

Analysis of Pressure Drop in a Concentrated Solar Collector with Direct Steam Production

Authors : Sara Sallam, Mohamed Taqi, Naoual Belouaggadia

Abstract : Solar thermal power plants using parabolic trough collectors (PTC) are currently a powerful technology for generating electricity. Most of these solar power plants use thermal oils as heat transfer fluid. The latter is heated in the solar field and transfers the heat absorbed in an oil-water heat exchanger for the production of steam driving the turbines of the power plant. Currently, we are seeking to develop PTCs with direct steam generation (DSG). This process consists of circulating water under pressure in the receiver tube to generate steam directly into the solar loop. This makes it possible to reduce the investment and maintenance costs of the PTCs (the oil-water exchangers are removed) and to avoid the environmental risks associated with the use of thermal oils. The pressure drops in these systems are an important parameter to ensure their proper operation. The determination of these losses is complex because of the presence of the two phases, and most often we limit ourselves to describing them by models using empirical correlations. A comparison of these models with experimental data was performed. Our calculations focused on the evolution of the pressure of the liquid-vapor mixture along the receiver tube of a PTC-DSG for pressure values and inlet flow rates ranging respectively from 3 to 10 MPa, and from 0.4 to 0.6 kg/s. The comparison of the numerical results with experience allows us to demonstrate the validity of some models according to the pressures and the flow rates of entry in the PTC-DSG receiver tube. The analysis of these two parameters' effects on the evolution of the pressure along the receiving tub, shows that the increase of the inlet pressure and the decrease of the flow rate lead to minimal pressure losses.

Keywords : direct steam generation, parabolic trough collectors, Ppressure drop, empirical models

Conference Title : ICATEST 2019 : International Conference on Advanced Thermal Energy Storage Technologies

Conference Location : London, United Kingdom

Conference Dates : August 20-21, 2019