

**INTERACTION OF CATIONIC AND ANIONIC SURFACTANTS IN PURE
WATER AND METHANOL-WATER MIXED SOLVENT MEDIA**



A Dissertation

Submitted to the Department of Chemistry, Mahendra Morang Adarsh Multiple Campus, Tribhuvan University, Biratnagar, Morang, Nepal, as a Partial Fulfillment of the Requirements for the Degree of Master of Science in Chemistry

By

KAVITA PATHAK

(Symbol No.: 21534/2069; T. U. Regd. No.: 5-1-2-21-2005)

Department of Chemistry

Mahendra Morang Adarsh Multiple Campus,

Institute of Science and Technology

Tribhuvan University

Biratnagar, Morang, Nepal

October, 2015

Tribhuvan University, Institute of Science and Technology
Department of Chemistry
Mahendra Morang Adarsh Multiple Campus,
Biratnagar, Morang, Nepal

LETTER OF ACCEPTANCE

This dissertation work entitled “*Interaction of Cationic and Anionic Surfactants in Pure Water and Methanol-Water Mixed Solvent Media*” submitted by *Ms. Kavita Pathak* (Symbol No.: 21534/2069; T. U. Regd. No.: 5-1-2-21-2005) has been accepted as a partial fulfillment of the requirements for the Degree of Master of Science in Chemistry.

Supervisor

Dr. Ajaya Bhattarai
Department of Chemistry
Mahendra Morang Adarsh Multiple Campus,
Tribhuvan University, Biratnagar, Morang,
Nepal

External Examiner

Professor Dr. Jagadeesh Bhattarai
Central Department of Chemistry
Tribhuvan University, Kirtipur
Kathmandu, Nepal

Internal & Head of the Department

Associate Professor Mr. Ghanashyam Shrivastav,
Department of Chemistry,
Mahendra Morang Adarsh Multiple Campus,
Tribhuvan University, Biratnagar, Morang,
Nepal

Date: *October 8, 2015 (Asoj 21, 2072)*

FORWARD

This M. Sc. dissertation work entitled “*Interaction of Cationic and Anionic Surfactants in Pure Water and Methanol-Water Mixed Solvent Media*” submitted by Ms. Kavita Pathak (Symbol No.: 21534/2069; T. U. Regd. No.: 5-1-2-21-2005) for the Degree of Master of Science in Chemistry of Tribhuvan University was carried out under my supervision in the academic year 2013-2014. During the research period, Ms. Pathak has performed the work sincerely and satisfactorily.

Supervisor

Dr. Ajaya Bhattarai

Department of Chemistry

Mahendra Morang Adarsh Multiple Campus,

Tribhuvan University, Biratnagar, Morang,

Nepal

October 8, 2015

DECLARATION

I, *Kavita Pathak* (Symbol No.: 21534/2069; T. U. Regd. No.: 5-1-2-21-2005), hereby declare that the present dissertation work is genuine and done originally and has not been submitted elsewhere for any degree. Any literature, data or works done by others and cited in this dissertation have been given due acknowledgements and listed in the reference section.

Kavita Pathak

October 8, 2015

DEDICATION

To my parents

Late Krishna K. Pathak & Mrs. Kamala Pathak

ACKNOWLEDGEMENTS

Foremost, I would like to express sincere gratitude to my supervisor Dr. Ajaya Bhattarai, Department of Chemistry, Mahendra Morang Adarsh Multiple Campus, Biratnagar, Nepal for his patience, motivation, enthusiasm, immense knowledge and for the continuous support. His guidance helped me in all the time of research and writing of this thesis.

I am honorably thankful to Associate Professor Mr. Ghanashyam Shrivastav, Head of The Department of Chemistry, Mahendra Morang Adarsh Multiple Campus, Biratnagar, Nepal for his continuous encouragement and insightful comments. I am also thankful to the TWAS Research Grants Programme for providing research requisites for this M.Sc. dissertation work.

