

**COMPETITIVE REMOVAL OF MIXED HEAVY METALS FROM WATER  
BY MULTISTAGE FOAM FRACTIONATION**

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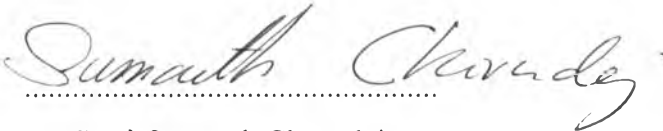
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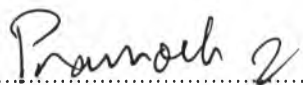
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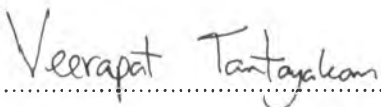
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## ABSTRACT

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In this study, a continuous multistage ion foam fractionation column with 5 bubble-cap trays will be employed to study the removal of (i) individual heavy metal including cadmium (Cd), copper (Cu) and nickel (Ni) and (ii) mixed heavy metals at a low concentration (10 mg/L). Sodium dodecyl sulfate (SDS) will be used as foam generator. In order to achieve a maximum process performance, several parameters affecting the separation performance will be investigated including SDS/Cd ratio, foam height, operating parameters—feed flow rate and air flow rate. The separation efficiency will be evaluated in terms of enrichment ratio, recovery or removal percentage, and separation factor. The system has operated at an air flow rate of 80 dm<sup>3</sup>/min and a feed flow rate of 60 mL/min, located in the operational zone, were selected to run the multistage ion foam fractionation column and a lowest feed SDS/Cd molar ratio of 8/1. An increase in feed SDS/Cd molar ratio enhanced significantly the removal of heavy metal ions. Under the optimum operational conditions, the studied multistage ion foam fractionation system was able to remove single heavy metal ions greater than 99 %. For mixed heavy metal, The highest separation efficiency of each heavy metal (the SDS recovery ~ 90%, the heavy metal removal ~ 90%) was obtained at a foam height of 60 cm, an air flow rate of 80 dm<sup>3</sup>/min, and a feed flow rate of 60 mL/min. For the mixed heavy metal system operated under the same optimum conditions, the selective separation of heavy metals was in orders of Cd > Cu > Ni because of larger ions preferentially adsorbed because its outer secondary hydration water molecules are more easily to be lost when interacting with the negatively charged head group of SDS adsorbed at the interface.

## บทคัดย่อ

ชกนกันท์ พงษ์เรือง : การแข่งขันการแยกของโลหะหนักผสมในน้ำโดยกระบวนการแยกโฟมและไอออนแบบลำดับส่วนต่อเนื่อง (Competitive Removal of Mixed Heavy Metals from Water by Multistage Foam Fractionation) อ. ที่ปรึกษา : ศ. ดร. สุเมธ ชวเดช 94 หน้า

ในการศึกษานี้ คอลัมน์สกัดส่วนฟองไอออนหลายขั้นตอนแบบต่อเนื่องที่มีสภาพประกอบด้วยฟองถูกนำมาใช้เพื่อแยกไอออนแคดเมียมจากน้ำที่มีความเข้มข้น(1) โลหะหนักชนิดเดียว ประกอบด้วย แคดเมียม(Cd), ทองแดง(Cu), นิกเกิล(Ni) และ (2) โลหะหนักผสม ในระดับต่ำ (10 มก./ล.) และ โซเดียมโดเดซิลซัลเฟต (SDS) ถูกใช้สร้างฟอง ในการทำให้ประสิทธิภาพการกำจัดโลหะสูงสุดในรูปของอัตราส่วนการกำจัด แฟคเตอร์การแยก และแฟคเตอร์ที่เหลือของโลหะหนัก ระบบต้องถูกควบคุมให้มีการขนถ่ายในแบบดูดซับสูงสุดด้วยการขนถ่ายแบบของเหลวต่ำสุด ในการเพิ่มของอัตราส่วนโมล SDS ต่อแคดเมียมในน้ำสามารถเพิ่มการกำจัดไอออนแคดเมียมอย่างมีนัยสำคัญ ภายใต้สภาวะการทำงานที่เหมาะสม ระบบที่ศึกษาสามารถแยกไอออนโลหะหนักชนิดเดียวได้สูงกว่า 99 เปอร์เซ็นต์ สำหรับกรณีโลหะหนักผสมพบว่าระบบที่ศึกษาสามารถแยกโลหะผสมได้สูงกว่า 97 เปอร์เซ็นต์ และจากการศึกษาพบว่าทางเลือกของการแยกไอออนโลหะหนักผสมมีผลดังนี้ แคดเมียมมากกว่าทองแดงและมากกว่านิกเกิล

