Research Paper

Cross Validation of Optimize Results Using Genetic and Particle Swarm Optimization (PSO) Algorithms, for the Single Cell Model of Molten Carbonate Fuel Cell (MCFC)

Engineering

S. K. Dhakad	Assistant Prof. MED, SATI (deg), Vidisha
Dr. S.C. Soni	Ex director MANIT Bhopal
Dr. Pankaj Agarwal	Prof. MED, SATI, Vidisha

ABSTRACT
This paper deals with the energy modeling and simulation analysis of high temperature fuel cell, e.g. Molten Carbonate Fuel Cell (MCFC). In the present work a new mathematical model of molten carbonate fuel cell has been developed using basic governing equations and chemical reactions base. Those have been applied in experiment and numerical simulation of molten carbonate fuel cell stack, to be generated power up to kilowatt [1, 2]. Using the Genetic algorithm optimized results obtained appeared in previous research paper [3], here simulated and optimized results compared with Genetic and PSO algorithm with each other. In the simulation and modeling MATLAB software has been used. The compared results has been shown in the tables 1& 2.

1. Introduction:

The previous research paper [3] has been discussed detailed of MCFC single cell model and methodology used in the analysis. In Present paper obtained simulated and optimized results using the Genetic and PSO algorithms, compared with each other along with standard references [4, 5, 6].

2 Results and analysis:

The analysis of single cell of the MCFC, VI Characteristic have been obtained at the various temperatures and pressures, membrane thickness domains. The maximum voltage of the cell corresponding to the temperature 900°K and optimized efficiency and power density for the single cell of MCFC has been determined corresponding to maximum voltage.

Table 1 Shows the Comparative simulated and optimized results of the mathematical model of single cell MCFC using the two optimization techniques.

MCFC Cell parameters	Input Value	Simulated results using Genetic Algorithm Voltage Power (volts) (watts)	Simulated results using PSO algorithmVoltage Power volts watts	Optimize Values Algorithm Genetic PSO	Remark
Temp. in 0C	200	0.82 0.34	0.81 0.38	Voltage: 1.17 1.12 Power: 0.46 0.55	Genetic better PSO better
	375	0.83 0.35	0.86 0.42		
	550	1 0.36	0.99 0.44		
	725	1.10 0.40	1.01 0.49		
	900	1.17 0.46	1.2 0.55		
Pressure in bar	1	1.2 0.56	1.18 0.59	Voltage: 1.12 1.18 Power: 0.56 0.59	PSO better
	2.8	1.1 0.44	1.14 0.46		PSO better
	4.6	0.90 0.40	1 0.41		PSO better
	6.4	0.860 0.39	0.90 over predict		Genetic better
	8.2	0.820 0.32	Over predict		Genetic better

Table 2 Shows the Comparative simulated and optimized results of the mathematical model of single cell MCFC using the two optimization techniques.

MCFC Cell Para-meters	Input Value	Simulated results using Genetic Algorithm Voltage Power (volts) (watts)	Simulated results using PSO Algorithm Voltage Power volts watts	Optimize Values Algorithm Genetic PSO	Remark
CathodeAnode Thickness cm	0.02	1.18 0.50	1.15 0.55	Voltage: 1.18 1.15 Power: 0.56 0.59	Genetic better
	0.024	1.14 0.48	1.11 0.50		
	0.028	0.96 0.42	1 0.46		
	0.032	0.88 0.38	0.85 0.42		
	0.036	0.82 0.33	0.81 0.39		
Membrane Thickness In mm	6	0.52	0.53	Power 0.52 0.53	PSO better
	7.8	0.49	0.50		
	9.6	0.47	0.44		
	1.14	0.43	0.41		
	1.32	0.38	0.40		

3 Results and discussion:

In the same temperature domain Voltage simulated and optimized results using the genetic algorithm better predicted as compared to PSO algorithm, but in same case power better predicted by the PSO algorithm. Similarly in the same pressure domain voltage and power better optimized results obtained by the PSO algorithm corresponding to 1 bar pressure, but at higher pressure the PSO algorithm over predict the simulated and optimized results.

4. Conclusion:

The present analysis, has been done for various parameters of single cell of MCFC and attempts to optimize the performances of the cell. The Optimize results are obtained using genetic and PSO algorithm, PSO algorithm take less time in the optimization process as compare to genetic algorithm and also better obtained optimized results are obtained in number of cases through the analysis. The Optimized results can be utilized in designing multi-cells of MCFCs.

REFERENCE

[1] L. J. Yu G. P. Ren X. M. Jiang et.al" Experiment and numerical simulation on the performance of a kw-scale molten carbonate fuel cell stack" Institute of Fuel Cell, Shanghai Jiao Tong University, Shanghai 200030, PR, China (Received: March 20, 2006 [2] Bengt Sundén and Jinliang Yuan on modeling of heat and mass transfer and other transfer phenomena in fuel cell Frontiers in Heat and Mass Transfer (FHMT), ISSN 2151 – 8625, 1013008 (2010) [3] S.K. Dhakad, et.al. "Mathematical Modeling and Performance Simulation and Optimization of Molten Carbonate Fuel Cell(MCFCs)" Published in International Journal of Engineering Research and Industrial Application,(IJERIA) p.p. 299-311 Vol.5, No.3, August 2012 . [4] Fuel Cell Handbook, Edited by EG&G Technical Servies ,National Energy T echnology laboratory Morgantown, West Virginia 26507-0880(2004). [5] Piotr Tomczyk MCFC versus other fuel cell Charcteristics techonologies and prospects Journal of Power Sources, (160), pp. 852-862, 2006. [6] Thermodynamic Analysis of Hybrid Molten Carbonate Fuel Cell Systems Ramin Rashidi Thesis University 2 Ontario Institute of Technology December 2008.