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CLOUD POINT EXTRACTION OF DYES BY THE USE OF SORBITOL AND TRITON X-100 SURFACTANTS

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ABSTRACT

In the present study, Triton X-100 and Sorbitol surfactants were utilized to remove and extract cationic brill red X-56-N and disperse red-60 dyes, respectively. The parameters influencing the extraction, like pH, dye concentration and surfactant, were optimized. The best condition for the extraction of cationic brill red X-56-N was in neutral pH and use of 12.5(wt %) surfactant and [dye] = 100mg/L; moreover, the best condition for disperse red-60 extraction was in acidic pH, surfactant=2.0(wt %) and [dye] = 150mg/L.

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Introduction

The method of graphite furnace atomic absorption spectrometry and inductively coupled plasma mass spectrometry are the most sensitive techniques for the determination of a great many of the elements featuring very low traceability. Separation and pre-concensation are widely applied for the determination of precious metals' ions. The commonly used methods are solid phase extraction (SPE) [1-3], sedimentation [4, 5], columnar extraction [6, 7], electrode ion [8, 9], liquid-liquid extraction (LLE) [10] and cloud point extraction(CPF) [11, 12]. Cloud point extraction can be employed to extract various contaminants and it is sometimes necessary to make use of an appropriate ligand to chelate the intended cation. A sufficient amount of the surfactant aqueous solution is added to the solutions containing analyte and the whole solution is heated to the cloud point. Micelles form in the cloud point and the cationic and anionic groups enter the middle hole of the micelles either alone or in combined form and hence separated from the aqueous phase. Therefore, two phases form in the solution. One is rich in surfactant and contains contaminant and the other is an aqueous phase. The rich phase enjoys a larger density in respect to surfactant and accumulates at the bottom of the container and there is an array of various methods that can be applied to determine the analyte's concentration in the condensed specimen [13]. In the present study, Triton x-100 and sorbitol surfactants were utilized to correspondingly extract cationic brill red X-56-N and disperse red-60 dyes. In doing so, parameters like pH, dye concentration and surfactant amounts were optimized.

Materials and Methods

The required dyes and high purity surfactants were procured from the Iranian Institute for color and technology (ICST) and the German Merck Company, respectively. The devices used in the study were pH-meter (Lutron pH-206), an Arex Model heater and a UV spectrophotometer, model SP-3000 plus.

Cloud Point Extraction Procedure

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In the beginning stock solutions of dyes and surfactants were prepared. Then, the required concentration of each solution was acquired by diluting these solutions. The λ_{max} values of cationic brill red X-56-N and disperse red-60 were respectively calculated equal to 421.4 nm and 528 nm following which the calibration curves were delineated. The entire measurements were undertaken in constant λ_{max}. The examined solutions were 10mL dye solution and 10mL surfactant solution. The solution was heated in a water bath up to 80°C for a period of one hour so as to obtain a single phase system. Then the solution was allowed to rest for a period of 24 hours so as to separate the phases. The diluted phase was sampled by the use of a micro-syringe and the absorption rate was determined in λ_{max} value of the dye. The following relation was utilized to determine the extraction amount.

$R\%=C_0-C_e/C_0X100$ Relation (1)

In this relation, C_0 is the initial concentration of dye, C_e is the post-extraction dye concentration and R% is the extraction percentage.
To investigate the pH effects, buffer solutions were prepared in various pH ranges:

HCI (1M) +Sodium acetate (1M) →pH=0.5-3.5 Relation (2)

Sodium acetate (1M) +Acetic acid (0.2M) →pH=4.0-7.0 Relation (3)

Ammonium chloride (2M) +NH_4OH (1M) →pH=7.5-10.0 Relation (4)

