

## **Stagnation and freezing tests and drain back behavior for solar collector loop with SEIDO5-8 solar collector**

A drain back solar collector loop with a solar collector of 8 tubes, SEIDO5-8, was installed in the laboratory test facility for solar heating systems at DTU to investigate the long term influences of stagnation and freezing on the evacuated tubular solar collector and the behavior of start up and emptying for a drain back system, see figure 1 and 2.



Figure 1. SEIDO5-8 on the roof of the lab at DTU



Figure 2. Drain back water tank in a solar collector loop

### **Stagnation and freezing tests**

The tests started on March 19, 2012, and ended at August 18, 2013. Stagnation occurred 11 days with a total duration of more than 343 hours. The collectors were in no way damaged in spite of the high number of stagnation periods with high temperatures. Further, the collectors were not damaged by the periods in the winter 2012-2013 with outdoor temperatures below 0°C. The tests show that SEIDO5-8 is suitable for drain back systems.

### **Drain back tests**

The behavior of start up and emptying for the solar collector loop is investigated. The time to get all air moved from the top of the solar collector loop to the drain back tank during start up with different

volume flow rates and start temperatures is listed in table 1. The time it takes for the water in the solar collector loop to return to the drain back tank after stop of the pump is listed in table 2. The volume flow rate and temperature before the stop of the pump are given as well.

Table 1. The behavior of start up for a drain back system

Date and time	Tem. (°C)	Flow rate (l/min)	Time for start up (s)
21/08/2013 11:35	29	16	40
21/08/2013 11:40	29	16	42
21/08/2013 11:44	29	16	40
21/08/2013 11:46	29	16	45
21/08/2013 11:49	29	16	43
21/08/2013 11:56	31	12	125
21/08/2013 12:01	31	12	128
21/08/2013 12:04	32	12	125
21/08/2013 12:08	32	12	128
21/08/2013 12:11	32	12	131
21/08/2013 13:37	32	5	81
21/08/2013 13:41	32	5	88
21/08/2013 13:46	33	5	86
21/08/2013 13:50	33	5	93
21/08/2013 13:54	33	5	88

The behavior of start up for the solar collector loop for different flow rates are shown in figures 3, 4 and 5.

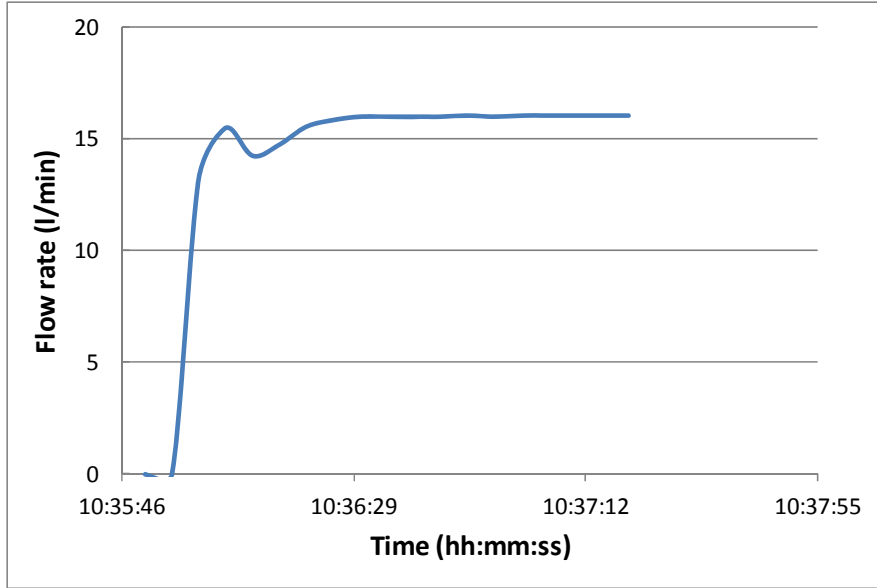


Figure 3. Volume flow rate during start up.

