

Comments regarding the paper to be presented at the evening meeting of the IOR in the City Conference Centre, 80 Coleman Street London EC2 at 5.45 .p.m.on the 8th May 2007, entitled:

Ground Source Heat Pumps in the UK

by

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I am pleased to see this paper on Earth Source Heat Pumps, as it was originally advertised, for I consider the UK should have taken much more interest in the topic before now.

The idea of heating buildings by currents of warm air was first presented by an eminent researcher such as William Thompson (Lord Kelvin) (1) in 1852 who had a wide research field. Another area was the measurement of the temperature of the earth at depth in his attempt to calculate the age of the earth. Incidentally he used mercury in glass thermometers graduated to one tenth of a degree and placed them in depth in the earth.

In the early seventies I commenced a study at The Queen's University of Belfast on the History and Development of the Heat Pump (2) before looking at sources of low grade energy. While looking at William Thompson's published work I found temperature measurements of the earth at depth interesting and proceeded to test samples of local soil for their thermal properties, i.e. conductivity and diffusivity etc. The temperatures at depth that I obtained were similar to that published and are well presented in this paper. I am sure that the authors would agree that the earth at the depth that could be used for a source of heat for a heat pump is mainly a large solar collector and little generally comes from other earth core action.

In my survey of the heat pump applications I visited a considerable number of sites. Two are memorable to me: The Festival Hall Heat Pump and the meeting with Mr John Sumner who was one of a number who took part in an Institution of Mechanical Engineers paper and was also the engineer who was responsible for the Norwich Heat Pump. John Sumner also demonstrated his horizontal pipe earth source heat pump that was used to heat the floor of his bungalow in Norwich. This was installed in the early 50's.

Experimental work on a small ground coil buried four feet below the surface was installed at Queen's University to determine the effect of the reduction in temperature on the surrounding soil as heat was extracted. Following this vertical coils were used to compare the effect of temperature change as heat was extracted. Similar temperatures were found to exist as far as the interaction was concerned, (FFR).

These tests were completed in the garden of one of the detached houses in the university property and the size of the garden could not support a full size horizontal pipe earth source suitable for the heating load of the house. The results from the vertical pipe source tests appeared to give enough information so that a vertical arrangement could be designed. Following publication of the above research (3)(4) the vertical arrangement was installed.

The vertical pipe earth source had 16 U-tubes, 10 metres long at 1.2 metres pitch (5) The source was connected to the heat pump and the circuit was designed to keep the earth source at constant temperature and run continuously. The reason for this was to determine if there would be a reduction in the output of the ground source energy. The heating side was arranged to heat water for the house by de-superheating the vapour and the refrigerant then entered the air handling units to heat the air in the house. This continuous heating kept the house very warm during the 131 days of non-stop operation with an average C.O.P. 2.9. and was frequently over 3.0. Isothermal line plots

were done to determine changes in temperature of the earth surrounding the U-Tubes. While the main change in temperature was adjacent to the pipes the area of soil affected could be taken as a 5m surface area and the volume of soil 250 m³. The heat pump output of the heat pump was approximately 9kW.

This system appears to be unique in that it showed that vertical pipe earth source could supply the low temperature energy required to heat the house with a small garden. The supply of heat from the earth source did not have any considerable variation but the temperature recovery of the earth took some time. If the system operated on the normal heating cycle i.e. heating controlled by a thermostat and by a time clock the ground source could recover on the off cycle and that constant operation did not have drastic repercussions.

Unfortunately while this research provided many opportunities for students to do further valuable studies, finance was not available at the time or afterwards. The system remained on the site for many years until further housing development took place. Similar to other examples of the use of heat pumps the research has not continued. It would appear that a new era has dawned and we appear to be installing earth sources in greater numbers. With this experience in the past, will it be possible to provide parameters to ensure that the exploitation is monitored and record for posterity.

Dr. John Fearon.

References

1. Thompson, W., "On the Economy of the heating or Cooling of Buildings by means of Currents of Air" Glasgow Phil. Soc. Proc. Vol. 111, Dec 1852.
2. J. Fearon., "The History and development of the Heat Pump" RAC Journal. April 1978, Pages 79 to 92.
3. J. Fearon, "Heat from Cold energy recovery with heat Pumps". CME September 1978, Pages 49 to 52.
4. J.R. Goulburn and J. Fearon, "Deep Ground Coil Evaporators for Heat Pumps," Applied Energy, Volume 4, No 4, October 1978, Pages 293 to 313.
5. J.R. Goulburn and J. Fearon, "Domestic Heat Pump with Deep Hole Ground Source Evaporator" Applied Energy, No 14 (1983) Pages 99 to 113. Applied Science Publishers Ltd.