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## TABLE OF CONTENTS

	<b>PAGE</b>
Title Page	i
Abstract (in English)	iii
Abstract (in Thai)	iv
Acknowledgements	v
Table of Contents	vi
List of Figures	ix
 <b>CHAPTER</b>	
<b>I INTRODUCTION</b>	<b>1</b>
 <b>II LITERATURE REVIEW</b>	
2.1 Surfactants	4
2.2 Foam	5
2.2.1 Foam Formation	5
2.2.2 Structure of Foam	6
2.2.3 Foam Stability	8
2.3 Surfactant Adsorption at Air–Water Interface	13
2.4 Adsorptive Bubble Separation	14
2.4.1 Principles of Foam Fractionation	15
2.4.2 Mole Balance in Foam Fractionation Column	17
2.4.3 Literature Review on Surfactant Recovery Using Foam Fractionation	21

<b>CHAPTER</b>	<b>PAGE</b>
2.5 Ion Foam Fractionation	22
2.5.1 Principle of Foam Fractionation for Ion Separation	22
2.5.2 Kinetics of Ion Foam Fractionation	22
2.5.3 Recovery of Metal Product from Foamate	24
2.5.4 Literature review on Ion Foam Fractionation and Ion Flotation	25
2.5.5 Literature review on Removal of Trace Cd <sup>2+</sup> using Continuous Multistage Ion Foam Fractionation	27
2.5.6 Literature review on Selective Removal of Heavy Metals using Ion Flotation	29
 <b>III    EXPERIMENTAL</b>	 31
3.1 Materials	31
3.2 Equipment	31
3.2.1 The Foam Fractionation Unit	31
3.3 Methodology	32
3.3.1 Individual Heavy Metal	32
3.3.2 Mixed Heavy Metals	33
3.4 Measurement and Analytical Method	35
 <b>IV    RESULTS AND DISCUSSION</b>	 36
4.1 Operating Limits	36
4.2 Removal of Individual of Heavy Metal	38
4.2.1 Removal of Cadmium	38
4.2.2 Removal of Copper	50
4.2.3 Removal of Nickel	60
4.3 Removal of Mixed Heavy Metals	70
4.4 Competitive Removal of Mixed Heavy Metals	83

<b>CHAPTER</b>		<b>PAGE</b>
<b>VI</b>	<b>CONCLUSIONS AND RECOMMENDATIONS</b>	<b>85</b>
	5.1 Conclusions	85
	5.2 Recommendations	86
	<b>REFERENCES</b>	<b>87</b>
	<b>APPENDIX</b>	<b>93</b>
	<b>Appendix A</b> Concentration of Heavy Metals by Various Foam Height	93
	<b>CURRICULUM VITAE</b>	<b>94</b>



