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A Feedback Control System with Reference Governor for a Solar Membrane Distillation Pilot Facility

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Abstract

This work presents the development of a feedback control system for a pilot membrane distillation facility powered with solar energy located at Plataforma Solar de Almería (PSA), Spain. The control system allows to fix a suitable operating temperature at the inlet of the distillation system, improving the operation quality. Four direct control schemes based on Proportional Integral (PI) controllers and Feedforward (FF) are designed as well as a reference governor which generates temperature references for the heat generation circuit direct control layer. Simulations and experimental tests are shown to demonstrate the effectiveness of the proposed scheme.

Keywords: Air-gap membrane distillation, feedforward, reference governor, solar energy, PI controllers.

1. Introduction and literature review

Nowadays, water scarcity is one of the main challenges of the World. The demand of fresh water for human use, agriculture and industrial purposes is increasing steadily, reducing the water reservoirs. Consequently, desalination technologies have become a necessity, specially in dry areas with water shortage. Due to the large amount of energy required, desalination technologies must be associated with renewable energy sources for their economical sustainability [1, 2]. Using renewable energy for desalination not only sorts out the water problem but also replaces traditional sources like fossil fuels, thus contributing to efficient environment development [3]. Due to the high solar irradiance available in places with lack of water, solar energy is the most suitable renewable source for desalination processes.

In this context, Solar Membrane Distillation (SMD) is an appropriate technology for developing small-scale desalination systems in remote areas with good

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