Results and Discussion

The pH effects were evaluated via keeping constant such parameters as dye concentration (50mg/L), total volume of the solution (20ml) and surfactant (2.0%wt). It was found out that acidic pH better serves the dispersed dye extraction. This was due to the formation of OH_2+ in sorbitol structure that caused an increase in the reaction between the dye molecules and surfactant' furthermore, it was figured out that neutral pH is more appropriate for cationic dye extraction (Diagram 7, 8).
In an investigation of the extent to which sorbitol and triton X-100 are effective as surfactants, the optimum amounts of 2.0 (wt %) and 12.5 wt (%) were respectively recorded. Any further increase in surfactant amounts caused a decrease in the extraction rates and this might have been due to the micelle pile-ups that prevent the surfactants to exert more appropriate effects (Diagram 9, 10).
The extraction rates of the surfactants were found reduced with the increase in the dye concentration due to an increase in the dye viscosity in the solution and the amalgamation of dye molecules followed by dye molecules agglutination. The performance thresholds of sorbitol and triton x-100 were obtained equal to 150 mg/L and 100 mg/L, respectively (Diagram 11, 12).

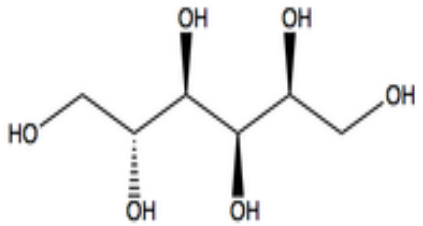

Diagram 1. Structure of disperse red-60

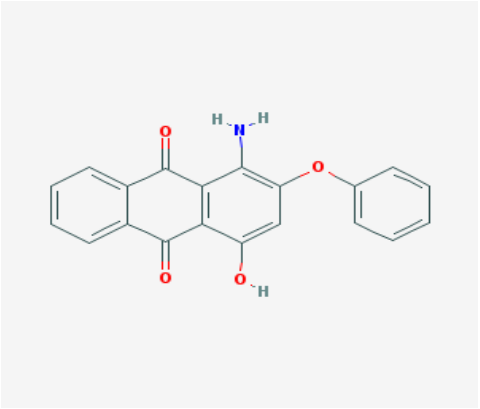

Diagram 2. Structure of sorbitol

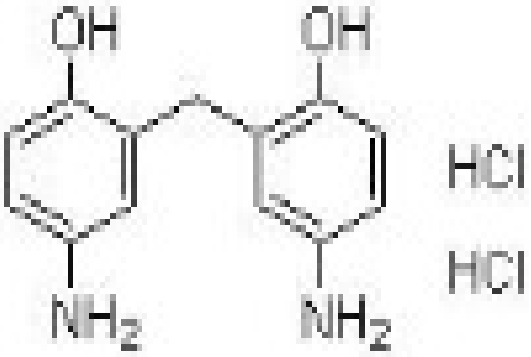

Diagram 3. Structure of cationic brill red X-56-N

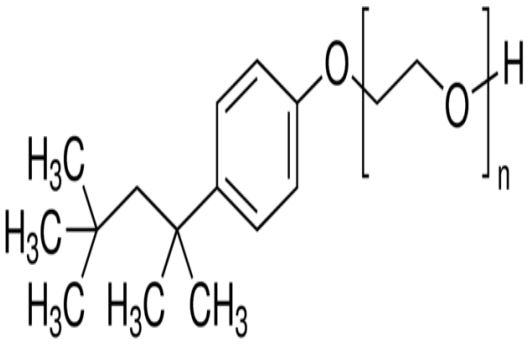

Diagram 4. Structure of Triton X-100

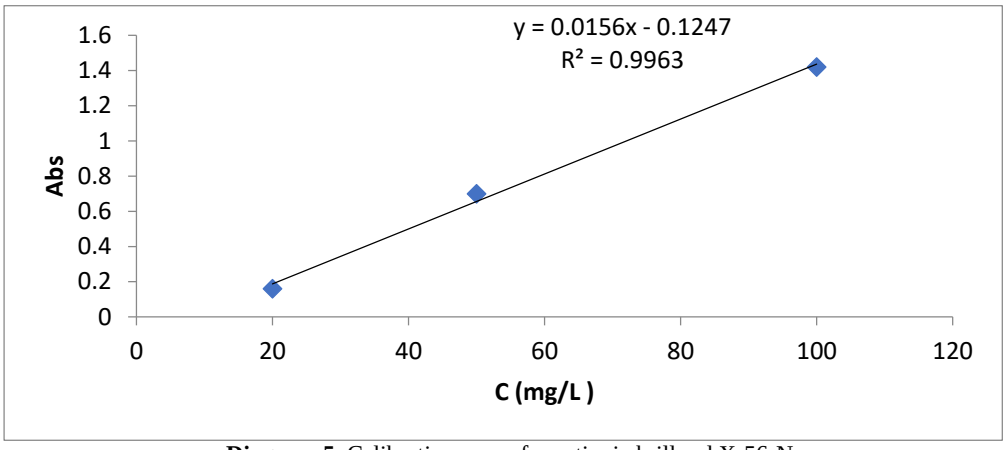

Diagram 5. Calibration curve for cationic brill red X-56-N

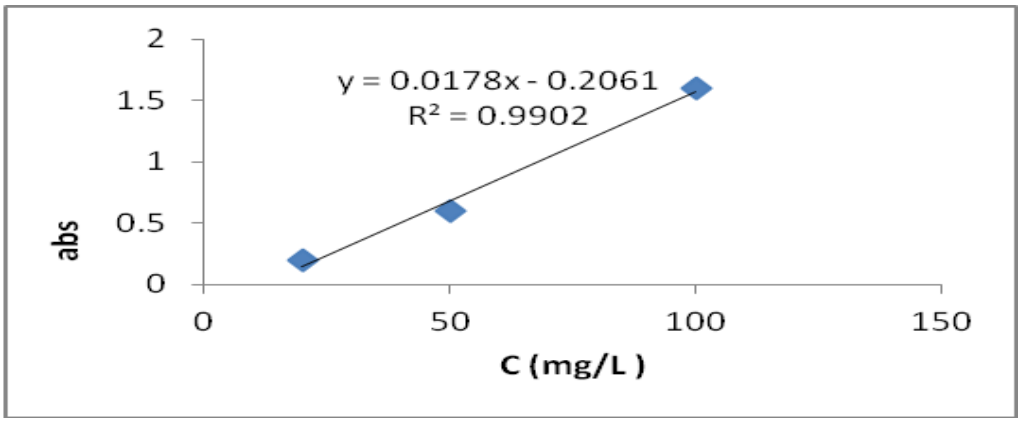

Diagram 6. Calibration curve for disperse red-60

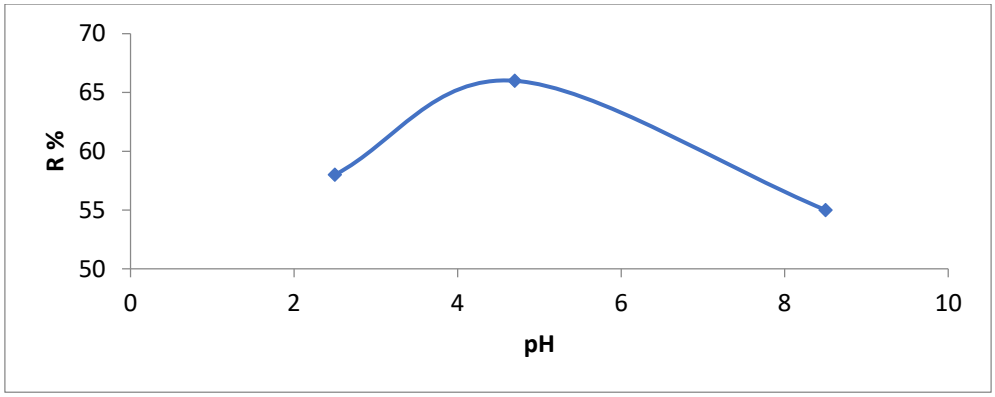

Diagram 7. Effect of pH in cationic brill red X-56-N extraction (C=50mg/L, V=20ml, Triton X-100=5.0%wt)

