



CONTENT

CONTENT	v
LIST OF FIGURES	v
LIST OF TABLES	viii
APPENDICES	viii
ABSTRACT.....	ix
CHAPTER I INTRODUCTION.....	1
1.1 Background of Research.....	1
1.2 Problem of Statements	4
1.3 Objectives of Research	5
1.4 General Scope of Research	6
1.5 Expected Outcome of the Research	7
1.6 Authenticity of the Research.....	10
CHAPTER II LITERATURE REVIEW AND THEORETICAL BACKGROUND	su
2.1 Literature Reviews and Theoretical Frameworks	su
2.2 Equations Governing in Groundwater Flow under Pumping Test.....	19
2.2.1 Theis Method	19
2.2.2 Cooper-Jacob Method	23
2.3 Equations Governing in Groundwater Flow under Slug Test.....	23
2.3.1 Hvorslev's Equation	24
2.4 Shape Factors of Wells.....	25
2.4.1 Sunjoto Equation and Shape Factors.....	30
CHAPTER III RESEARCH METHODOLOGY	33
3.1 Research Methodology	33
3.1.1 Data Collection.....	33
3.1.2 Research Design	33
3.1.3 Experimental Test Set Up for Recharging Test and Slug Test	34
3.1.4 Method Procedure for Recharging Test	34
3.1.5 Method Procedure for Slug Test	35
3.1.6 Data Analysis	37
3.2 Hydraulic Conductivity Test	41
3.2.1 Laboratory Methods (Falling Head Method)	42
3.2.2 Laboratory Methods (Constant Head Method)	43
3.2.3 Large Scale Field Method (Pumping Test)	44
3.2.4 Borehole Casing Test	45
3.3 Research Limitation.....	46
CHAPTER IV LABORATORY TEST (GRAIN SIZE ANALYSIS TEST AND CONSTANT HEAD TEST)	48
4.1 Characteristics of Soil.....	48
4.2 Grain Size Analysis.....	48
4.2.1 Data Analysis From Grain Size Analysis Test	48



4.3	Determining Hydraulic Conductivity Value by Constant Head Test	50
4.4	Data Analysis and Calculation	50
4.4.1	Fundamental Test Conditions	50
4.4.2	Apparatus	51
4.4.3	Preparation of Specimen	52
4.4.4	Preparation of Specimen for Permeability Test	53
4.4.5	Procedure.....	54
4.4.6	Data Analysis of Constant Head Test	54
CHAPTER V RECHARGING TEST AND ANALYSIS		56
5.1	Pump Test.....	56
5.2	Pump Test and Groundwater Level.....	56
5.2.1	Theis Curve Fitting Method	56
5.2.2	Groundwater Data Analysis by using Theis Method	58
5.3	Recharging Test Analysis by Sunjoto Shape Factors Method.....	59
5.4	Physical Experiment Tank	59
5.4.1	Construction and Description of Experiment Tank.....	60
5.5	Recharging Test	63
5.6	Shape Factor Value Based on Well Conditions	63
5.7	Pump Test in the Field Area.....	64
CHAPTER VI SLUG TEST ANALYSIS		67
6.1	Slug Test and Shape Factor	67
6.2	Slug Test Experiment in Laboratory.....	67
6.3	Data Analysis by Sunjoto Equation and Hvorslev Equation	68
6.4	Data Measurement under Slug Test.....	69
6.5	Data Measurement under Slug Test in the Field Area.....	70
6.6	Publications.....	71
6.6.1	Sunjoto Shape Factor under Full Penetration Slug Test	71
6.6.2	Determination of Hydraulic Conductivity Value by Using Sunjoto Shape Factor	71
6.6.3	Shape Factor and Hydraulic Conductivity in Slug Test.....	71
CHAPTER VII RESULT ANALYSIS		72
7.1	Result Analysis of the Research	72
7.2	Statistical Analysis of Results.....	72
7.2.1	Results Analysis of Pump Test and Slug Test by ANOVA Method.....	72
7.2.2	One-Way ANOVA.....	73
CHAPTER VIII DISCUSSION AND CONCLUSION		75
8.1	Discussion of the Research	75
8.2	Conclusion of the Research	76
APPENDICES		82
REFERENCES		79



