

INTERNSHIP REPORT

**CTCI Advanced Systems Inc.
20th JUNE – 31st AUGUST 2018**



Submitted by:

Chiesa Valentino NRP. 5203015021

Vania NRP. 5203015022

**DEPARTMENT OF CHEMICAL ENGINEERING
FACULTY OF ENGINEERING
WIDYA MANDALA CATHOLIC UNIVERSITY
SURABAYA
2018**

LETTER OF APPROVAL

Seminar of **INTERNSHIP** for a student with identity below :

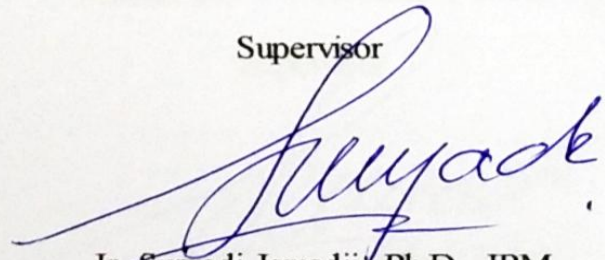
Name : Chiesa Valentino

NRP : 5203015021

has been conducted on 4th December 2018. Therefore the student has fulfilled one of several requirements to obtain **Bachelor of Engineering** degree in **Chemical Engineering** Department, Faculty of Engineering, Widya Mandala Catholic University Surabaya.

Surabaya, 17th December 2018

Supervisor



Ir. Suryadi Ismadji, Ph.D., IPM

NIK. 521.93.0198

Head of Chemical

Engineering Department



Sandy Budi Hartono, Ph.D., IPM

NIK. 521.99.0401

LETTER OF APPROVAL

Seminar of **INTERNSHIP** for a student with identity below :

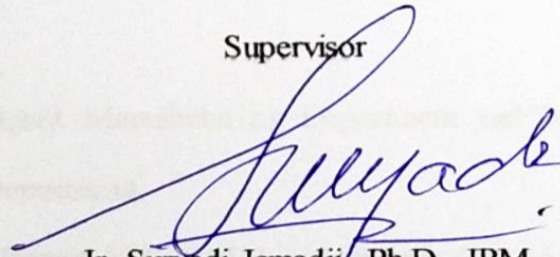
Name : Vania

NRP : 5203015022

has been conducted on 4th December 2018. Therefore the student has fulfilled one of several requirements to obtain **Bachelor of Engineering** degree in **Chemical Engineering** Department, Faculty of Engineering, Widya Mandala Catholic University Surabaya.

Surabaya, 17th December 2018

Supervisor



Ir. Suryadi Ismadji, Ph.D., IPM

NIK. 521.93.0198

Head of Chemical

Engineering Department



Sandy Budi Hartono, Ph.D., IPM

NIK. 521.99.0401

COPY RIGHT AGREEMENT

In order to support the development of science and technology, We are as the student of Widya Mandala Surabaya Catholic University :

Nama / NRP : Chiesa Valenitno / 5203015021

Vania / 5203015022

Agree to transfer the copyright of our internship report with title :

Internship Report CTCI Advanced System Inc.

To be published in internet or other media (Digital Library of Widya Mandala Surabaya Catholic University) for academic purpose according to copyright law in Indonesia.

Surabaya, 17th December 2018

Authors,



Vania

NRP. 5203015021



Chiesa Valentino

NRP. 5203015021

LETTER OF DECLARATION

I declare that this internship report was my own work and does not contain any material that belongs to the others, unless it was stated in the references. Should it is known that this research belongs to the others. I aware and accept the consequences that this research cannot be used as requirement to achieve a Bachelor of Engineering degree.

Surabaya, 17th December 2018

Student,



Chiesa Valentino

NRP. 5203015021

LETTER OF DECLARATION

I declare that this internship report was my own work and does not contain any material that belongs to the others, unless it was stated in the references. Should it is known that this research belongs to the others. I aware and accept the consequences that this research cannot be used as requirement to achieve a Bachelor of Engineering degree.

