ARCHIMEDES SCREW TURBINE MODEL SIMULATION ON THE EFFECT OF EXTERNAL AND INTERNAL DESIGN PARAMETERS IN POWER GENERATION

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ABSTRAK

Tahun demi tahun, permintaan elektrik meningkat disebabkan oleh pertumbuhan pesat dunia, yang menggunakan elektrik sebagai sumber tenaga utamanya. Untuk mengatasi cabaran menjana elektrik dari sumber tenaga konvensional yang menyumbang kepada kesan rumah hijau, tenaga boleh diperbaharui boleh digunakan. Salah satu alternatif untuk menjana elektrik dalam persekitaran yang bersih ialah turbin skru Archimedes (AST). Objektif kajian penyelidikan ini adalah untuk menyiasat sudut kecenderungan cerun AST, nisbah diameter, dan bilangan skru bilah berdasarkan konsep reka bentuk sebelumnya untuk penjanaan kuasa dan menentukan penjanaan kuasa dan kecekapan tertinggi berdasarkan parameter dalaman dan luaran. Penyelidikan ini bertujuan untuk mengkaji konsep reka bentuk AST untuk menjana elektrik. Konsep reka bentuk dianalisis berdasarkan parameter geometri, yang kemudiannya disahkan antara simulasi dan data sebenar. Tiga parameter yang dipertimbangkan dalam penyelidikan ini adalah sudut kecenderungan cerun, nisbah diameter, dan bilangan skru bilah. Setiap parameter mempengaruhi penjanaan kuasa AST dengan ketara. Simulasi konsep reka bentuk AST telah dijalankan menggunakan ANSYS CFX. Simulasi ini dibahagikan kepada beberapa langkah, seperti pengesahan antara simulasi dan data eksperimen, dan simulasi AST menggunakan tiga parameter yang berbeza pada kadar aliran malar dan kelajuan putaran.Sebanyak 36 simulasi dijalankan berdasarkan kadar aliran malar dengan beberapa skru bilah 1,2 dan 3, dengan nisbah diameter 0.25,0.5 dan 0.6 digabungkan dengan sudut kecenderungan cerun 20°, 25°,35° dan 40°. Daripada simulasi, kuasa tertinggi 2.3W dihasilkan pada 1 skru bilah, $0.5D_r$ dan 40°, manakala kecekapan tertinggi (79.42%) berlaku pada 3 skru bilah, 20° dan $0.25D_r$. Setiap reka bentuk kajian parameter memberi kesan kepada pengeluaran kuasa dan kecekapan AST.

ABSTRACT

Year after year, electricity demand increases due to the world's rapid growth, which uses electricity as its main source of energy. In order to overcome the challenge of generating electricity from conventional energy resources that contribute to the greenhouse effect, renewable energy is in demand. One of the alternatives to generating electricity in a clean environment is the Archimedes screw turbine (AST). The objective of this research study is to investigate the AST slope inclination angle, diameter ratio, and number of bladed screws based on previous design concepts for power generation and determine the power output and highest efficiency based on the internal and external parameters. This research is aimed at studying the AST design concept for generating electricity. The design concept was analysed based on the geometric parameters, which were then validated between the simulation and actual data. Three parameters considered in this research were the slope inclination angle, α ratio of diameter, D_r and number of bladed screws, N. Each parameter affects the AST power generation significantly. The simulation of the AST design concept was carried out using ANSYS CFX. The simulation was divided into several steps, such as validation between the simulation and experimental data, and simulation of the AST using three different parameters at a constant flow rate and rotational speed. A total of 36 simulations were run based on constant flow rate with a number of bladed screws of 1,2 and 3, with a diameter ratio of 0.25,0.5 and 0.6 combined with a slope inclination angle of 20°, 25°,35° and 40°. From the simulation, the highest power of 2.3W was produced at 1 bladed screw, 0.5Dr and 40°, whereas the highest efficiency (79.42%) occurred at 3 bladed screws, 20° and 0.25Dr. Each of the designs of the parameter studies impacted the power production and efficiency of AST.

