

Genetic algorithm-based optimization of a multi-stage flash desalination plant

G.N. Sashi Kumar*, A.K. Mahendra, A. Sanyal, G. Gouthaman

*Machine Dynamics Division, CEL-5, Bhabha Atomic Research Centre, Trombay, Mumbai 400085, India
Tel. +91 (22) 2559 3611; Fax: +91 (22) 2550 5151; email: gnsk@barc.gov.in*

Received 16 October 2007; Accepted 1 April 2008

ABSTRACT

The MSFSIM, a simulator which predicts the performance of a multi-stage flash (MSF) desalination plant, has been coupled with a genetic algorithm (GA) optimizer. The nuclear desalination demonstration project (NDDP) at Kalpakkam, India, has an MSF plant under construction. Exhaustive optimization case studies have been conducted on this plant with an objective to increase the performance ratio (PR) and minimize the start-up time. The steady-state optimization performed was targeting the best stage-wise pressure profile to enhance thermal efficiency which, in turn, improves the performance ratio. Apart from this, the recirculating brine flow rate was also optimized. This optimization study enabled us to increase the PR of the NDDP-MSF plant from a design value of 9.0 to an optimized value of 13.1. A further increase of 20% in the heat transfer area, extra area provided for seasonal variation, has taken the PR to 15.1 under optimized conditions. A desire to maintain equal flashing rates in all of the stages (a feature required for long life of an MSF plant) has also been achieved. The deviation in the flashing rates within stages has been reduced. The start-up variation behavior of the plant was also optimized using MSFSIM coupled with the GA optimizer. This study minimized the start-up time to reach the optimized steady state.

Keywords: Optimization; MSFSIM; NDDP; MSF; Performance ratio; Genetic algorithm; Start-up

* Corresponding author.