Surabaya, 17th December 2018

Student,



Vania

NRP. 5203015022

PREFACE

The authors would like to thank God for His blessing that the internship in CTCI Advanced System Inc. has been accomplished. This report is one of the prerequisites in achieving a Bachelor of Engineering degree in Chemical Engineering Department of Widya Mandala Catholic University Surabaya. The authors realize that the completion of this report is achieved through the help of many people. Therefore, the authors would like to thank to:

1. Prof. Liang-Sun Lee who help to open the relationship work between CTCI Advanced System Inc. and Widya Mandala Catholic University Surabaya and take care of us during internship in Taiwan
2. Chen-Chin Chen as the Chairman and Tsung-Kung Shu as the Vice President of CTCI Advanced System Inc.
3. Kuo-Chun Chang as the Manager of Intelligent Manufacturing Department and Stephen Hu as the Manager of IIoT Application Department.
4. Ophelia Chang, Roger Huang, Seth Hsu, Bryant Yeh, Will Jang, Hannah Chen as great mentors.
5. Ir. Suryadi Ismadji, Ph.D., IPM as a supervisor from the Chemical Engineering Department Widya Mandala Catholic University Surabaya and pioneer to make this internship happened.
6. Felycia E. Soetaredjo, Ph.D., IPM as a pioneer to make this internship happened.
7. Tanya Yang, Sherry Chiu, Caren Chou, and Alice Chiu as people in charge of the internship program regarding daily internship and life at CTCI Advanced System Inc, Taiwan.
8. Advisor Chu and Sun as instructors at CPC Corp. Kaohsiung Refinery plat visit.

9. Our parents and family who have given a lot of help and support, both materially and morally.
10. Our lecturers, friends and also those who are too many to be listed by name that had contributed their kind assistance.

The authors realize that this report is far from perfect; therefore any critics and comments which will better improve the report is gladly accepted. Lastly, the authors hope that the report will be useful to all readers who need information regarding the internship.

Surabaya, 2018

The Authors

CONTENTS

LETTER OF APPROVAL	ii
COPY RIGHT AGREEMENT	iv
LETTER OF DECLARATION	v
PREFACE.....	vii
CONTENTS	ix
LIST OF FIGURES	x
LIST OF TABLES	xiv
ABSTRACT	xv
CHAPTER I.....	1
INTRODUCTION	1
I.1. Background.....	1
I.2. CTCI Advanced System Incorporation	2
I.3. Profile	12
CHAPTER II	15
ACTIVITY REPORT	15
II.1. Academic Activity.....	15
II.1.2. Office Work.....	16
II.1.2.2. 5 th Naphtha Cracker Plant Visit.....	19
II.2. Non-Academic Activity	22
CHAPTER III	26
PROJECT AND DISCUSSION	26
III.1. Integraph SmartPlant P&ID	26
III.2. Process Safety Management (Vania's Part).....	34
III.3. Kaohsiung CPC 5 th Naphtha Cracker Plant Visit	40
III.4. Aspen Plus.....	48
CHAPTER IV CONCLUSION AND RECOMMENDATION	122
VI.1. Conclusion	122
VI.2. Recommendation	122

LIST OF FIGURES

Figure I. 1. CTCI ASI Company Logo	3
Figure I. 2. CTCI Group National Taiwan Company Rank	4
Figure I. 3. Building Office A	9
Figure I. 4. Office Area, Building A on left and Building B on right.	9
Figure I. 5. CTCI Advanced System Inc. Location	10
Figure I. 6. Structure Organization of CTCI ASI (2018)	11
Figure II. 1. Introduction Presentation by Valen (left) and Vania (right).....	15
Figure II. 2. CTCI ASI Office 5 th Floor.....	16
Figure II. 3. The Authors' Office Desk Vania (left) & Valen (right)	16
Figure II. 4. (Left) The Authors at 5 th Naphtha Cracker Plant, (Right) ASI Plant Visit Team 20	
Figure II. 5. Discussion about The Author's Plant Visit Report with Mr.KC and Senior Staff of IM1 Department	20
Figure II. 6. Final Presentation Day.....	21
Figure II. 7. Vegetarian Lunch at CTCI ASI	22
Figure II. 8. CTCI ASI Hiking Team on 24 th June (left) and 9 th August (Right)	23
Figure II. 9. One of Four Photos Submitted By The Authors.....	24
Figure II. 11. Farewell Lunch with Prof Lee and Widya Mandala's Teacher and Alumni	25
Figure II. 10. Farewell Dinner with CTCI ASI Staff.....	25
Figure III. 1. SmartPlant P&ID's User Interface	27
Figure III. 2. Drawing Manager's User Interface	27
Figure III. 3. Option Manager's User Interface	28
Figure III. 4. Data Directory Manager's User Interface	28
Figure III. 5. Data Directory Manager's User Interface	29
Figure III. 6. SmartSketch's User Interface	29
Figure III. 7. Simple P&ID on Internship Project #1	31
Figure III. 8. Simple P&ID on Internship Project #2	32
Figure III. 9. Simple P&ID on Internship Project #1 with Display Set Feature (in this picture, piping more than 10in are highlighted with red colour).....	32
Figure III. 10. One of Plant Report on the Project Based On Figure 3.7.	32
Figure III. 11. OPTC Reactor Piping and Instrumentation Diagram.....	33
Figure III. 12. PSM System Elements	34
Figure III. 13. Mr.PSI's User Interface.....	35
Figure III. 14. CRW's User Interface	35
Figure III. 15. Case Study Article.....	36
Figure III. 16. Simplified PFD of the CSI HA Vacuum Distillation Process.....	37
Figure III. 17. HazOp and LOPA Evaluation Flow Diagram.....	38
Figure III. 18. Author's Main Source of Lesson at Aspen Plus	48
Figure III. 19. A Process to Seperate Hexane and Decane using Distillation at Pressure	49
Figure III. 20. User Interface of Aspen Plus Program	49
Figure III. 21. Components Form.....	50