LIST OF FIGURES

Figure 2.1	Intake and Shape Factors of Wells (Hvorslev, 1951).....	29
Figure 3.1	Demonstration of Recharging Test and Measurement.	35
Figure 3.2	Demonstration of Slug Test and Measurement.	36
Figure 3.3	Flow Chart of Methodology of Research.	38
Figure 3.4	Experiment Test for Hydraulic Conductivity Test under Recharging Test.....	39
Figure 3.5	Experiment Test for Hydraulic Conductivity Test under Slug Test..	39
Figure 3.6a	Partial Penetration in Unconfined Aquifer	40
Figure 3.6b	Full Penetration in Unconfined Aquifer	40
Figure 3.7	Falling Head Test.....	43
Figure 3.8	Constant Head Test	44
Figure 4.1	Grain Size Analysis Test of Soil Material.....	49
Figure 5.1a	Front View of Experiment Model.....	62
Figure 5.1b	Back Side View of Experiment Model	62
Figure 5.2a	Location of Well and Piezometers	62
Figure 5.2b	Cross-Sectional View	62
Figure 6.1a	Over View of Slug Test Experiment Test.....	68
Figure 6.1b	Cross-Sectional View of Slug Test and Measurement.....	68
Figure 7.1	Comparison of Hydraulic Conductivity Value by using Sunjoto Shape Factor and Theis Method (Field).....	74
Figure 7.1	Comparison of Hydraulic Conductivity Value by using Sunjoto Shape Factor and Hvorslev Method (Field).....	74



LIST OF TABLES

Table 1.1	Shape Factors of Full and Partial Penetration of Unconfined and Confined Aquifer	9
Table 1.2	Comparison of the Researches	11
Table 2.1	Existing Shape Factors and Well Conditions	31
Table 3.1	Research Limitation	47
Table 4.1	Data of Constant Head Test	55
Table 5.1	Comparison of Laboratory Test Value and Theis Method Value	63
Table 5.2	Shape Factor (F) Value Calculation for Unconfined Aquifer Test (1 to 4)	64
Table 5.3	Hydraulic Conductivity Value by Sunjoto Method	64
Table 5.4	Pump Test in the Field Area (Theis Method)	65
Table 5.5	Pump Test in the Field Area (Sunjoto Method).....	66
Table 6.1	Parameter of the Well for Slug Test	69
Table 6.2	Hydraulic Conductivity Value under Slug Test in Laboratory	70
Table 6.3	Parameter of the well for Slug Test in the Field.....	70
Table 6.4	Hydraulic Conductivity Value under Slug Test in Field Area	70



LIST OF APPENDICES

Appendix	Page
Appendix (1-A)	Groundwater Level Data, May.7.201984
Appendix (1-B)	Groundwater Level Data, May.7.201985
Appendix (1-C)	Groundwater Level Data, May.10.201987
Appendix (1-D)	Groundwater Level Data, May.10.201989
Appendix (1-E)	Groundwater Level Data, May.12.201991
Appendix (1-F)	Groundwater Level Data, May.12.201993
Appendix (1-G)	Groundwater Level Data, May.14.201995
Appendix (1-H)	Groundwater Level Data, May.14.201997
Appendix (2-A)	Data for Theis Method, May.7.2019100
Appendix (2-B)	Data for Theis Method, May.10.2019102
Appendix (2-C)	Data for Theis Method, May.12.2019104
Appendix (2-D)	Data for Theis Method, May.14.2019106
Appendix (3-A)	Theis Type Curve and Data Curve, May.7.2019109
Appendix (3-B)	Theis Type Curve and Data Curve, May.10.2019110
Appendix (3-C)	Theis Type Curve and Data Curve, May.12.2019111
Appendix (3-D)	Theis Type Curve and Data Curve, May.19.2019.112
Appendix (4)	Theis Well Log (W (u) Vs U) Data.113
Appendix (5)	Hydraulic Conductivity Value by Sunjoto Method (Test-1) 114
Appendix (6)	Hydraulic Conductivity Value by Sunjoto Method (Test-2) 115
Appendix (7)	Hydraulic Conductivity Value by Sunjoto Method (Test-3) 116
Appendix (8)	Hydraulic Conductivity Value by Sunjoto Method (Test-4) 117
Appendix (9)	Slug Test (1).....118
Appendix (10)	Slug Test (2)119
Appendix (11)	Measurement of Pumping Test Data (Test 1, Field)120
Appendix (12)	Measurement of Pumping Test Data (Test 2, Field)121
Appendix (13)	Measurement of Pumping Test Data (Test 3, Field)122
Appendix (14)	Measurement of Slug Test Data (Test 3, Field)123
Appendix (15)	Measurement of Slug Test Data (Test 4, Field)124