

SELECTIVE ADSORPTION OF HEAVY METAL AND IONIC DYE
ON SUPERPARAMAGNETIC PARTICLES

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A Thesis Submitted in Partial Fulfillment of the Requirements
for the Degree of Master of Science Program in Environmental Management

(Interdisciplinary Program)

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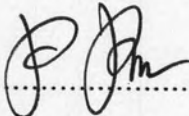
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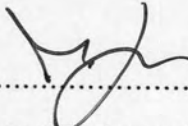
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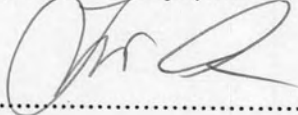
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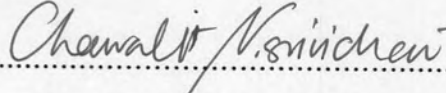

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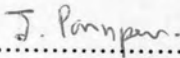
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สุเมธ จันทร์สุทนต์พจน์ : การดูดซับแบบคัดเลือกของโลหะหนักและสีย้อมชนิดมีประจุบนอนุภาคที่มีสมบัติซูเปอร์พาราแมกเนติก. (SELECTIVE ADSORPTION OF HEAVY METAL AND IONIC DYE ON SUPERPARAMAGNETIC PARTICLES) อ.ที่ปรึกษาวิทยานิพนธ์หลัก : อ. ดร. ปฏิภาณ ปัญญาพลกุล, 194 หน้า.

งานวิจัยนี้ได้ทำการศึกษาผลกระทบของหมู่ฟังก์ชันบนพื้นผิวของอนุภาคเคลือบซิลิกาที่มีสมบัติซูเปอร์พาราแมกเนติก (SCP) ต่อการดูดซับแบบคัดเลือกของสีย้อมชนิดมีประจุ (สีแอมิโดบลู 45 และสีเมทิลีนบลู) และโลหะหนัก (ทองแดง แคดเมียม และ ตะกั่ว) จากน้ำเสียสังเคราะห์โดยทำการศึกษาเปรียบเทียบโดยใช้ข้อมูลทางจลนพลศาสตร์และไอโซเทอมการดูดซับในกรณีผลสารแบบเดี่ยวและแบบคู่ โดยทำการสังเคราะห์อนุภาคขนาดนาโนชนิดแมกเนไทต์และเคลือบผิวด้วยผลิตภัณฑ์เกิดรวมถึงต่อติดหมู่ฟังก์ชันชนิด 3-aminopropyltriethoxy- และ 3-mercaptopropyl- (AM-SCP และ MP-SCP ตามลำดับ) ทำการวิเคราะห์คุณสมบัติทางกายภาพ-เคมีของตัวกลางดูดซับสังเคราะห์โดยวิธีไอโซเทอมการดูดซับของก๊าซไนโตรเจน (BET) FT-IR การวิเคราะห์ทรานสดูคชันและ SEM เป็นต้น MP-SCP สามารถดูดซับโลหะหนักชนิดทองแดง แคดเมียม และ ตะกั่วได้สูงสุดที่พีเอช 5 ประมาณ 13, 6 และ 5 มิลลิกรัมต่อกรัม AM-SCP สามารถดูดซับสีแอมิโดบลู 45 ได้สูงสุดที่พีเอช 5 ประมาณ 50 มิลลิกรัมต่อกรัม และ MP-SCP สามารถดูดซับสีเมทิลีนบลูได้สูงสุดที่พีเอช 9 ประมาณ 90 มิลลิกรัมต่อกรัม ประสิทธิภาพการดูดซับทองแดง แคดเมียม และ ตะกั่วของอนุภาคต่างๆจะสูงขึ้นเมื่อเพิ่มค่าพีเอชเป็น 5 แรงดึงดูดทางไฟฟ้าซึ่งเกี่ยวข้องกับค่าพีเอชส่งผลกระทบต่อประสิทธิภาพการดูดซับสีแอมิโดบลู 45 และเมทิลีนบลู สันนามแม่เหล็กสามารถเพิ่มประสิทธิภาพในการแยกอนุภาคออกจากน้ำเสียและการมีอยู่ของโลหะหนักและสีย้อมชนิดมีประจุไม่ส่งผลต่อประสิทธิภาพการแยกอนุภาคฯ

