Thermal performance assessment and improvement of a solar domestic hot water tank with PCM in the mantle - DTU Orbit (18/12/2018)

To develop an appropriate solar DHW (Domestic Hot Water) tank for residential dwellings and put it into the European solar thermal market for promotion, thermal performance tests of PCM (Phase Change Material) hot water storage tanks of both a prototype and an improved version with a water volume of 148 l and 35 kg PCM in the mantle has been carried out. The tank was designed to provide DHW for residential dwellings through a combination of solar and auxiliary heating, concurrently using PCM on the basis of cheap SAT (Sodium Acetate Trihydrate) as a thermal battery to shave off peak auxiliary power or to work under power outage. Heat transfer matching properties of the bottom and the top spirals separately for solar charge and auxiliary charge of the prototype DHW tank were ascertained in terms of heat exchanger capacity rate (HXCR) and the rule of thumb of boiler powers, respectively. Moreover, heat content of the PCM was estimated via a series of test cycles in order to infer its capacity and stability. It was found that there were some technical problems for the prototype tank module, such as mismatching property of the heat exchanger spirals, heat mixing phenomena during hot water draw-off. Thus, an improved tank was manufactured based on the test results of the prototype. Further tests indicated that the matching property of the top heat exchanger spiral was ameliorated for auxiliary charge and the heat mixing between hot water supply pipe and water tank was restrained during discharge, except that the length of the bottom spiral should be further reduced. Regarding the PCM in the mantle, it was inferred that the PCM heat content was somewhat lower than that of ideally working SAT. The PCM tended to perform stably under 16 test cycles with more than 3-month consecutive tests, implying no phase segregation occurred as that would degraded its performance.

General information
State: Published
Organisations: Department of Civil Engineering, Section for Building Energy, Chinese Academy of Sciences
Contributors: Deng, J., Furbo, S., Kong, W., Fan, J.
Number of pages: 12
Pages: 10-21
Publication date: 2018
Peer-reviewed: Yes

Publication information
Journal: Energy and Buildings
Volume: 172
ISSN (Print): 0378-7788
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 4.96 SJR 2.061 SNIP 2.12
Web of Science (2017): Impact factor 4.457
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 4.64 SJR 2.055 SNIP 1.968
Web of Science (2016): Impact factor 4.067
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 4.07 SJR 2.04 SNIP 2.146
Web of Science (2015): Impact factor 2.973
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 4.21 SJR 2.079 SNIP 2.875
Web of Science (2014): Impact factor 2.884
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 3.79 SJR 1.852 SNIP 2.404
Web of Science (2013): Impact factor 2.465
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2