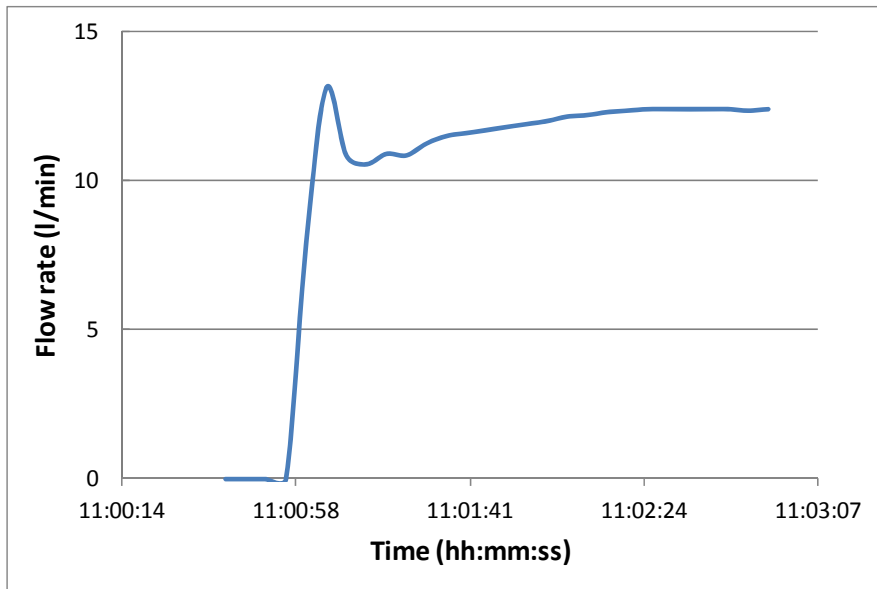


Figure 4. Volume flow rate during start up.

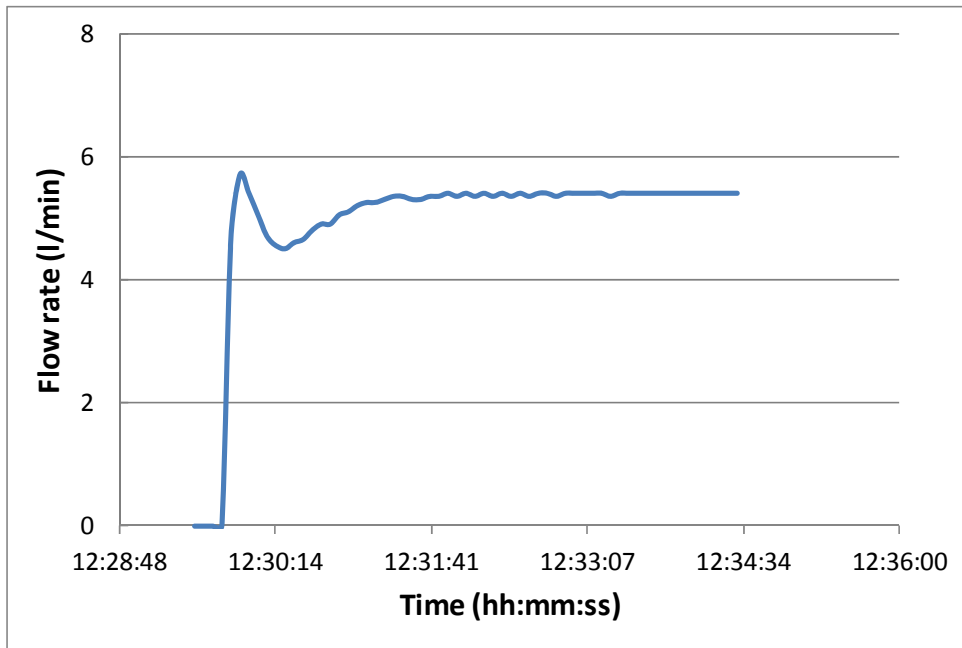


Figure 5. Volume flow rate during start up.

Table 2. The behavior of emptying for a drain back system

Date and time	Tem. (°C)	Flow rate (l/min)	Time to drain (s)
21/08/2013 11:33	29	16	52
21/08/2013 11:38	29	16	51
21/08/2013 11:42	29	16	52
21/08/2013 11:45	29	16	63
21/08/2013 11:47	29	16	54
21/08/2013 11:54	31	10	53
21/08/2013 11:59	31	12	54
21/08/2013 12:03	32	12	55
21/08/2013 12:06	32	12	56
21/08/2013 12:10	32	12	54
21/08/2013 13:27	32	5	75
21/08/2013 13:35	32	5	64
21/08/2013 13:40	32	5	62
21/08/2013 13:45	33	5	64
21/08/2013 13:48	33	5	64
21/08/2013 13:52	33	5	64

The behavior of emptying for the solar collector loop for different volume flow rates are shown in figure

