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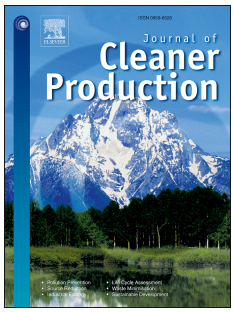

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Modeling and design of solar heat integration in process industries with heat storage

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Abstract

Heat is a major contributor to total energy demand of process industries. Therefore, integrating solar heat into processes is a suitable alternative for fossil fuels. However, there are several challenges in design and optimization of solar heat integration. In this paper, the proper distribution of solar heat among direct heating solar heat exchangers and different temperature levels of heat storage is analytically solved for. As a result, a new concept is developed which can help design and operate solar heat integrated systems with heat storage. In the case study, the effect of collector area and efficiency, minimum solar temperature difference, storage size, and heat loss rate on the solar fraction are evaluated. Results show that while there is virtually no difference in solar fraction when 1,000 collectors are installed, it ranges from 17 to 47 % with 6,000 collectors when thermal storage is possible and different collector efficiencies are included. In addition, the effect of storage type and size becomes significant only when enough number of collectors are installed to provide adequate excess heat during the sunny hours. The highest observed difference in solar fraction over the considered range of storage type and size was 1.5%.

Keywords: Solar Energy; Heat Integration; Process Industries; Heat Storage; Heat Exchanger Network