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Effects of surface functional groups of silica coated superparamagnetic nanoparticles (SCPs) on selective adsorption of ionic dyes (Acid Blue 45 and Methylene Blue) and heavy metal (Cu(II), Cd(II) and Pb(II)) from synthetic wastewater have been evaluated based on adsorption kinetic and isotherms in single and bi solute. Nano-size magnetite (Fe_3O_4) was coated by silica matrix and modified by grafting 3-aminopropyltriethoxy- and 3-mercaptopropyl- groups (AM-SCP and MP-SCP, respectively). Physico-chemical characteristics of adsorbents were investigated by nitrogen adsorption isotherm (BET), FT-IR, acid-base titration, SEM, etc. MP-SCP had highest adsorption capacities of Cu(II), Cd(II) and Pb(II) at pH 5 about 13, 6 and 5 mg/g, due to chemical bonding. AM-SCP had highest adsorption capacities of acid blue 47 at pH 5 about 50 mg/g. MP-HMS had highest adsorption capacity of methylene blue at pH 9 about 90 mg/g. Increasing to pH 5 could enhance the adsorption capacities of Cu(II), Pb(II) and Cd(II) on SCP, AM-SCP and MP-SCP. Electrostatic interaction caused by pH of solution effect to adsorption capacity of acid blue 45 and methylene blue on synthesized SCPs. The presence of the heavy metals didn't affect to adsorption capacity of the ionic dyes significantly. Magnetic field could enhance sedimentation efficiency of all SCPs. The presence of the heavy metals and the ionic dyes on the surfaces did not affect to the sedimentation efficiency of all synthesized SCPs.

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CONTENTS

	Page
ABSTRACT (IN THAI).....	iv
ABSTRACT (IN ENGLISH).....	v
ACKNOWLEDGEMENTS.....	vi
CONTENTS.....	vii
LIST OF TABLES.....	xi
LIST OF FIGURES.....	xiv
LIST OF ABBREVIATIONS.....	xix
CHAPTER I INTRODUCTION.....	1
1.1 General.....	1
1.2 Hypotheses.....	5
1.3 Objectives.....	5
1.4 Scopes of Study.....	6
CHAPTER II THEORETICAL BACKGROUNDS.....	8
2.1 Nanoparticle.....	8
2.1.1. History of Nanoparticle.....	8
2.1.2. Properties of Nanoparticle.....	9
2.1.3 Classification of Nanoparticle.....	10
2.1.4 Characterization of Nanoparticle.....	10
2.2 Superparamagnetic Nanopraticles.....	11
2.3 Descriptions of magnetic behaviors.....	12
2.3.1. Paramagnetism.....	13
2.3.2. Diamagnetism.....	13
2.3.2. Ferromagnetism.....	14

	Page
2.4 Adsorption.....	15
2.4.1 Physisorption (physical adsorption).....	16
2.4.2 Chemisorption (chemical adsorption).....	16
2.4.3 Adsorption Kinetic	18
2.4.3.1 The pseudo-first-order model	18
2.4.3.1 The pseudosecond-order model.....	19
2.4.4 Adsorption Isotherm.....	20
2.4.4.1 Langmuir Isotherm.....	20
2.4.4.2 Freundlich Isotherm.....	22
2.4.5 Comparison of Sorption Performance.....	23
2.5 Nanotechnology and the environment.....	23
CHAPTER III MATERIAL AND METHODS.....	27
3.1 Materials.....	27
3.2 Preparation of Adsorbents.....	28
3.2.1 SCP Synthesis.....	28
3.2.2 Grafting of Organic functional groups on SCP	29
3.3 Physico-Chemical Characterization for Adsorbents.....	30
3.3.1 Surface Area.....	30
3.3.2 Surface Functional group.....	31
3.3.3 Elemental Analysis.....	31
3.3.3.1 Analysis of Nitrogen content.....	31
3.3.3.2 Analysis of Sulfer content.....	32
3.3.4 Surface Charge.....	33
3.4 Adsorption Experiments.....	33
3.4.1 Adsorption Kinetic.....	33