TABLE OF CONTENT

DECLARATION

TITLE PAGE

ACKNOWLEDGEMENTS **ii**

ABSTRAK **iii**

ABSTRACT **iv**

TABLE OF CONTENT **v**

LIST OF TABLES **viii**

LIST OF FIGURES **ix**

LIST OF SYMBOLS **x**

LIST OF ABBREVIATIONS **xi**

CHAPTER 1 INTRODUCTION **1**

1.1 Introduction 1

1.2 Problem Statement 3

1.3 Objectives of the Study 4

1.4 Scopes of the Study 4

1.5 Summary 5

CHAPTER 2 LITERATURE REVIEW **7**

2.1 Introduction 7

2.2 Renewable Energy 7

2.3 Hydropower Plant 9

2.4 Archimedes Screw Runner Blade 10

2.4.1 History of the Archimedes Screw Runner Blade as a Pump and Turbine 10

2.4.2 Advantages of the Archimedes Screw Turbine 12

2.4.3 Concept of Archimedes Screw Turbine Application 13

2.5 Parameter Studied for AST 16

2.6 Computational Fluid Dynamics (CFD) 27

CHAPTER 3 METHODOLOGY 30

3.1 Introduction 30

3.2 Simulation of Parameter Selection 35

3.2.1 Independent Parameter 36

3.2.2 Internal Parameters 37

3.2.3 External Parameters 37

3.3 Dimensional Analysis 37

3.4 Computational Fluid Dynamics Simulation 38

3.4.1 Simulation Set Up 39

3.4.2 Meshing Sensitivity 47

3.4.3 Simulation Convergence Criteria 49

3.5 Calculation for Power Output and Efficiency of AST 50

CHAPTER 4 RESULTS AND DISCUSSIONS 52

4.1 Introduction 52

4.2 Model Validation 53

4.3 Results for N=1, 2 and 3 54

4.3.1 At N=1 54

4.3.2 At N=2 56

4.3.3 At N=3 58

4.4 Efficiency of the AST 59

4.5 Summary of the Findings 62

CHAPTER 5 CONCLUSION AND RECOMMENDATION **63**

5.1 Conclusion 63

5.2 Recommendation 63

REFERENCES **65**

APPENDICES **70**

LIST OF TABLES

Table 2.1	Classification of hydropower plants	9
Table 2.2	Summary of parameters studied by previous researcher	19
Table 3.1	Dimensions of the AST model	36
Table 3.2	Geometric parameters for the simulation study	37
Table 3.3	Type of quality and the level of accuracy	45
Table 3.4	Torque generated from the simulation and corresponding percentage error	48
Table 4.1	Pressure exerted on AST based on slope inclination angle	54
Table 4.2	Results of efficiencies based on N, Dr and α	59

LIST OF FIGURES

Figure 2.1	Malaysia's primary energy consumption in 2011	8
Figure 2.2	Schematic diagram of a micro hydroelectric power plant	10
Figure 2.3	A three-bladed Archimedes screw runner pump	11
Figure 2.4	Side view of the Archimedes screw turbine	12
Figure 2.5	Classification of head and water flow rates for different types of turbines	13
Figure 2.6	Energy conversion of Archimedes Screw Turbine (AST)	14
Figure 2.7	Side view of the AST diagram	14
Figure 3.1	Research flow chart	31
Figure 3.2	Geometrical parameters of the AST model	36
Figure 3.3	Schematic diagram of CFD elements	39
Figure 3.4	Details project schematic using ANSYS CFX	40
Figure 3.5	Cross section - stationary part of the flow	41
Figure 3.6	Cross section - rotating part of the blades	41
Figure 3.7	Boundary condition applied	42
Figure 3.8	Coarse, medium, and fine relevance center of meshing	43
Figure 3.9	Meshing of blade part	44
Figure 3.10	Close up of the meshing of blade part	44
Figure 3.11	RMS Residual curve	49
Figure 4.1	Comparison between simulation and experimental data using three different slope inclination angles	53
Figure 4.2	Power output of AST for different slope inclination angle and diameter ratio with constant N=1	55
Figure 4.3	Power output of AST for different slope inclination angle and diameter ratio with constant N=2	57
Figure 4.4	Power output of AST for different slope inclination angle and diameter ratio with constant N=3	58

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