## LIST OF FIGURES

FIGURE	PAGE
2.1	Schematic of a surfactant molecule. <span style="float: right;">4</span>
2.2	Structure of micelle. <span style="float: right;">5</span>
2.3	Formation of foam. <span style="float: right;">6</span>
2.4	Plateau border at point of meeting of three bubbles. <span style="float: right;">7</span>
2.5	Structure of foam. <span style="float: right;">7</span>
2.6	Schematic of foam structure in a column. <span style="float: right;">8</span>
2.7	Surface elasticity of foam film. <span style="float: right;">9</span>
2.8	Reduction of foam film drainage by particle trapped in the plateau border. <span style="float: right;">11</span>
2.9	(a) Surfactants at the air–liquid interface in the absence of thin film drainage. (b) Surface tension gradient on the surface is created as the surfactants are displaced due to the bulk viscous drag force in the presence of drainage. (c) The Marangoni effect results in a decrease in the net drainage rate. <span style="float: right;">13</span>
2.10	Classification for the adsorptive bubble separation methods. <span style="float: right;">14</span>
2.11	Principle of foam fractionation. <span style="float: right;">16</span>
2.12	Material balance around foam phase. <span style="float: right;">17</span>
2.13	Dependence of normalized bulk liquid transport on foamate volumetric ratio as described by Equation 2.12. <span style="float: right;">19</span>
2.14	Dependence of % surfactant recovery on foamate volumetric ratio and normalized adsorptive transport as described by Equation 2.13. <span style="float: right;">20</span>
2.15	Co-adsorption of surfactant and metal mechanism for ion separation in ion foam fractionation. <span style="float: right;">23</span>

<b>FIGURE</b>	<b>PAGE</b>
2.16 A conceptual diagram of foam fractionation of ions integrated with the recovering unit (FF-Electrolysis).	25
3.1 The Multistage Foam Fractionation Unit	32
4.1 Boundaries of the operational zone.	38
4.2 Effect of feed SDS/Cd molar ratio on (a) enrichment ratios of SDS and Cd, (b) % SDS recovery and Cd removal, and (c) separation factors of SDS and Cd at an air flow rate of 80 L/min, a feed flow rate of 60 mL/min, a foam height of 60 cm, a feed Cd concentration of 10 mg/L, and the number of trays equal to 5. Effect of air flow rate on the enrichment ratios of Cd and SDS (a); foamate volumetric ratio and molar ratio of SDS/Cd in foamate (b); SDS recovery and Cd.	40
4.3 Effect of foam height on (a) the enrichment ratios of Cd and SDS; (b) SDS recovery and Cd removal; and (c) the separation factors of SDS and Cd at air flow rate = 80 dm <sup>3</sup> /min, feed flow rate = 60 mL/min, number of trays = 5, feed Cd concentration = 10 mg/L, and a feed SDS/Cd molar ratios of 8/1. the residual factors of SDS and Cd (d); and the separation factors of SDS and Cd (e) at two conditions.	42
4.4 Effect of air flow rate on the enrichment ratios of Cd and SDS (a); SDS recovery and Cd removal (b); and the separation factors of SDS and Cd (c) at foam height = 60 cm, feed flow rate = 60 mL/min, number of trays = 5, feed Cd concentration = 10 mg/L, and a feed molar ratios of SDS/Cd of 8/1.	46

<b>FIGURE</b>	<b>PAGE</b>	
4.5	Effect of feed flow rate on the enrichment ratios of Cd and SDS (a); SDS recovery and Cd removal (b); and the separation factors of SDS and Cd (c) at foam height = 60 cm, air flow rate = 60 dm <sup>3</sup> /min, SDS/Cd = 8/1. feed Cd concentration = 10 mg/L, and number of trays = 5	48
4.6	Effect of feed SDS/Cu molar ratio on (a) enrichment ratios of SDS and Cu, (b) % SDS recovery and Cu removal, and (c) separation factors of SDS and Cu at an air flow rate of 80 L/min, a feed flow rate of 60 mL/min, a foam height of 60 cm, a feed Cu concentration of 10 mg/L, and the number of trays equal to 5.	51
4.7	Effect of foam height on (a) the enrichment ratios of Cu and SDS; (b) SDS recovery and Cu removal; and (c) the separation factors of SDS and Cu at air flow rate = 80 dm <sup>3</sup> /min, feed flow rate = 60 mL/min, number of trays = 5, feed Cu concentration = 10 mg/L, and a feed SDS/Cu molar ratios of 8/1.	53
4.8	Effect of air flow rate on the enrichment ratios of Cu and SDS (a); SDS recovery and Cu removal (b); and the separation factors of SDS and Cu (c) at foam height = 60 cm, feed flow rate = 60 mL/min, number of trays = 5, feed Cu concentration = 10 mg/L, and a feed molar ratios of SDS/Cu of 8/1.	56
4.9	Effect of feed flow rate on the enrichment ratios of Cu and SDS (a); SDS recovery and Cu removal (b); and the separation factors of SDS and Cu (c) at foam height = 60 cm, air flow rate = 60 dm <sup>3</sup> /min, SDS/Cd = 8/1, feed Cu concentration = 10 mg/L, and number of trays = 5.	58