	Page
3.4.2 Adsorption Isotherm.....	34
3.4.3 Effect of pH.....	35
3.5 Separation by magnet.....	35
3.6 Analytical Method.....	36
CHAPTER IV RESULTS AND DISCUSSION.....	37
4.1 Physico-Chemical Characterization.....	37
4.1.1 Surface Area and Partical Size.....	37
4.1.2 Surface Functional Groups.....	38
4.1.3 Elemental Analysis.....	40
4.1.5 Surface Charge.....	41
4.2 Adsorption Kinetic.....	44
4.3 Adsorption Isotherm.....	65
4.3.1 Adsorption isotherm of single solute	65
4.3.1.1 Heavy metal (Cu(II), Pb(II) and Cd(II)).....	65
4.3.1.2 Ionic dyes (Acid Blue and Methylene Blue).....	69
4.3.1.2.1 Acid Blue.....	69
4.3.1.2.1 Methylene Blue	72
4.3.2 Effect of pH.....	75
4.3.3 Adsorption isotherm of bi solute	84
4.3.3.1 Cu(II) and Acid blue	84
4.3.3.2 Cu(II) and Methylene blue	89
4.4 Separation.....	93
4.4.1 Effect of pH to separation efficiency.....	93
4.4.2 Effect on weight adsorbent to separation efficiency	95

4.4.3 Effect on presence of pollutants (Cu(II), AB and MB) to separation efficiency.....	97
CHAPTER V CONCLUSIONS AND RECOMMENDATIONS.....	105
REFERENCE.....	108
APPENDICES.....	113
APPENDIX A.....	114
APPENDIX B.....	117
APPENDIX C.....	130
APPENDIX D.....	167
APPENDIX E.....	192
BIOGRAPHY.....	194

LIST OF TABLES

Table	Page
4.1 BET surface area and particle size of SCP and Functionalized SCP.....	38
4.2 Ph_{PZC} of SCP, AM-SCP, and MP-SCP.....	43
4.3 Particle size, BET surface area, Ph_{PZC} , nitrogen and sulfur content, surface functional groups and hydrophilicity of SCP and functionalized SCPs.....	44
4.4 Kinetics values calculated for Cu(II) adsorption SCP, AM-SCP and MP-SCP at pH 3.....	47
4.5 Kinetics values calculated for Pb(II) adsorption onto SCP, AM-SCP and MP-SCP at pH 3.....	47
4.6 Kinetics values calculated for Cd(II) adsorption onto SCP, AM-SCP and MP-SCP at pH 3.....	48
4.7 Kinetics values calculated for Cu(II) adsorption SCP, AM-SCP and MP-SCP at pH 5.....	48
4.8 Kinetics values calculated for Pb(II) adsorption onto SCP, AM-SCP and MP-SCP at pH 5.....	49
4.9 Kinetics values calculated for Cd(II) adsorption onto SCP, AM-SCP and MP-SCP at pH 5.....	49
4.10 Kinetics values calculated for AB adsorption onto SCP, AM-SCP and MP-SCP at pH 5.....	50
4.11 Kinetics values calculated for AB adsorption onto SCP, AM-SCP and MP-SCP at pH 7.....	50
4.12 Kinetics values calculated for AB adsorption onto SCP, AM-SCP and MP-SCP at pH 9.....	51
4.13 Kinetics values calculated for MB adsorption onto SCP, AM-SCP and MP-SCP at pH 5.....	51

