Contents lists available at SciVerse ScienceDirect

## Applied Thermal Engineering

journal homepage: www.elsevier.com/locate/apthermeng

# Experience of modification of thermo-compressors in multiple effects desalination plants in Assaluyeh in IRAN

### Ramin Kouhikamali<sup>a,\*</sup>, Navid Sharifi<sup>b</sup>

<sup>a</sup> Faculty of Engineering, University of Guilan, P.O. Box 3756, Rasht, Iran
<sup>b</sup> Department of Aerospace Engineering, Amirkabir University of Technology, Tehran, Iran

#### ARTICLE INFO

Article history: Received 27 July 2011 Accepted 2 February 2012 Available online 10 February 2012

Keywords: Multi effect distillation Thermo-compressor Operational condition optimization Experimental investigation

#### ABSTRACT

Nowadays multiple effect desalination plants are used widely in water treatment processes. They utilize thermal vapor compressors instead of mechanical ones. One of the major complexities about thermocompressors is related to its unstable operational mode. An experimental malfunctioning occurred in a desalination unit established in south pars gas field phases 9&10 with 1718 cubic meter per day capacity. Some modifications on the thermo-compressor design were applied and well tested.

In the current study a numerical investigation was performed on a malfunctioning thermo-compressor and the source of the problem was observed via a numerical simulation. Afterwards, the modifications were conducted on the numerical models and then a perfect analyzed and verified model was selected to manufacture and install. The test results were shown a better performance of thermo-compressor which yields an increase in entrainment ratio and extend the stable region of thermo-compressor working. It is shown that the entrainment ratio is very sensitive to the geometrical parameters of mixing area zone and throat section of thermo-compressor.

© 2012 Elsevier Ltd. All rights reserved.

#### 1. Introduction

The need for high quality water significantly increased during the last decade. The lack of the fresh water resources is the main reason to apply desalination technologies to produce purified water for the utilities. The desalination systems are the most important systems that several countries use to prepare potable and industrial water for their requirements. Using the desalination systems in the countries near the Persian Gulf such as Iran has been increased significantly in the last decade. Development and improvement in desalination technologies are associated with the reduction in the energy consumption. There are a lot of desalination packages with small and medium capacities in IRAN especially in Assaluyeh city. Assaluyeh is the main region in IRAN for the refinery and production of natural gas and lot of gas fields established near this city such as South Pars Gas Field. Phases 9&10 are one of the biggest gas production plants in IRAN. There are three MED-TVC (Multiple Effect Desalination with Thermal Vapor Compressor) plants at the utility site with 1718 cubic meter per day of product water capacity. Fig. 1 shows a photo of three MED-TVC packages installed in Assaluyeh.

A lot of numerical and experimental researches on thermocompressors and ejectors have been performed in the past decade. Performance prediction of steam ejectors was obtained by Sriveerakul *et al.* [1,2]. CFD simuluation of a supersonic ejector was presented by Hemidi *et al.* [3]. The performance of thermocompressors was investigated numerically by Park *et al.* [4]. A computer simulation code was developed by KouhiKamali *et al.* to simulate MED-TVC packages [5–7].

Thermo-compressor is the essential part of the multi effect desalination systems. The thermo-compressor performance is affected by its geometrical characteristics such as converging angle in mixing area section, constant area section diameter, and mixing zone inlet and outlet diameters and so on. These parameters should be designed and qualified accurately according to the number of the nozzles inside the thermo-compressor. Fig. 2 shows geometrical parameters of the thermo-compressor. MyoungKuk Ji *et al.* [8] simulated flow structure inside thermo vapor compressor.

The objective of this article is to investigate the effect of an effective area known as constant area section on thermocompressor performance. Constant area zone plays roll of a throat for delivered steam to the downstream of thermo-compressor. In this study, the effect of throat diameter is numerically evaluated and also experimentally verified. According to the numerical results, a new thermo-compressor with a different throat diameter





<sup>\*</sup> Corresponding author. Tel.: +98 131 6690276; fax: +98 131 6690270. *E-mail address*: kouhikamali@guilan.ac.ir (R. Kouhikamali).

<sup>1359-4311/\$ -</sup> see front matter  $\odot$  2012 Elsevier Ltd. All rights reserved. doi:10.1016/j.applthermaleng.2012.02.002