Figure III. 22. Choosing a Property Method.....	50
Figure III. 23. Binary Interaction.....	51
Figure III. 24. Setting Up The Flowsheet	51
Figure III. 25. Connecting the Outlet Stream from Distillation Column.....	52
Figure III. 26. Specifying the State Variables for Inlet Stream.....	52
Figure III. 27. Setting Up the Specifications of Unit Operation.....	52
Figure III. 28. Distillation Column Result	53
Figure III. 29. Stream Result	53
Figure III. 30. Binary Interaction Databanks	54
Figure III. 31. Creating a VLE Diagram.....	54
Figure III. 32. Setting Up a Binary Phase-Diagram Analysis	55
Figure III. 33. Txy Diagrams at Three Different Pressures	55
Figure III. 34. The Completed Flowsheet for Chapter 2	56
Figure III. 35. Changing the Maximum Iterations in the Convergence Form for the Distillation Column.....	56
Figure III. 36. Stream Analysis Feature.....	57
Figure III. 37. Steps for Creating the Flowsheet	57
Figure III. 38. A Process to Generate Electricity by Using Heat from a Reactor	57
Figure III. 39. The Completed Flowsheet for Chapter 3	58
Figure III. 40. Setting the Define Tab of a Design Spec	59
Figure III. 41. The Tabulate Tab of the Sensitivity	60
Figure III. 42. Sensitivity Results	60
Figure III. 43. A Plot of the Sensitivity Results	61
Figure III. 44. Deactivating Design Specs and Sensitivity	61
Figure III. 45. Two Heater Blocks that Make One Complete Heat Exchanger Model	62
Figure III. 46. A Model of Heat Exchanger using HeatX Block	62
Figure III. 47. Temperature Crossover of Streams	63
Figure III. 48. Allowing Temperature Crossovers in HeatX Model.....	63
Figure III. 49. A Process to Separate a Mixture of Acetone, Methanol, and Butanol using Pressure Swing Distillation.....	64
Figure III. 50. Utilities Feature	65
Figure III. 51. Inputting the Utilities Used in the Simulation.....	65
Figure III. 52. Customizing Utilities.....	66
Figure III. 53. Building the Flowsheet.....	66
Figure III. 54. Assigning the Utility for Condenser in Distillation Column	67
Figure III. 55. Defining Variables for Optimization.....	68
Figure III. 56. Defining a Constraint for Optimization	69
Figure III. 57. Optimization Result.....	69
Figure III. 58. (a) Utility cost before optimization; (b) Purities of products obtained before optimization; (c) Utility cost after optimization; (d) Purities of products obtained after optimization.	70
Figure III. 59. Changing the maximum flowsheet evaluations	70
Figure III. 60. The Reaction of Interest for the First Part in this Tutorial.....	71
Figure III. 61. The Reaction for the Second Part.....	71
Figure III. 62. Defining the Stoichiometric Coefficients for a Reaction	72
Figure III. 63. Power Law Kinetics	72