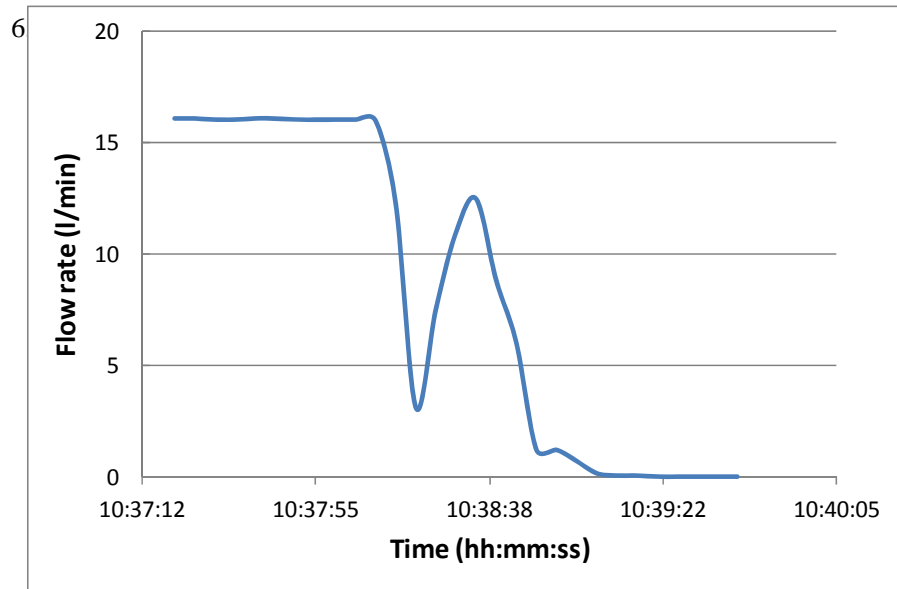


Figure 6. Volume flow rate after stop of pump.

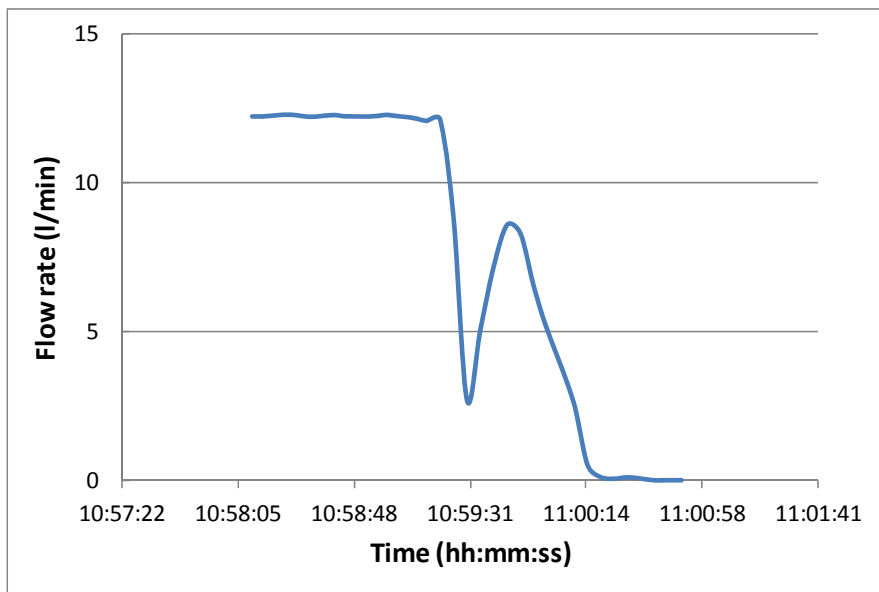


Figure 7. Volume flow rate after stop of pump.

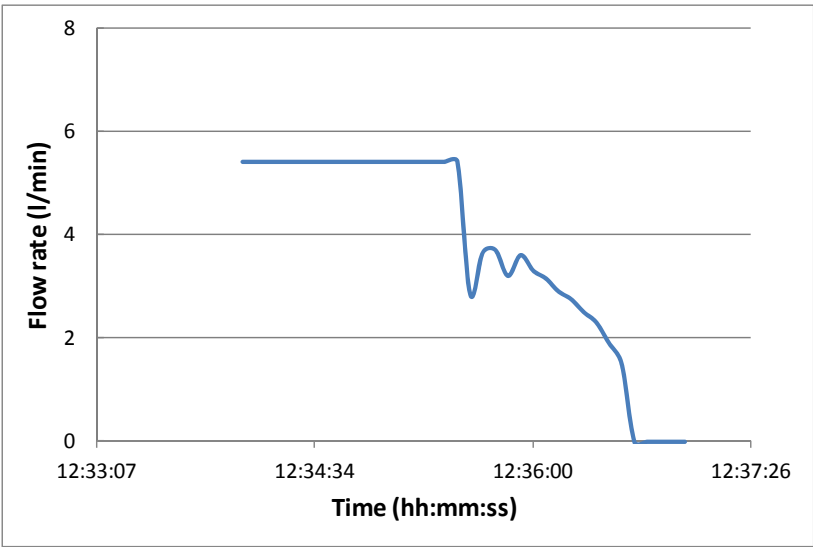


Figure 8. Volume flow rate after stop of pump.