I anticipate the valuable suggestions kindly laid by my respected teachers; Prof. Dr. S.K. Chatterjee, Mr. Tulasi P. Niraula and Mr. Sujit K. Shah during this thesis work.

I am equally thankful to all other faculty members and staffs of the Department of Chemistry. A special thank goes to Brother Mr. Bikash Dev for providing me all the help being required and conducive conditions to complete my dissertation work.

I take this opportunity to thank God, my family members: my mother Mrs. Kamala Pathak, my husband Mr. Rohit J. Bhattarai, my sister Mrs. Kusum Giri, my brother-in-law Mr. Bhupesh Giri and Ms. Prerana Khadka for supporting me throughout the entire process, both by keeping me harmonious and helping me putting pieces together. Last but not the least; I would like to express my warm thanks to one and all, who directly or indirectly, have lent their hand in this venture.

Kavita Pathak
October 8, 2015

ABSTRACT

The properties of anionic-rich and cationic-rich mixtures of DTAB (Dodecyltrimethylammonium bromide) and SDS (Sodiumdodecyl sulfate) in pure water and methanol-water mixed solvent media were studied by measuring the conductivity, density and surface tension at room temperature. Various physico-chemical properties like cmc, thermodynamic parameters (G_m) and surface activity parameters (γ_{max} , A_{min}) were evaluated.

The result showed that sharp increased in conductance with increasing the concentration of surfactant mixtures, were found to decrease with increasing methanol content in the solvent composition. The density was almost increased and surface tension was initially decreased with increasing concentration of surfactants for both the anionic-rich and the cationic-rich mixtures. With increasing methanol content in the solvent composition, critical micelle concentration (cmc) of the mixed surfactants increased for conductance, density and surface tension measurements. The degree of micellar dissociation (α) was found to be increased whereas the surface excess concentration (Γ_{max}) was found to be decreased. However, the increase in minimum area per molecule was seen with increasing in volume fraction of the methanol for both the anionic-rich and cationic-rich systems.

CONTENTS

	Page No.
Letter of Acceptance	i
Forward	ii
Declaration	iii
Dedication	iv
Acknowledgements	v
Abbreviations	vi
Contents	vii
Abstract	viii
Chapter –1: INTRODUCTION	1-26
1.1 Surfactant Science and Technology	1-2
1.2 Historical Background	3-4
1.3 Surface Active Agents	4-4
1.3.1. Introduction of Surfactants	4-6
1.3.2. Mixed Surfactant system	6-7
1.3.3. Classification of Surfactants	8-10
1.3.4. Critical Micelle Concentration	11-14
1.3.5. Factors affecting the micelle formation and CMC	14-17
1.3.6. Different types of Aggregates	17-20
1.3.7. Development and uses of Surfactants	20-21
1.3.8. Information of Surfactant under study	21-22
1.4 Literature Survey of the Study	23-25
1.5 Objectives of Study	25-26
Chapter–2: EXPERIMENTAL METHODS	27-34
2.1 Materials	27
2.2 Methods	27-30
2.3 Procedure	31-34
Chapter –3: RESULTS AND DISCUSSION	35-57
3.1 Conductance Measurement	35-47
3.2 Surface Tension Measurement	47-53
3.3 Density Measurement	53-56
3.4 Conclusions	57
REFERENCES	58-61
APPENDIX	62-65

ABBREVIATIONS

DTAB	:	Dodecyltrimethylammonium bromide
SDS	:	Sodiumdodecyl sulfate
ABS	:	Alkylbenzene sulfonates (ABS)
PT	:	Propylene tetramer (PT)
cmc	:	Critical micelle concentration
T_k	:	Kraft temperature
CTAB	:	Cetyltrimethylammonium bromide
κ	:	Specific conductivity
Γ_{max}	:	Surface excess concentration
A_{min}	:	Minimum area per molecule
α	:	Degree of micellar dissociation