SDS. It offers several advantages over the other previously reported procedures. The proposed method used 25 ml aqueous sample instead of 100 ml or 50 ml, cited in the published reports [10, 11]. Only 5 ml portion of organic solvent is sufficient for each measurement in the proposed method; meanwhile, other reported methods used larger volumes. . It is well suited for the determination of trace AS in industrial and domestic sewage systems collected from urban and rural areas of Bilaspur city, Chhattisgarh, India.

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REFERENCES

[1] GG Ying, *Environment International*, **2006**, 32, 417 – 431.
[2] PS Ambily; MS Jisha, *J. Environ Biol*, **2012**, 37, 717- 720.
[3] M Renzi; A Jiovani; SE Focardy, *Journal of Environmental Protection*, **2012**, 3, 1004 -1009.
[4] SK Sar; C Verma; PK Pandey, and A Bhui, *Journal of the Chinese Chemical Society*, **2009**, 56, *(6)*, 1250-1256.
[5] SH Venhuis; M Meharvar, *International Journal Of Photo energy*, **2004**, 6, 115-125.
[6] DM Cacic; MS Bosnar; RM Puac; M Samardzic, *International Journal Of Electrochemical Science*, **2012**, 7, 875-885.
[7] J Wang; Z Du; W wang; W Xue, Turk *J. Chem.*, **2012**, 36, 545-555.
[8] CA Smith; X Li.; TH Mize, *Analytical Chemistry*, **2013**, 85, (8), 3812-3816.
[9] S Cathum; H Sabik, *Chromatographia*, **2001**, 53, 400-405.
[10] E Jurado; MF Serrano; JN Olea, *Chaemosphere*, **2006,** 65, 278-285.
[11] M Kamaya, Y Tomizawa, K Nagashima, *Anal. Chim. Acta*, **1998**, 362: 157.