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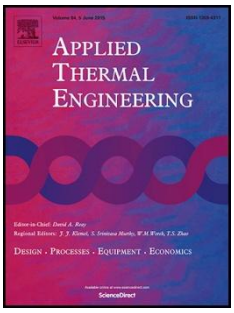

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On the evaluation of a cyclone separator for cleaning of open volumetric air receiver

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Highlights

- Analysis of cyclone separator for cleaning/collection of dust from open volumetric air receiver.
- Experiment to demonstrate dust deposition in an absorber is presented.
- A modified coefficient of pressure-drop is proposed.
- A strategy for integration of cyclone separator with open volumetric air receiver is discussed.

Abstract

Rajasthan and Gujarat on being located at the equatorial belt receive almost the highest solar irradiation in India. At the same time, such arid desert regions are blessed with dust. This energy can be harnessed using, for instance, solar thermal technology. The recovered heat can be employed for applications, like, heat treatment of metal. For this purpose, an open volumetric air receiver based solar tower technology concept is adopted. In this receiver concentrated solar irradiation is focused onto porous absorber, which is open to atmosphere. The atmospheric air is used as heat transfer fluid with suction. The suspended dust particles in atmosphere will deposit in the pores of the open absorber and even pass to the internals of the complete systems. This is expected to damage the receiver and prevent continuous operation of such a system. In this paper, design and evaluation of a cyclone separator for cleaning and collection strategy of dust from open volumetric air receiver is described. In particular, this paper presents (a) an experiment demonstrating the dust deposition in porous absorber (b) evaluation of the designed cyclone separator and (c) proposed modification in Lapple model for prediction of pressure-drop in cyclone separator including the effect of operating temperature.

Keywords: cyclone separator, pressure-drop, volumetric air receiver

1. Introduction

Increase in energy demand and depletion of non-renewable sources of energy necessitates special attention towards renewable sources of energy. The renewable sources, like, solar energy, wind energy and geothermal energy are currently in focus. In particular, the availability of solar energy is several times the required quantity the civilization [1]. Solar energy can be harnessed by, for instance, solar thermal systems that are based on parabolic trough collector, linear Fresnel reflectors, heliostat and parabolic dish. Solar thermal technologies can be used for power generation, cooling and for process heat applications, like, smelting of a metal. Currently, direct electrical energy is utilized for such process heat applications. The use of solar thermal technology would avoid double conversion (a) fuel → heat and then (b) heat→ electricity. Therefore, it may be argued that such a system would (a) save fuel (e.g. coal, fossil) and, (b) improve the overall efficiency of the system. In particular, heliostat based solar tower technology, which