

**LIFE CYCLE ASSESSMENT OF PETROCHEMICAL PRODUCTS:
POLYSTYRENE AND POLYURETHANE FOAM**



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จรรยา ฝ่าหลักแหลม : การประเมินวัฏจักรชีวิตของผลิตภัณฑ์ปิโตรเคมี: โพลีสไตรีน และ โพลียูรีเทนโฟม (Life Cycle Assessment (LCA) of Petrochemical Products: Polystyrene and Polyurethane Foam) อ. ที่ปรึกษา : ผศ. ดร. ปมทอง มาลากุล และ ผศ. ดร. มานิตย์ นิธิธนากุล 176 หน้า ISBN 974-9651-93-6

งานวิจัยนี้ทำการประเมินผลกระทบต่อสิ่งแวดล้อมของผลิตภัณฑ์ปิโตรเคมีที่มีความสำคัญทางเศรษฐกิจของประเทศ 2 ชนิด คือ โพลีสไตรีนและโพลียูรีเทนโฟม โดยทำการประเมินวัฏจักรชีวิตและทำการเก็บรวบรวมข้อมูลเพื่อทำการวิเคราะห์บัญชีรายการที่บริษัท ดาวเคมีคอล จำกัด ที่มาบตาพุด จังหวัดระยอง การศึกษานี้ใช้โปรแกรม SimaPro 5.1 และวิธี Eco-indicator 95 และ Eco-indicator 99 ในการประเมินผลกระทบทางสิ่งแวดล้อมของผลิตภัณฑ์ทั้งสองชนิด ขอบเขตการศึกษาของทั้งโพลีสไตรีนและโพลียูรีเทนโฟมครอบคลุมตั้งแต่การผลิต การขนส่งวัตถุดิบและผลิตภัณฑ์ การใช้งานที่บริษัทที่ทำการฉีดพลาสติก และการกำจัด (ฝังกลบ เผา และรีไซเคิล) สำหรับโพลีสไตรีนนั้นได้ศึกษาผลิตภัณฑ์ 2 ชนิด คือ โพลีสไตรีนสำหรับใช้ทั่วไป (จีพีพีเอส) และโพลีสไตรีนแบบทนแรงกระแทก (เอชไอพีเอส) ผลการศึกษาพบว่า ผลกระทบทางสิ่งแวดล้อมของผลิตภัณฑ์ปิโตรเคมีทั้ง 2 ชนิดมาจากช่วงการผลิตและการใช้งาน (ฉีด) เป็นส่วนใหญ่ สำหรับโพลีสไตรีน ผลกระทบต่อสิ่งแวดล้อมส่วนมากมาจากสไตรีน โมโนเมอร์ที่เป็นวัตถุดิบในการผลิต และการผลิตกระแสไฟฟ้าในช่วงการใช้งาน (ฉีด) ซึ่งก่อให้เกิดการลดลงของเชื้อเพลิงฟอสซิล ฝนกรด และหมอกที่เกิดจากปฏิกิริยาเคมีที่ใช้แสง สำหรับโพลียูรีเทน ผลกระทบต่อสิ่งแวดล้อมมาจากวัตถุดิบที่สำคัญ คือ ไอโซไซยานเนตและโพลีอีเธอร์โพลีออล ซึ่งก่อให้เกิดการถดถอยของทรัพยากร โลหะหนัก และฝนกรด นอกจากนี้ ยังพบว่าผลกระทบต่อสิ่งแวดล้อมของการผลิตโพลีสไตรีนนั้นมีมากกว่าโพลียูรีเทนโฟมประมาณ 1.5 เท่า