Table	Page
4.14 Kinetics values calculated for MB adsorption onto SCP, AM-SCP and MP-SCP at pH 7.....	52
4.15 Kinetics values calculated for MB adsorption onto SCP, AM-SCP and MP-SCP at pH 9.....	52
4.16 Parameters of Langmuir and Freundlich isotherm model for Cu(II) adsorption on SCP, AM-SCP and MP-SCP at pH 3 and 5.....	82
4.17 Parameters of Langmuir and Freundlich isotherm model for Pb(II) adsorption on SCP, AM-SCP and MP-SCP at pH 3 and 5.....	82
4.18 Parameters of Langmuir and Freundlich isotherm model for Cd(II) adsorption on SCP, AM-SCP and MP-SCP at pH 3 and 5.....	83
4.19 Parameters of Langmuir and Freundlich isotherm model for acid violet adsorption on SCP, AM-SCP and MP-SCP at pH 5, 7 and 9.....	83
4.20 Parameters of Langmuir and Freundlich isotherm model for acid violet adsorption on SCP, AM-SCP and MP-SCP at pH 5, 7 and 9.....	84
4.21 Effect of magnetic field on separation efficiency of SCP at pH 2.....	95
4.22 Efficiency separation of SCP 0.1g at different pH.....	95
4.23 Efficiency separation of MP- SCP 0.1g at different pH.....	95
4.24 Efficiency separation of AM- SCP 0.1g at different pH.....	96
4.25 Efficiency separation of SCP at pH 2, different weight.....	96
4.26 Efficiency separation of MP-SCP at pH 2, different weight.....	97
4.27 Efficiency separation of AM-SCP at pH 2, different weight.....	97
4.28 Efficiency separation of SCP at pH 2, presence Cd(II).....	98
4.29 Efficiency separation of AM-SCP at pH 2, presence Cd(II).....	98
4.30 Efficiency separation of MP-SCP at pH 2, presence Cd(II).....	98
4.31 Efficiency separation of SCP at pH 2, presence Cu(II).....	99
4.32 Efficiency separation of AM-SCP at pH 2, presence Cu(II).....	99
4.33 Efficiency separation of MP-SCP at pH 2, presence Cu(II).....	100
4.34 Efficiency separation of SCP at pH 2, presence Pb(II).....	100

Table	Page
4.35 Efficiency separation of AM-SCP at pH 2, presence Pb(II).....	101
4.36 Efficiency separation of MP-SCP at pH 2, presence Pb(II).....	101
4.37 Efficiency separation of SCP at pH 2, presence AB.....	102
4.38 Efficiency separation of MP-SCP at pH 2, presence AB.....	102
4.39 Efficiency separation of AM-SCP at pH 2, presence AB.....	102
4.40 Efficiency separation of SCP at pH 2, presence MB.....	103
4.41 Efficiency separation of MP-SCP at pH 2, presence MB.....	103
4.42 Efficiency separation of AM-SCP at pH 2, presence MB.....	104

LIST OF FIGURES

Figure	Page
3.1 Silanization reaction of 3-aminopropyltriethoxysilane on SCP (AM-SCP).....	29
3.2 Silanization reaction of 3-mercaptopropyltrimethoxysilane on SCP (MP-SCP).....	29
4.1 SEM picture of SCP and functionalized SCP.....	37
4.2 FT-IR spectra of SCP.....	39
4.3 FT-IR spectra of AM-SCP.....	39
4.4 FT-IR spectra of MP-SCP.....	40
4.5 Total nitrogen and sulfur content in functionalized SCPs.....	41
4.6 Surface charges of SCP , AM-SCP, and MP-SCP as a function of pH.....	42
4.7 Adsorption kinetic of Cu(II) adsorption onto (a) SCP, (b) AM-SCP and(c) MP-SCP at pH 3, Temperature 25 °C and Ionic strength 0.01 M.....	53
4.8 Adsorption kinetic of Pb(II) adsorption onto (a) SCP, (b) AM-SCP and(c) MP-SCP at pH 3, Temperature 25 °C and Ionic strength 0.01 M.....	54
4.9 Adsorption kinetic of Cd(II) adsorption onto (a) SCP, (b) AM-SCP and (c) MP-SCP at pH 3, Temperature 25 °C and Ionic strength 0.01 M.....	55
4.10 Adsorption kinetic of Cu(II) adsorption onto (a) SCP, (b) AM-SCP and (c) MP-SCP at pH 5, Temperature 25 °C and Ionic strength 0.01 M.....	56
4.11 Adsorption kinetic of Pb(II) adsorption onto (a) SCP, (b) AM-SCP and (c) MP-SCP at pH 5, Temperature 25 °C and Ionic strength 0.01 M.....	57

