Monitoring: Seasonal Thermal Energy Storage and the Passivhaus - lessons from 5 years of monitoring

19TH INTERNATIONAL PASSIVE HOUSE CONFERENCE 2015

University of ULSTER

1 Description

This paper describes the measured performance of the Seasonal Thermal Energy Store (STES) over a five-year period. The 23m^3 STES is integrated with a solar array of 10.6 m^2 and 300l DHW tank and the HRV space heating system of a house constructed to the Passivhaus standard which is located in Galway, Ireland. Details have previously been reported [1], [2] and presented at the International Passive House Conference [3].

2 Performance of Seasonal Energy Store

2.1 Temperature Profiles

The Mean Bulk Tank Temperature (MBTT) of the water in the 23 m^3 STES tank and the outside STES tank wall temperature (measured at a depth of 1 m) recorded on the 15th day of each month can be seen in figures 1 and 2 respectively below. A temperature "buffer" has not developed in the soil surrounding the tank as has been reported at other (larger) STES sites. The outside wall temperature has been more heavily influenced by the thermal conductivity of the soil and the climatic conditions experienced at the site. The difference between the STES wall temperature and 1m soil temperature measured 1 m from the STES has not varied by more than 1.2°C.

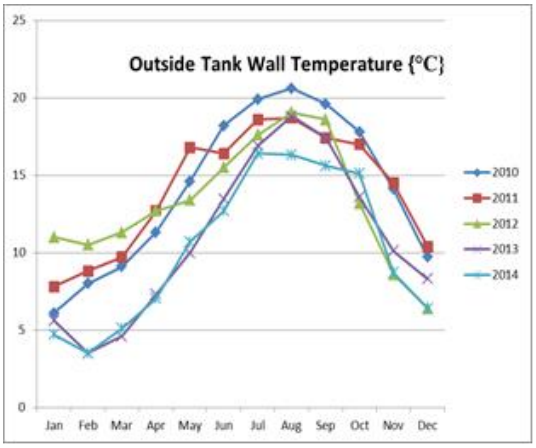

Figure 1, STES Outside wall Temp {°C}

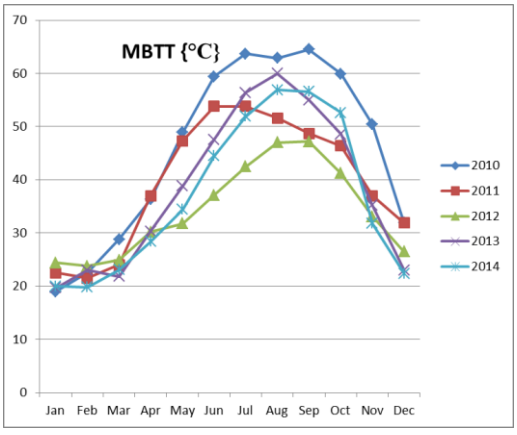

Figure 2, STES MBTT {°C}

2.2 Calculated Heat Loss Co-Efficient

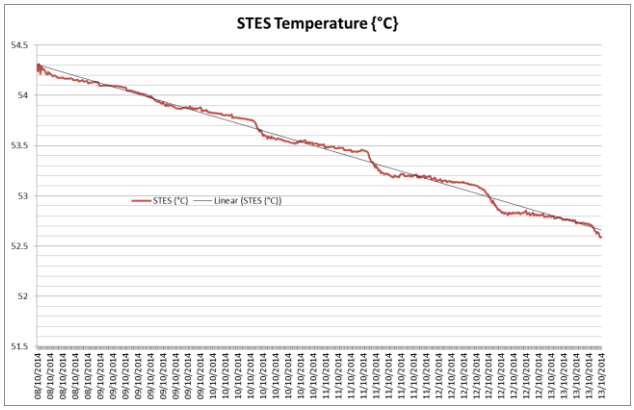

Figure 3 STES temperature profile during cool down test 8 to 13 October 2014

Due to the risk of insulation degradation due to moisture ingress into the EPS insulation surrounding the STES, the heat loss coefficient U_s of the tank has been calculated using cool down tests for periods in 2009, 2010, 2011, and 2014. The figures obtained are compared with the calculated heat loss coefficient of 4.19 W/K.

At the start of the monitoring period in November 2009 U_s was 9.99 Watts/Kelvin and in October 2014 it was calculated at 9.53 W/K, a variation of only 5%. The average calculated value of U_s has varied between +10.8% and -12.1% about the mean with variations predominantly attributed to the relatively short periods of some tests (which ranging from 27 hours to 9.5 days).

While calculated and in situ heat loss coefficients can exhibit significant variations, an invasive measurement at the installation is now required to determine the moisture content of the EPS.

3. References

[1] COLCLOUGH, S.M., 2011. *Thermal energy storage applied to the Passivhaus standard in the Irish climate*, PhD Thesis,University of Ulster.

[2] COLCLOUGH, S.M. et al, 2012. One Passivhaus' Search for Zero Carbon, *International Passive House Conference* 2012, pp. 577 – 582

[3] CLARKE, J., COLCLOUGH, S., GRIFFITHS, P. and MCLESKEY, J.T., 2013. A passive house with seasonal solar energy store: in situ data and numerical modelling.

4. Acknowledgements

This work was undertaken as part of the Irish Governments Charles Parsons Initiative, and the COST Network TU0802 Next Generation Cost Effective Phase Change Materials for Increased Energy Efficiency in Renewable Energy Systems and Buildings (www.tu0802.eu).

Dr. Shane Colclough, Dr David Redpath, Dr Philip Griffiths, University of Ulster, Newtownabbey, Northern Ireland, BT37 0QB. Corresponding author: Shane Colclough S.Colclough@ulster.ac.uk