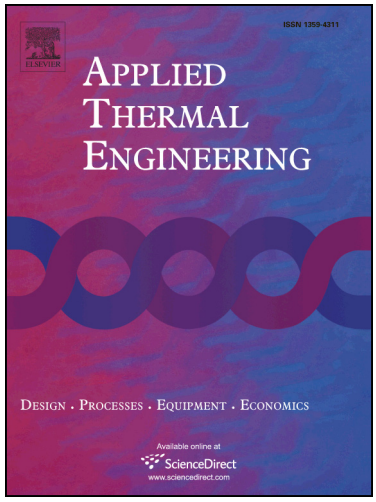

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PII: S1359-4311(16)30444-6
DOI: http://dx.doi.org/10.1016/j.applthermaleng.2016.03.136
Reference: ATE 8004

To appear in: *Applied Thermal Engineering*

Received Date: 6 October 2015
Accepted Date: 21 March 2016

Please cite this article as: A.K. Shukla, O. Singh, Performance Evaluation of Steam Injected Gas Turbine Based Power Plant with Inlet Evaporative Cooling, *Applied Thermal Engineering* (2016), doi: http://dx.doi.org/10.1016/j.applthermaleng.2016.03.136

Performance Evaluation of Steam Injected Gas Turbine Based Power Plant with Inlet Evaporative Cooling

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Abstract

Present paper deals with the study for performance evaluation of steam-injected gas turbine (STIG) based power plant with inlet evaporative cooling. It investigates the combined effect of inlet evaporative cooling (IEC), steam injection (SI) and film cooling (FC) on the power augmentation of simple gas turbine cycle. Thermodynamic modelling has been carried out and presented along with results showing the influence of inlet evaporative cooling on various performance parameters of STIG based power plant. Results show that there occurs increment of 3.2 percent in cycle thermal efficiency due to lowering of the compressor inlet temperature from 318K to 282K at 5% steam to air ratio (SAR). At 1850K turbine inlet temperature and cycle pressure ratio of 24 there occurs increase in thermal efficiency of the GT cycle with IEC, SI and FC as compared to the simple GT cycle. Injection of steam in the combustion chamber enhances the specific expansion work in the gas turbine, which increases at rate of 2.95% for every increase in SAR by 2%. The study shows that gas turbine cycle configuration with inlet evaporative cooling (IEC), steam injection and film cooling is the best combination for obtaining more efficiency and power.

Key words: steam injection, specific power, steam air ratio, thermal efficiency

Nomenclature

c	Blade chord
c_p	Specific heat at constant pressure (kJ/kgK)
f	Ratio of mass flow rate of fuel to mass flow rate of air

Greek symbols

α	coolant flow discharge angle
φ	Relative humidity
λ	Ratio of cooled blade surface area to hot gas flow area (A_b/A_g)
ε	Film cooling effectiveness
η	Efficiency