Figure	Page
4.12 Adsorption kinetic of Cd(II) adsorption onto (a) SCP, (b) AM-SCP and (c) MP-SCP at pH 5, Temperature 25 °C and ionic strength 0.01 M.....	58
4.13 Adsorption kinetic of AB adsorption onto (a) SCP, (b) AM-SCP and (c) MP-SCP at pH 5, Temperature 25 °C and ionic strength 0.01 M	59
4.14 Adsorption kinetic of AB adsorption onto (a) SCP, (b) AM-SCP and (c) MP-SCP at pH 7, Temperature 25 °C and ionic strength 0.01 M.....	60
4.15 Adsorption kinetic of AB adsorption onto (a) SCP, (b) AM-SCP and (c) MP-SCP at pH 9, Temperature 25 °C and ionic strength 0.01 M.....	61
4.16 Adsorption kinetic of MB adsorption onto (a) SCP, (b) AM-SCP and (c) MP-SCP at pH 5, Temperature 25 °C and ionic strength 0.01 M.....	62
4.17 Adsorption kinetic of MB adsorption onto (a) SCP, (b) AM-SCP and (c) MP-SCP at pH 7, Temperature 25 °C and ionic strength 0.01 M.....	63
4.18 Adsorption kinetic of MB adsorption onto (a) SCP, (b) AM-SCP and (c) MP-SCP at pH 9, Temperature 25 °C and ionic strength 0.01 M.....	64
4.19 Chemical reaction between metal ions and mercapto functional groups on MP-SCP.....	67
4.20 Adsorption isotherm of Cu(II) adsorption onto SCP, AM-SCP and MP-SCP at pH 3, Temperature 25 °C and ionic strength 0.01 M	67
4.21 Adsorption isotherm of Pb(II) adsorption onto SCP, AM-SCP and MP-SCP at pH 3, Temperature 25 °C and ionic strength 0.01 M.....	68
4.22 Adsorption isotherm of Cd(II) adsorption onto SCP, AM-SCP and MP-SCP at pH 3, Temperature 25 °C and ionic strength 0.01 M.....	68

Figure	Page
4.23 Adsorption isotherm of Cu(II) adsorption onto SCP, AM-SCP and MP-SCP at pH 5, Temperature 25 °C and Ionic strength 0.01 M.....	69
4.24 Adsorption isotherm of Pb(II) adsorption onto SCP, AM-SCP and MP-SCP at pH 5, Temperature 25 °C and Ionic strength 0.01 M.....	69
4.25 Adsorption isotherm of Cd(II) adsorption onto SCP, AM-SCP and MP-SCP at pH 5, Temperature 25 °C and Ionic strength 0.01 M.....	66
4.26 Adsorption isotherm of AB adsorption onto SCP, AM-SCP and MP-SCP at pH 5, Temperature 25 °C and Ionic strength 0.01 M.....	67
4.27 Adsorption isotherm of AB adsorption onto SCP, AM-SCP and MP-SCP at pH 7, Temperature 25 °C and Ionic strength 0.01 M.....	68
4.28 Adsorption isotherm of AB adsorption onto SCP, AM-SCP and MP-SCP at pH 9, Temperature 25 °C and Ionic strength 0.01 M.....	72
4.29 Adsorption isotherm of MB adsorption onto SCP, AM-SCP and MP-SCP at pH 5, Temperature 25 °C and Ionic strength 0.01 M.....	73
4.30 Adsorption isotherm of MB adsorption onto SCP, AM-SCP and MP-SCP at pH 7, Temperature 25 °C and Ionic strength 0.01 M.....	74
4.31 Adsorption isotherm of MB adsorption onto SCP, AM-SCP and MP-SCP at pH 9, Temperature 25 °C and Ionic strength 0.01 M.....	74
4.32 Adsorption isotherm of Cu(II) adsorption onto (a) SCP, (b) AM-SCP and (c) MP-SCP at different pH, Temperature 25 °C and Ionic strength 0.01 M.....	77
4.33 Adsorption isotherm of Pb(II) adsorption onto (a) SCP, (b) AM-SCP and (c) MP-SCP at different pH, Temperature 25 °C and Ionic strength 0.01 M.....	78
4.34 Adsorption isotherm of Cd(II) adsorption onto (a) SCP, (b) AM-SCP and (c) MP-SCP at different pH, Temperature 25 °C and Ionic strength 0.01 M.....	79