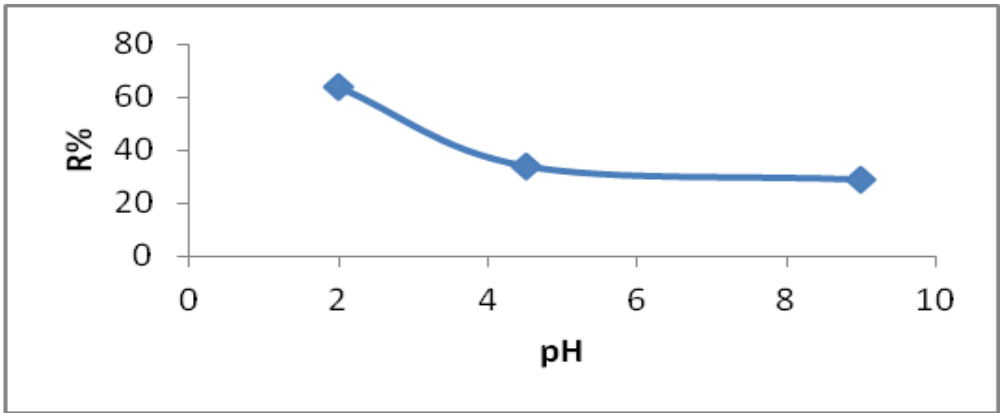

Diagram 8. Effect of pH in disperse red-60 extraction (C=50mg/L, V=20ml, Sorbitol=2.0%wt)

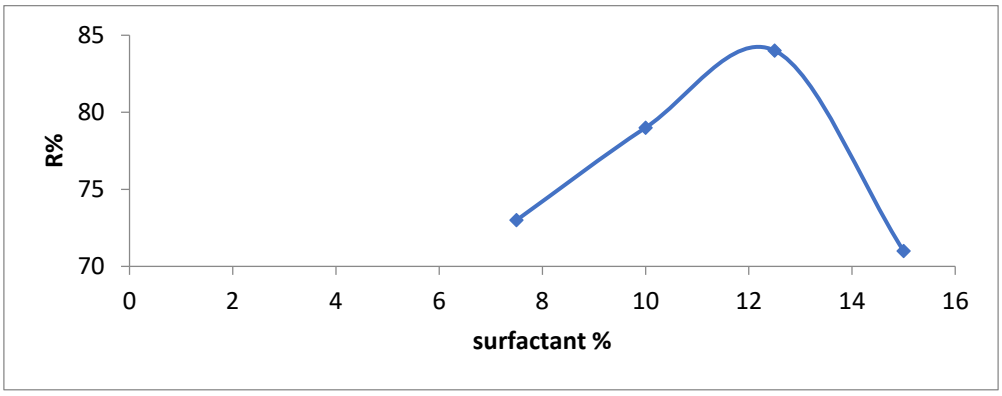

Diagram 9. Effect of Triton X-100 in extraction ([dye]=50mg/L, V=20ml, pH=7.5)