FIGURE	PAGE
4.10 Effect of feed SDS/Ni molar ratio on (a) enrichment ratios of SDS and Ni, (b) % SDS recovery and Ni removal, and (c) separation factors of SDS and Ni at an air flow rate of 80 L/min, a feed flow rate of 60 mL/min, a foam height of 60 cm, a feed Ni concentration of 10 mg/L, and the number of trays equal to 5.	61
4.11 Effect of foam height on (a) the enrichment ratios of Ni and SDS; (b) SDS recovery and Ni removal; and (c) the separation factors of SDS and Ni at air flow rate = 80 dm <sup>3</sup> /min, feed flow rate = 60 mL/min, number of trays = 5, feed Ni concentration = 10 mg/L, and a feed SDS/Ni molar ratios of 8/1.	63
4.12 Effect of air flow rate on the enrichment ratios of Ni and SDS (a); SDS recovery and Ni removal (b); and the separation factors of SDS and Ni (c) at foam height = 60 cm, feed flow rate = 60 mL/min, number of trays = 5, feed Ni concentration = 10 mg/L, and a feed molar ratios of SDS/Ni of 8/1.	66
4.13 Effect of feed flow rate on the enrichment ratios of Ni and SDS (a); SDS recovery and Ni removal (b); and the separation factors of SDS and Ni (c) at foam height = 60 cm, air flow rate = 60 dm <sup>3</sup> /min, SDS/Ni = 8/1, feed Ni concentration = 10 mg/L, and number of trays = 5	68

FIGURE	PAGE
4.14 Effect of feed SDS/heavy metal molar ratio on (a) enrichment ratios of SDS and heavy metals, (b) % SDS recovery and heavy metals removal, and (c) separation factors of SDS and heavy metals at an air flow rate of 80 L/min, a feed flow rate of 60 mL/min, a foam height of 60 cm, a feed mixed heavy metals concentration of 10 mg/L, and the number of trays equal to 5.	72
4.15 Effect of foam height on (a) the enrichment ratios of heavy metals and SDS; (b) SDS recovery and heavy metals removal; and (c) the separation factors of SDS and heavy metals at air flow rate = 80 dm <sup>3</sup> /min, feed flow rate = 60 mL/min, number of trays = 5, feed Ni concentration = 10 mg/L, and a feed SDS/Ni molar ratios of 8/1.	75
4.16 Effect of air flow rate on the enrichment ratios of heavy metals and SDS (a); SDS recovery and heavy metals removal (b); and the separation factors of SDS and heavy metals (c) at foam height = 60 cm, feed flow rate = 60 mL/min, number of trays = 5, feed Ni concentration = 10 mg/L, and a feed molar ratios of SDS/Ni of 8/1.	79
4.17 Effect of feed flow rate on the enrichment ratios of heavy metals and SDS (a); SDS recovery and heavy metals removal (b); and the separation factors of SDS and heavy metals (c) at foam height = 60 cm, air flow rate = 60 dm <sup>3</sup> /min, SDS/Ni = 8/1, feed Ni concentration = 10 mg/L, and number of trays = 5	81
4.18 Heavy metal concentrations at foam height = 60 cm, air flow rate = 60 dm <sup>3</sup> /min, SDS/Ni = 8/1, feed Ni concentration = 10 mg/L, and number of trays = 5	84