Figure	Page
4.35 Adsorption isotherm of AB adsorption onto (a) SCP, (b) AM-SCP and (c) MP-SCP at different pH, Temperature 25 °C and Ionic strength 0.01 M.....	80
4.36 Adsorption isotherm of AB adsorption onto (a) SCP, (b) AM-SCP and (c) MP-SCP at different pH, Temperature 25 °C and Ionic strength 0.01 M.....	81
4.37 Adsorption capacity of Cu(II) onto SCP by fixing initial AB concentration under mixing with various Cu(II) concentration at pH 5, Temperature 25 °C and Ionic strength 0.01 M.....	86
4.38 Adsorption capacity of AB onto SCP by fixing initial Cu(II) concentration under mixing with various AB concentration at pH 5, Temperature 25 °C and Ionic strength 0.01 M.....	86
4.39 Adsorption capacity of Cu(II) onto MP-SCP by fixing initial AB concentration under mixing with various Cu(II) concentration at pH 5, Temperature 25 °C and Ionic strength 0.01 M.....	87
4.40 Adsorption capacity of AB onto MP-SCP by fixing initial Cu(II) concentration under mixing with various AB concentration at pH 5, Temperature 25 °C and Ionic strength 0.01 M.....	87
4.41 Adsorption capacity of Cu(II) onto AM-SCP by fixing initial AB concentration under mixing with various Cu(II) concentration at pH 5, Temperature 25 °C and Ionic strength 0.01 M.....	88
4.42 Adsorption capacity of AB onto AM-SCP by fixing initial Cu(II) concentration under mixing with various AB concentration at pH 5, Temperature 25 °C and Ionic strength 0.01 M.....	88
4.43 Adsorption capacity of Cu(II) onto SCP by fixing initial MB concentration under mixing with various Cu(II) concentration at pH 5, Temperature 25 °C and Ionic strength 0.01 M.....	90

Figure	Page
4.45 Adsorption capacity of MB onto SCP by fixing initial Cu(II) concentration under mixing with various MB concentration at pH 5, Temperature 25 °C and Ionic strength 0.01 M.....	90
4.46 Adsorption capacity of Cu(II) onto MP-SCP by fixing initial MB concentration under mixing with various Cu(II) concentration at pH 5, Temperature 25 °C and Ionic strength 0.01 M.....	91
4.47 Adsorption capacity of MB onto MP-SCP by fixing initial Cu(II) concentration under mixing with various MB concentration at pH 5, Temperature 25 °C and Ionic strength 0.01 M.....	91
4.48 Adsorption capacity of Cu(II) onto AM-SCP by fixing initial MB concentration under mixing with various Cu(II) concentration at pH 5, Temperature 25 °C and Ionic strength 0.01 M.....	92
4.49 Adsorption capacity of MB onto AM-SCP by fixing initial Cu(II) concentration under mixing with various MB concentration at pH 5, Temperature 25 °C and Ionic strength 0.01 M.....	92

LIST OF ABBREVIATIONS

SCP	=	Silica coated superparamagnetic nanoparticle
APTES	=	Aminopropyltriethoxysilane
MPTMS	=	Mercaptopropyltrimethoxysilane
AM-SCP	=	Amino functionalized Silica coated superparamagnetic nanoparticle
MP-SCP	=	Mercapto functionalized Silica coated superparamagnetic nanoparticle
TEOS	=	Tetraethylorthosilicate or tetraethoxysilane
XRD	=	X-ray diffraction
BET	=	Brunauer-Emmett-Teller
BJH	=	Barrett-Joyner-Halenda
FT-IR	=	Fourier transform Infrared
TN	=	Total nitrogen content
ICP-AES	=	Inductively coupled plasma atomic emission spectroscopy
UV	=	Ultraviolet
UV-VIS	=	Ultraviolet-Visible
IR	=	Infrared
pH _{zpc}	=	pH of zero point of charge
SEM	=	Scanning electron microscopy
TEM	=	Transmission electron microscopy
RBS	=	Rutherford backscattering spectrometry
AB	=	Acid blue
MB	=	Methylene blue
ATSDR	=	Agency for toxic substances and disease registry
COD	=	Chemical oxygen demand
BOD	=	Biochemical oxygen demand
TOC	=	Total Organic Carbon
AOX	=	Absorbable organically bound halogens

ESRF	=	European synchrotron radiation facility
ETAD	=	Ecological and toxicological association of dyes and organic pigments manufacturers
AFM	=	Atomic force microscopy
DLS	=	Dynamic light scattering
NTA	=	Nanoparticle tracking analysis
US	=	United State