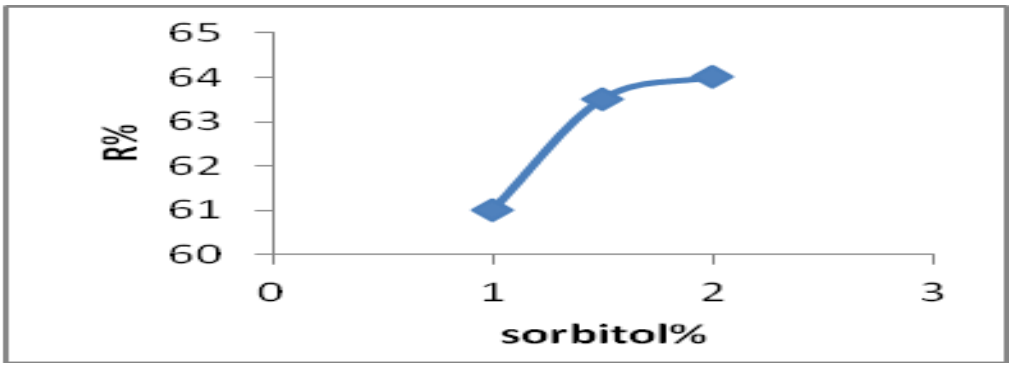

Diagram 10. Effect of Sorbitol in extraction ([dye]=50mg/L, V=20ml, acidic pH)

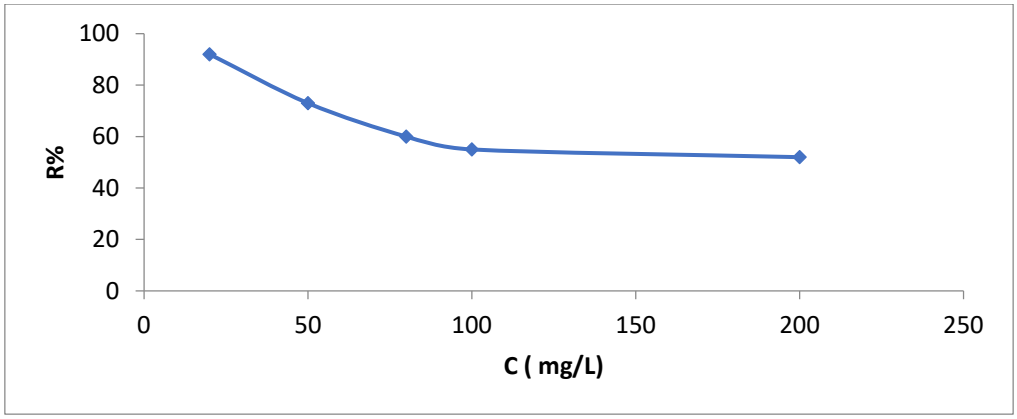

Diagram 11. Effect of cationic brill red X-56-N concentration in extraction (Triton X-100=7.5%wt, V=20mL, pH=7.5)

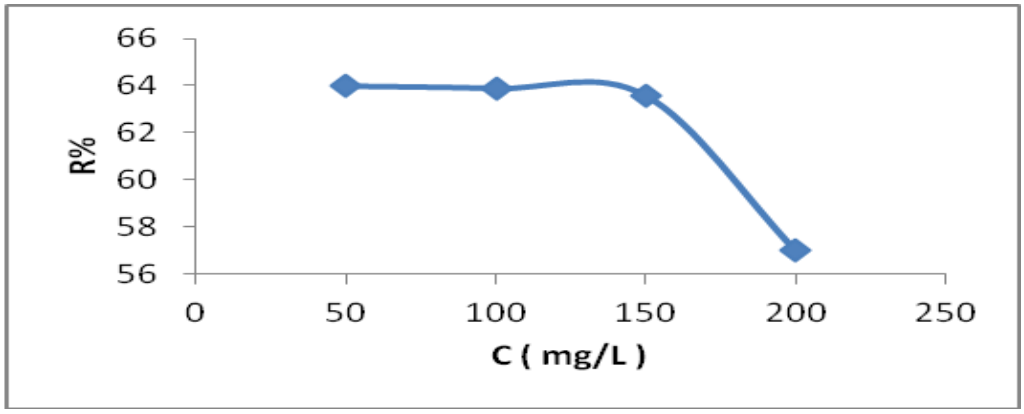

Diagram 12. Effect of disperse red-60 concentration in extraction (sorbitol=2.0%, V=20mL, acidic pH)

Conclusion

The study results indicated that triton x-100 and sorbitol can be utilized to extract dye contaminants from industrial wastewaters with no use of solvents. According to CPE method's being a simple and less expensive process, these surfactants can be also applied for the elimination of aromatic contaminants and/or heavy metals in the industry.