ABSTRACT

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In this research, a life cycle assessment (LCA) study was conducted to assess the environmental impacts of the production of two commercially important petrochemical products, polystyrene (PS) and polyurethane foam (PU foam). Life cycle inventory (LCI) data for both PS and PU were collected from Dow Chemical Company plants in Maptaphut, Rayong. LCA software, SimaPro 5.1 with Eco-Indicator 95 and Eco-Indicator 99 methods, was used to assess the environmental impacts. The system boundary of PS and PU foam production was set to include manufacturing, distribution and transportation of raw materials and products, use phase (injection) at the plastic manufacturing companies and disposal (landfill, incineration and recycle). For PS, two products were studied separately; general purpose PS (GPPS) and high impact PS (HIPS). The results showed that the environmental impacts of these two model petrochemical products (PS and PU) come mainly from the manufacturing and use phases. For PS, the environmental impacts were found to be essentially from styrene monomer (both GPPS and HIPS) and polybutadiene rubber (only HIPS) in the manufacturing phase and the generation of electricity used in the use phase which resulted in depletion of fossil fuels, acidification and summer smog. For PU, the impacts caused mainly by two important raw materials, isocyanate (MDI) and polyether-polyol, which resulted in resources depletion, heavy metal effect and acidification. It was also observed that the production of PS creates the environmental impacts approximately 1.5 times higher than PU foam.

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TABLE OF CONTENTS

	PAGE
Title Page	i
Abstract (in English)	iii
Abstract (in Thai)	iv
Acknowledgements	v
Table of Contents	vi
List of Tables	viii
List of Figures	xiii
 CHAPTER	
I INTRODUCTION	1
 II LITERATURE REVIEW	 3
 III EXPERIMENTAL	 34
3.1 Materials	34
3.2 Experimental	34
 IV RESULTS AND DISCUSSION	 44
4.1 Life Cycle Inventory	44
4.1.1 Polyurethane Foam Inventory	44
4.1.2 General Purpose Polystyrene (GPPS) Inventory	54
4.1.3 High Impact Polystyrene (HIPS) Inventory	68
4.2 Environmental Impact Assessment	82
4.2.1 Environmental Impact Assessment of Polyurethane Foam	 82
4.2.2 Environmental Impact Assessment of General Purpose Polystyrene	 97

CHAPTER	PAGE
4.2.3 Environmental Impact Assessment of High Impact Polystyrene	117
4.3 Comparison of the Life Cycle Assessment of Polyurethane Foam, General Purpose Polystyrene and High Impact Polystyrene	137
4.4 Suggestions for Improvement	139
4.4.1 Polyurethane Foam Production	139
4.4.2 General Purpose Polystyrene Production	140
4.4.3 Use of Cleaner Technology in the Production Process	141
V CONCLUSIONS AND RECOMMENDATIONS	142
REFERENCES	144
APPENDICES	146
Appendix A Raw Data Collecting of Energy Consumption	146
Appendix B Raw Data Collecting of Emission to Water	149
Appendix C Raw Data Collecting of Emission to Air	151
Appendix D Ratio of Raw Materials in Polyurethane Foam Production	155
Appendix E Data Collecting of Packaging	156
Appendix F Data Collecting of Transportation	158
Appendix G Characterization Factor of Eco-indicator 99	160
Appendix H Characterization Factor of Eco-indicator 99	166
CURRICULUM VITAE	176

LIST OF TABLES

TABLE	PAGE
2.1 Global warming potentials (GWP) given in kg CO ₂ -eq./kg gas	8
2.2 Acidification potentials for acidifying substances	10
2.3 Ozone depletion potentials (OPD) given in kg CFC-11 equivalents/kg gas	11
2.4 Classification and properties of plastics	16
2.5 Plastics Application	17
4.1 Input-Output data of polyurethane foam production	46
4.2 Input details of raw materials acquisition and preparation process	47
4.3 Output details of raw materials acquisition and preparation process	47
4.4 Packaging details of raw materials acquisition and preparation process	48
4.5 Transportation details of raw materials acquisition and preparation process	48
4.6 Input details of mixing process	49
4.7 Output details of mixing process	49
4.8 Energy consumption of mixing process	49
4.9 Characteristics of wastewater in mixing process	49
4.10 Input details of injection process	50
4.11 Output details of injection process	50
4.12 Energy consumption of injection process	51
4.13 Packaging details of injection process	51
4.14 Transportation details of injection process	51
4.15 Emission to air details of injection process	52

