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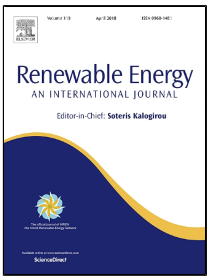

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Waste Tire Pyrolysis using Thermal Solar Energy: An Integrated Approach

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Abstract

Pyrolysis is a well-known thermochemical process used to treat various types of solid waste that is often associated with an intensive energy demand. To this date, the heat source for pyrolysis has been mainly through burning fossil fuels (e.g. coal or natural gas) or via electric heating. As a result, pyrolysis is still considered an economically unattractive solid waste management technique. One environmentally-attractive solution would be to integrate solar thermal energy, via concentrated solar power (CSP) systems, into the pyrolysis process to reduce its dependency on fossil fuel.

In the current work, we investigate the pyrolysis of waste tires integrated with CSP using linear Fresnel reflectors (LFRs) technology. The heat transfer fluid (HTF) is heated to elevated temperatures of 520°C to provide the necessary thermal energy for the pyrolysis reactor operating at 550°C. Using System Advisor Model (SAM) integrated with the Aspen Plus® tire pyrolysis flowsheet proved that solar energy in Lebanon can provide on average 47.14% of the annual energy demands of the pyrolysis reactor. Energy savings can decrease on average to 26.6% in winter season and increase to 60.8% in the summer.

Keywords: Tire Pyrolysis; Concentrated Solar Power; Process Modeling; Thermal Energy Storage

Introduction

The amount of solid waste is continuously increasing along with the world population and the growing use of fossil-fuel based materials. While the dependency on fossil fuel and non-renewable resources is unsustainable on the long run, the harm can be reduced by developing renewable and green-energy alternatives. In 2010, world production of tires was estimated at 17 million tons, whereas in 2011, it was estimated that 1.4 billion tires were taken off the road and needed proper solid waste management and disposal [1]. These statistics will continue to rise with the annual increase in the number of cars introduced on the road. Since tires are non-biodegradable and have a life span of 80–100 years in a landfill, and because they cannot be transformed into their basic chemical components after melting as they are thermoset polymers [1], waste tires are now considered a growing environmental and economic problem. The current end of life options of these waste tires include; material recycling and recovery, landfilling, and/or incineration for energy recovery [2].