References

1. Y. Wu, Z. Jiang, B. Hu, Duan, (2004). Electrothermal Vaporization Inductively Coupled Plasma Atomic Emission Spectrometry Determination of Gold, Palladium, and Platinum using Chelating Resin YP. Ai as both extractant and Chemical Modifier, J. Talanta, 585-592.
2. Y. Qing, Y. Hang, R. Wanjaul, Z. Jiang, B. Hu, (2003). Adsorption Behavior of Noble Metal Ions (Au, Ag, Pd) on Nanometer-size Titanium Dioxide · with ICP-AES, Anal. Sci. 1417-1420.
3. P. Yin, Q. Xu, R. Qu, G. Zhao, Y. Sun, (2010). Adsorption of Transition Metal Ions from Aqueous Solutions onto a Novel Silica Gel Matrix Inorganic-Organic Composite Material, J. Hazard. Mater. 710-716.
4. R. Chand, T. Watari, K. Inoue, H. Kawakita, H.N. Luitel, D. Parajuli, T. Torikai, M. Yada, (2009). Selective Adsorption of Precious Metals from Hydrochloric Acid Solutions Using Porous Carbon Prepared from Barley Straw and Rice Husk, Minerals. Eng. 1277-1282.
5. M.Soylak, M. Tuzen, (2008). Solid Phase Extraction of Heavy Metal Ions in Environmental Samples on Multiwalled Carbon Nanotubes, J. Hazard. Mater. 632-639.
6. S.S. Sawant, (2009). Sequential Separation and Spectrophotometric Determination of Osmium and Platinum with 5-Chloro-2- Hydroxythiobenzhydrazide, Anal. Sci. 813-818.
7. Q. Hu, X. Yang, Z. Huang, J. Chen, G. Yang, (2005). Simultaneous Determination of Palladium, Platinum, Rhodium and Gold by on-Line Solid Phase Extraction and High Performance Liquid Chromatography with 5-(2-Hydroxy-5-Nitrophenylazo) Thiorhodanine as Pre-Column Derivatization Regents, J. Chromatography. A, 77-82.

8. J.M. Sanchez, O. Obrezkov, V. Salvad, (2000). Separation of some Platinum Group Metal Chelates with 8-Hydroxyquinoline by Various High-Performance Liquid Chromatographic Methods, J. Chromatography. A, 217-226.
9. M.B. Gholivand, M. Mohammadi, M. Khodadadian, M.K. Rofouei, (2009). Novel Platinum(II) Selective Membrane Electrode Based on 1,3- Bis (2-Cyanobenzene) Triazene, Talanta, 922-928.
10. S. Kagaya, D. Takata, T. Yoshimori, T. Kanbara, K. Tohda, (2010). A Sensitive and Selective Method for Determination of Gold(ill) Based on Electrothermal Atomic Absorption Spectrometry in Combination with Dispersive Liquid-Liquid Microextraction Using Dicyclohexylamine, Talanta, 1364-1370.
11. Y.J. Park, D.J. Fray, (2009). Recovery of High Purity Precious Metals from Printed Circuit Boards, J. Hazard. Mater, 1152-1158.
12. L. Pan, Z.D. Zhang, (2009). Solvent Extraction and Separation of Palladium(II) and Platinum(IV) from Hydrochloric Acid Medium with Dibutyl Sulfoxide, Minerals. Eng. 1271-1276.
13. T. Saitoh, W.L. Hinze, (1991). Concentration of Hydrophobic Organic Compounds and Extraction of Protein Using Alkylammoniosulfate Zwitterionic Surfactant Mediated Phase Separations Cloud Point Extractions, Anal. Chem. 2520-2525.