Figure III. 64. Kinetic Tab	72
Figure III. 65. Units for Pre-Exponential Factor	73
Figure III. 66. Using Duplicate Feature on the Flowsheet	73
Figure III. 67. Setting Up RBatch.....	74
Figure III. 68. Plotting the Composition Result into a Graph	74
Figure III. 69. Reactor Composition Trajectories.....	75
Figure III. 70. Regression Feature; (a)Define Tab; (b)Data Tab	75
Figure III. 71. Defining the Pre-exp Variable on Vary Tab	76
Figure III. 72. Setting Up the RPlug.....	76
Figure III. 73. Determining the Length of RPlug using Design Specs	77
Figure III. 74. The Completed Flowsheet for Part 2.....	77
Figure III. 75. Inputting the Component Yields	78
Figure III. 76. Editing Stoichiometry on RStoic Block	78
Figure III. 77. Editing Stoichiometry on REquil Block.....	79
Figure III. 78. Defining Operation Conditions on RGibbs	79
Figure III. 79. Estimating Missing Property Parameters	81
Figure III. 80. Specifying the Components and its Boiling Point on Binary Tab	82
Figure III. 81. Defining Molecule by its Conectivity	82
Figure III. 82. The Graphical Structure of a Molecule on Aspen Plus Database	82
Figure III. 83. The Completed Flowsheet for Chapter 7	83
Figure III. 84. Defining the Specifications of DSTWU.....	83
Figure III. 85. Generating Table of Reflux Ratio and Number of Theoretical Stages	84
Figure III. 86. Results of Reflux Ratio Profile on DSTWU	84
Figure III. 87. The Reflux Ratio vs the Number of Stages plot as Predicted by DSTWU	85
Figure III. 88. Result of DSTWU Calculation.....	85
Figure III. 89. Setting Up the RadFrac	85
Figure III. 90. Murphree Efficiencies Feature on Aspen Plus.....	86
Figure III. 91. Specifying Efficiency of the Stages	86
Figure III. 92. The Completed Flowsheet for Chapter 8	87
Figure III. 93. Liquid Mole Fraction Profiles for a Well-designed Column	87
Figure III. 94. Column Diameter of Each Section.....	88
Figure III. 95. Changing the Parameters of the Flooding Calculation.....	88
Figure III. 96. Switching to Rate-based on Calculation Type	89
Figure III. 97. Switching to rate-based mode on Column Internals	89
Figure III. 98. Activating Rate-based Calculation for All the Column Sections.....	89
Figure III. 99. Changing the Maximum Number of Iterations	90
Figure III. 100. Generating Estimates Feature.....	90
Figure III. 101. Methane Reforming Flowsheet with Recycle; (a) Using Calculator Block; (b) Using Design Spec.....	91
Figure III. 102. Defining Import and Export Variables.....	91
Figure III. 103. Inputting the Equation.....	92
Figure III. 104. Yield as a Function of the Partial Pressure	92
Figure III. 105. The Completed Flowsheet for Chapter 9	92
Figure III. 106. (a)Variables and (b)Statements that are Entered into the Calculator Tab.....	93
Figure III. 107. Specifying Default Values in the SEP Block	93
Figure III. 108. Creating a New Project in Aspen Capital Cost Estimator.....	96

Figure III. 109. Selecting and changing the units of measure	96
Figure III. 110. Changing the currency in the General Project Data form	97
Figure III. 111. The Project Basis View	97
Figure III. 112. Getting Access to Custom Cost Indexes	98
Figure III. 113. Adding Equipment to the Simulation	98
Figure III. 114. Filling the Item Description	99
Figure III. 115. Editing the Design Parameters for the Pump	99
Figure III. 116. Individual Equipment Evaluation.....	100
Figure III. 117. Equipments Evaluation Result	100
Figure III. 118. Used Flowsheet in Chapter 10	100
Figure III. 119. Aspen Process Economic Analyzer Calculation Result on Aspen Plus	101
Figure III. 120. Getting Access to Design Heat Exchanger Networks (HENs)	102
Figure III. 121. Heat Exchanger Network Result	104
Figure III. 122. The Energy Panel in Aspen Plus connects to AEA.....	104
Figure III. 123. Energy Analysis Result	105
Figure III. 124. Chemical Looping Combustion Process for Producing Power and Hydrogen from Syngas	105
Figure III. 125. The Completed Flowsheet for Chapter 9	106
Figure III. 126. Converting Solids in Simulation from Type “conventional” to Type “solid	106
Figure III. 127. MIXCISLD Stream Class.....	107
Figure III. 128. MIXCIPSD Stream Class.....	107
Figure III. 129. Entering Solids Information and Particle Size Distribution to a Material Stream.....	107
Figure III. 130. Steps to Use Electrolyte Chemistry.....	108
Figure III. 131. Electrolyte Compound Exist on Stream Results	109
Figure III. 132. Piping and Instrument Diagram of MC04 Distillation Tower	110
Figure III. 133. Design Specification of MC04 Distillation Tower.....	110
Figure III. 134. Data of Flow Indicator and Control 401 for 2 nd January Period	112
Figure III. 135. Data of Pressure Indicator 402 for 2 nd January Period	112
Figure III. 136. Data of Temperature Indicator 401 for 2 nd January Period.....	112
Figure III. 137. Data of Level Indicator and Control 402 for 2 nd January Period	112
Figure III. 138. Aspen Plus Worksheet on Last Project for 2 nd January Period	114
Figure III. 139. Graphic of Comparison Between Temperature Obtained from Aspen and Temperature from Real Data for 2 nd January Period	115
Figure III. 140. Data of Flow Indicator and Control 401 for 25 th January Period.....	116
Figure III. 141. Data of Pressure Indicator 402 for 25 th January Period	117
Figure III. 142. Data of Temperature Indicator 401 for 25 th January Period.....	117
Figure III. 143. Data of Level Indicator and Control 402 for 25 th January Period.....	117
Figure III. 144. Distillation Column Temperature Profile Using 40 Stages and Feed Location at Stage 20.....	119
Figure III. 145. Distillation Column Temperature Profile Using 20 Stages and Feed Location at Stage 10.....	119
Figure III. 146. Setting Rate Based Mode in the Distillation Column	120
Figure III. 147. Graphic of Comparison Between Temperature Obtained from Aspen and Temperature from Real Data for 25 th January Period.....	121