TABLE	PAGE
4.16 Input-Output data of general purpose polystyrene production	56
4.17 Input details of raw materials acquisition and preparation process	57
4.18 Output details of raw materials acquisition and preparation process	57
4.19 Transportation details of raw materials acquisition and preparation process	58
4.20 Input details of polymerization process	58
4.21 Output details of polymerization process	59
4.22 Input details of devolatilization process	59
4.23 Output details of devolatilization process	60
4.24 Emission to air details of devolatilization process	60
4.25 Input details of SM recovery process	61
4.26 Output details of SM recovery process	61
4.27 Emission to air details of SM recovery process	61
4.28 Input details of extrusion and finishing process	62
4.29 Output details of extrusion and finishing process	62
4.30 Input details of packaging process	63
4.31 Output details of packaging process	63
4.32 Transportation details of packaging process	64
4.33 Packaging details of packaging process	64
4.34 Input details of injection process	65
4.35 Output details of injection process	65
4.36 Transportation details of injection process	65
4.37 Packaging details of injection process	65
4.38 Emission to air details of injection process	66
4.39 Input-Output data of high impact polystyrene production	70

TABLE	PAGE
4.40 Input details of raw material acquisition and preparation process	71
4.41 Output details of raw material acquisition and preparation process	72
4.42 Transportation details of raw material acquisition and preparation process	72
4.43 Input details of polymerization process	73
4.44 Output details of polymerization process	73
4.45 Input details of devolatilization process	74
4.46 Output details of devolatilization process	74
4.47 Emission to air details of devolatilization process	74
4.48 Input details of SM recovery process	75
4.49 Output details of SM recovery process	75
4.50 Emission to air details of SM recovery process	76
4.51 Input details of extrusion and finishing process	76
4.52 Output details of extrusion and finishing process	77
4.53 Input details of packaging process	78
4.54 Output details of packaging process	78
4.55 Transportation details of packaging process	78
4.56 Packaging details of packaging process	78
4.57 Input details of injection process	79
4.58 Output details of injection process	79
4.59 Transportation details of injection process	80
4.60 Emission to air details of injection process	80
4.61 Environmental impact in equivalent units for each impact category for the production of 1 kg polyurethane foam	87
4.62 Environmental impact in equivalent units for each impact category for the manufacturing phase of PU foam production	88

TABLE	PAGE
4.63 Environmental impact in equivalent units for each impact category for the use phase of PU foam production	89
4.64 Environmental impact in equivalent units for each impact category for the production of 1 kg GPPS	103
4.65 Environmental impact in equivalent units for each impact category for the manufacturing phase of kg GPPS production	104
4.66 Environmental impact in equivalent units for each impact category for the use phase of GPPS production	105
4.67 Environmental impact in equivalent units for each impact category for raw material preparation process in the manufacturing phase of GPPS production	106
4.68 Environmental impact in equivalent units for each impact category for SM recovery process in the manufacturing phase of GPPS production	107
4.69 Environmental impact in equivalent units for each impact category for disposal phase of GPPS production	108
4.70 Environmental impact in equivalent units for each impact category for the production of 1 kg HIPS	123
4.71 Environmental impact in equivalent units for each impact category for the manufacturing phase of kg HIPS production	124
4.72 Environmental impact in equivalent units for each impact category for the use phase of HIPS production	125
4.73 Environmental impact in equivalent units for each impact category for raw material preparation process in the manufacturing phase of HIPS production	126

