

Accepted Manuscript

Effect of atmospheric condition and ammonia mass fraction on the combined cycle for power and cooling using ammonia water mixture in bottoming cycle

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PII: S0360-5442(18)30159-2

DOI: [10.1016/j.energy.2018.01.131](https://doi.org/10.1016/j.energy.2018.01.131)

Reference: EGY 12243

To appear in: *Energy*

Received Date: 25 June 2017

Revised Date: 25 December 2017

Accepted Date: 25 January 2018

Please cite this article as: Maheshwari M, Singh O, Effect of atmospheric condition and ammonia mass fraction on the combined cycle for power and cooling using ammonia water mixture in bottoming cycle, *Energy* (2018), doi: 10.1016/j.energy.2018.01.131.

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9 **Abstract:**

10 Gas/steam combined cycle power plants are being extensively used for power generation due
11 to their better performance as compared to gas turbine based or steam turbine based power
12 plants operating in isolation. These combined cycle power plants have natural aspiration in
13 compressors where the state of ambient air entering it, significantly affects the work
14 requirement of compressors and thus affects the overall combined cycle power plant
15 performance. It is felt that in tropical countries with significant seasonal variations, when the
16 atmospheric temperatures become quite high during some months in a calendar year, the
17 cooling of ambient air before entering compressor using the energy available in combined
18 cycle power plant may help in improving the overall plant performance. In view of this a
19 combined cycle with ability of producing power and provision of simultaneous cooling of air
20 entering the compressor and cooling of gas turbine blades through ammonia water mixture
21 and steam using closed loop cooling scheme has been studied in this paper. A comparative
22 analysis of the combined cycle's considered shows that for a cycle pressure ratio of 40 and
23 turbine inlet temperature of 2000K maximum work of 2093kJ/kg of compressed air is
24 obtained for ammonia mass fraction of 0.6 for the combined cycle using only ammonia water
25 mixture as coolant where as maximum first law efficiency and second law efficiency of
26 62.6% and 59.67% are being achieved for ammonia mass fraction of 0.7, for the same
27 configuration and at an ambient temperature of 30°C. Cooling load of 22 kW is observed to
28 be maximum for the configuration using steam and ammonia water mixture as coolant and

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