LIST OF TABLES

Table I. 1. List of CTCI ASI Staff and Their Role During Internship	12
Table III. 1. Brief Summary of Each Block Reactor	79
Table III. 2. Average Data of 2 nd January Steady State Period	113
Table III. 3. Inputted Data on Aspen Plus for 2 nd January Simulation.....	113
Table III. 4. Murphee Efficiency	114
Table III. 5. Temperature from Aspen and Real Data Comparison for 2 nd January Period ...	115
Table III. 6. Result of Aspen Plus for 2 nd January Period	116
Table III. 7. Average Data of 25 th January Steady State Period	118
Table III. 8. Inputted Data on Aspen Plus for 25 th January Simulation	118
Table III. 9. Temperature from Aspen and Real Data Comparison for 25 th January Period ..	120
Table III. 10. Result of Aspen Plus for 25 th January Period	121

ABSTRACT

CTCI Advanced System Inc. (CTCI ASI) is a subsidiary company of CTCI, a top-leading and largest engineering group in Taiwan. CTCI ASI provides modern industry 4.0 system and applies it into any aspects of engineering such as mechanical system, electrical system, process system. Their product of services are intelligent energy management system, industrial internet of things, smart E&M for railway transportation. Not only the services provider, but CTCI also provide software related to the manufacture industry, especially chemical industry. They are selling their own software-related into their services, and CTCI ASI is a exclusive seller of Aspen Software and Integraph Hexagon in Taiwan.

For 40 years, CTCI ASI already got many achievement and award, also done many notable projects given by the government and big company. Latest award achieved by CTCI such as TOP 5% Stock Exchange in Taiwan by Corporate Governance Evaluation, Top 50 of a gold medal for the service industry from TCSA, Excellent Company of Industry-Academic Cooperation, and Distinguished Construction and Business Institution Award from Chinese Institute of Engineers. While the project was done by CTCI such as baggage handling system at Taiwan Taoyuan International Airport, MRT SongShan-XinYi line power remote system, Taichung MRT signalling system installation, instrumentation and control system engineering for Saudi Methacrylates Company.

For 2.5 months author learnt about safety management and how to implement it with industrial internet of things, drawing process and instrument diagram with Integraph SmartPlant P&ID, and process engineering with Aspen Plus software. For safety management, author learn how to do Hazard Operational (HazOp) and Layer of Protection Analysis (LOPA). Author also learn how to operate CTCI's software related to safety management, Mr.PSM. For P&ID session, author learn how to interpret symbol and the function of some instrument. Then, the author learn how to draw P&ID using Integraph, convert conventional P&ID into e-P&ID with improved feature. For process engineering session we learn how to optimize process using aspen, and basic of aspen plus. In each session, authors were given test using real cases or data. The author also had been invited to 5th Naptha Cracker Plant, in Kaohsiung, Taiwan to observe and learn about the naptha cracker process and its equipment.