TABLE	PAGE
--------------	-------------

4.74	Environmental impact in equivalent units for each impact category for SM recovery process in the manufacturing phase of HIPS production	127
4.75	Environmental impact in equivalent units for each impact category for disposal phase of HIPS production	128

LIST OF FIGURES

FIGURE	PAGE
2.1 LCA frameworks	4
2.2 Phases of a LCA	5
2.3 Procedure of life cycle impact assessment	12
2.4 Applications of LCA	14
2.5 Polymer resin integration	19
2.6 The reaction scheme for producing polystyrene from styrene monomer	20
2.7 Polystyrene production	21
2.8 STYRON production process	21
2.9 Block diagram of a processing plant for polyurethane elastomers	24
2.10 Principle of low-pressure mixing	25
2.11 Principle of high pressure mixing	25
2.12 World polymer demand	26
2.13 Zoning of world polymer demand	26
2.14 Plastic demands in Thailand	27
2.15 Plastics supply in Thailand	27
2.16 GPPS application in Thailand	28
2.17 HIPS application in Thailand	28
2.18 Polyurethane world consumption	29
2.19 Polyurethane product output by country in Southeast Asia and Australia	29
2.20 Thai output of polyurethane products, 2003	30
3.1 Polystyrene boundary	35
3.2 Polyurethane boundary	35
4.1 Polyurethane foam processes	45

FIGURE	PAGE
4.2 Input-output of raw materials acquisition and preparation process	47
4.3 Input-output of mixing process	48
4.4 Input-output of injection process	50
4.5 Overall input-output of polyurethane foam production (base on 1 kg)	53
4.6 General purpose polystyrene production processes	55
4.7 Input-output of raw material acquisition and preparation process	57
4.8 Input-output of polymerization process	58
4.9 Input-output of devolatilization process	59
4.10 Input-output of SM recovery process	60
4.11 Input-output of extrusion and finishing process	62
4.12 Input-output of packaging process	63
4.13 Input-output of injection process	64
4.14 Overall input-output of general purpose polystyrene production	67
4.15 High impact polystyrene processes	69
4.16 Input-output of raw material acquisition and preparation process	71
4.17 Input-output of polymerization process	72
4.18 Input-output of devolatilization process	73
4.19 Input-output of SM recovery process	75
4.20 Input-output of extrusion and finishing process	76
4.21 Input-output of packaging process	77
4.22 Input-output of injection process	79
4.23 Overall input-output of HIPS process	81

FIGURE	PAGE
4.24 Overall results of the environmental impact assessment of the production of 1 kg polyurethane obtained by using Eco-Indicator 95	83
4.25 Environmental impact categories of 1 kg polyurethane foam production obtained by using Eco-indicator 95	84
4.26 Environmental impact categories of each phase in the production of 1 kg polyurethane foam obtained by using Eco-indicator 95	83
4.27 Environmental impact categories of the manufacturing phase in the production of 1 kg polyurethane foam obtained by using Eco-Indicator 95	85
4.28 Environmental impact categories of the use phase in the production of 1 kg polyurethane foam obtained by using Eco-Indicator 95	85
4.29 Damage assessment for the production of 1 kg polyurethane foam by using Eco-indicator 99	91
4.30 Impact assessment by category for the production of 1 kg polyurethane foam by using Eco-indicator 99	91
4.31 Impact assessment for each phase in the production of 1 kg polyurethane foam by using Eco-indicator 99	92
4.32 Impact assessment of use phase in the production of 1 kg polyurethane foam by using Eco-indicator 99	92
4.33 Impact assessment for manufacturing phase in the production of 1 kg polyurethane foam by using Eco-indicator 99	93
4.34 Comparison of the environmental impacts assessed by Eco-indicator 95 and Eco-indicator 99 for 1 kg PU foam	94

