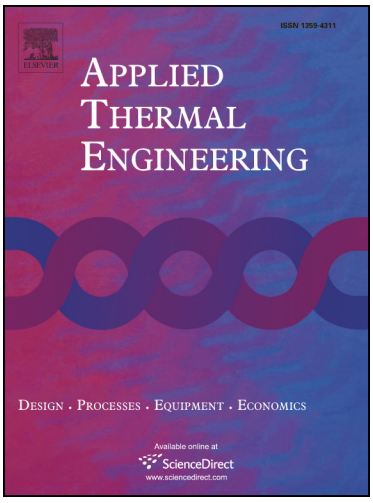

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Material screening and compatibility for thermocline storage systems using thermal oil

Sophie MOLINA[1]*, Didier HAILLOT[1], Alexandre DEYDIER[2], Jean-Pierre BEDECARRATS[1]

[1] Univ Pau & Pays Adour, LaTEP - IPRA, EA1932, ENSGTI, Avenue Jules Ferry, BP7511, 64000 Pau, France
[2] CNIM (Constructions Industrielles de la Méditerranée), Siège social, Direction Générale, 35, rue de Bassano, 75008 Paris, France
*(corresponding author: sophie.molina@univ-pau.fr)

Abstract – Among existing heat storage technologies, dual-media thermocline systems are considered an economical option, experimentally demonstrated at several scales. To obtain cost reduction for these storage systems, a part of the heat transfer fluid is replaced by a low-cost solid. The contact between these two media raises the question of their compatibility and behavior in time, as the storage performance directly depends on it. Ageing and compatibility tests have been performed at the laboratory scale with Jarytherm® DBT oil and various solid media. These tests, carried out at 340°C for 500h, have shown the strong influence of the solid composition on its compatibility with oil. A strong incompatibility has been highlighted between Jarytherm® DBT oil and the selected natural rocks at 330°C, through chromatographic analysis and oil properties evaluation before and after ageing. To the contrary, glass, steel and alumina fared well, and are thus considered as promising storage media.

Keywords: *thermocline storage, ageing, compatibility, thermal oil*

Nomenclature

C_P	specific heat, $J.kg^{-1}.K^{-1}$
D	storage inner diameter, m
d_P	particle diameter, cm
H	storage height, m
T	temperature, $°C$
V	volume, m^3

Greek symbols

ε	porosity, -
λ	thermal conductivity, $W.m^{-1}.K^{-1}$
μ	dynamic viscosity, $Pa.s$
ρ	density, $kg.m^{-3}$

Subscripts

cold	cold storage temperature
hot	hot storage temperature
l	liquid
s	solid

1. Introduction

During the last decades, the energy demand has kept increasing, leading to stronger constraints on energy supply and use. Among the technological solutions developed in answer to these issues, thermal energy storage has recently been recognized by IRENA (International Renewable ENergy Agency) as one of the most promising way to accelerate the renewables penetration in energy supply networks [1]. IRENA's calculations also showed that in Europe, 1.4 million GWh could be provided by thermal energy storage, thus avoiding 400 million tons of CO_2 emissions [2].

Thermal energy storage can be classified in three main groups: sensible heat, latent heat and thermochemical storage [3]. Sensible heat storage is based on the temperature change of the storage media, and is nowadays the most mature technology, having benefited from