FIGURE	PAGE
4.35 Overall results of the environmental impact assessment of the production of 1 kg General Purpose Polystyrene (GPPS) obtained by using Eco-indicator 95	98
4.36 Environmental impact categories of 1 kg GPPS production obtained by using Eco-indicator 95	99
4.37 Environmental impact categories of each phase in the production of 1 kg GPPS obtained by Eco-indicator 95	99
4.38 Environmental impact categories of each process in the manufacturing phase of 1 kg GPPS production obtained by using Eco-indicator 95	100
4.39 Environmental impact categories of raw material preparation process in the manufacturing phase of 1 kg GPPS production obtained by using Eco-indicator 95	100
4.40 Environmental impact categories of SM recovery process in the manufacturing phase of 1 kg GPPS production obtained by using Eco-indicator 95	101
4.41 Environmental impact categories of the use phase in the production of 1 kg GPPS obtained by using Eco-indicator 95	101
4.42 Damage assessment for the production of 1 kg GPPS by using Eco-indicator 99	110
4.43 Impact assessment by category for the production of 1 kg GPPS by using Eco-indicator 99	110
4.44 Impact assessment for each phase in the production of 1 kg GPPS by using Eco-indicator 99	111
4.45 Impact assessment for each process in the manufacturing phase of 1 kg GPPS production by using Eco-indicator 99	111

FIGURE	PAGE
4.46 Impact assessment for raw material preparation process in the manufacturing phase of 1 kg GPPS production by using Eco-indicator 99	112
4.47 Impact assessment for SM recovery process in the manufacturing phase of 1 kg GPPS production by using Eco-indicator 99	112
4.48 Impact assessment of use phase in the production of 1 kg GPPS by using Eco-indicator 99	113
4.49 Comparison of the environmental impacts assessed by Eco-indicator 95 and Eco-indicator 99 for 1 kg GPPS	114
4.50 Overall results of the environmental impact assessment of the production of 1 kg High Impact Polystyrene (HIPS) obtained by using Eco-indicator 95	118
4.51 Environmental impact categories of 1 kg HIPS production obtained by using Eco-indicator 95	119
4.52 Environmental impact categories of each phase in the production of 1 kg HIPS obtained by Eco-indicator 95	119
4.53 Environmental impact categories of each process in the manufacturing phase of 1 kg HIPS production obtained by using Eco-indicator 95	120
4.54 Environmental impact categories of raw material preparation process in the manufacturing phase of 1 kg HIPS production obtained by using Eco-indicator 95	120
4.55 Environmental impact categories of SM recovery process in the manufacturing phase of 1 kg HIPS production obtained by using Eco-indicator 95	121
4.56 Environmental impact categories of the use phase in the production of 1 kg HIPS obtained by using Eco-indicator 95	121

FIGURE	PAGE	
4.57	Damage assessment for the production of 1 kg HIPS by using Eco-indicator 99	130
4.58	Impact assessment by category for the production of 1 kg HIPS by using Eco-indicator 99	130
5.59	Impact assessment for each phase in the production of 1 kg HIPS by using Eco-indicator 99	131
4.60	Impact assessment for each process in the manufacturing phase of 1 kg HIPS production by using Eco-indicator 99	131
4.61	Impact assessment for raw material preparation process in the manufacturing phase of 1 kg HIPS production by using Eco-indicator 99	132
4.62	Impact assessment for SM recovery process in the manufacturing phase of 1 kg HIPS production by using Eco-indicator 99	132
4.63	Impact assessment of use phase in the production of 1 kg HIPS by using Eco-indicator 99	133
4.64	Comparison of the environmental impacts assessed by Eco-indicator 95 and Eco-indicator 99 for 1 kg HIPS	134
4.65	LCA comparison between PU foam, GPPS, and HIPS	137
4.66	LCA comparison between PU foam, GPPS, and HIPS for various impact categories	138
4.67	Comparison of the environmental impact in PU foam production using MDI versus TDI in the injection process	139
4.68	Comparison of the environmental impact of GPPS production by using 350-ton injection machine versus 450-ton injection machine in injection process	140