

BeCoola Test Report Using the New Units

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Abstract

The report describes experimental testing on the two BeCoola units. The tests were carried out using an environmental chamber at the Institute of Sustainable Energy Technology, University of Nottingham.

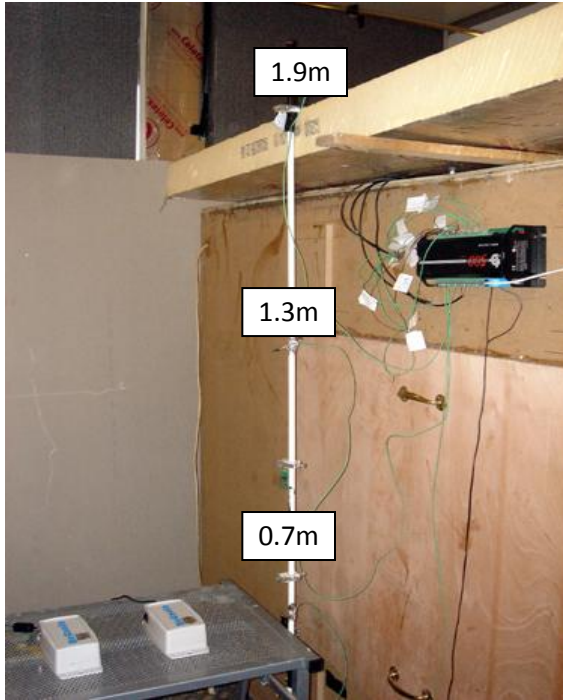


Figure 1 Chamber Test Rig



Figure 2 Two BeCoola Units

1 Testing Method

The tests were carried out using an environmental chamber at the University of Nottingham. The dimensions of the chamber are 4.2 x 3 x 2.8 m. The air temperatures were measured using temperature sensors, and the readings were recorded using a datataker D500 and PC (see Figs. 1 and 2). Three different test points were set at different heights, 0.7m, 1.3m and 1.9m, see Fig.1.

When the chamber indoor environment reached the set temperature, the heating in chamber was switched off. The air temperature in the chamber was found to drop gradually. The tests were carried out with BeCoola, and without using same test conditions. The tests period was carried out for one hour. The interval of recorded

temperatures was one minute. By comparing the speed of temperature drop, the cooling effectiveness of the BeCoola was determined.

2 BeCoola Testing Using the Environmental Chamber

The temperature inside the chamber was set at 31°C. The ambient temperature was around 23°C. The coolers used in the test were BeCoola I and BeCoola II. The tests were carried out at same environmental conditions as the test without BeCoola units. The tests were carried out with BeCoola I, with BeCoola II and with both BeCoola I& II. The average air temperatures were the average temperatures at three test points.

As shown in Fig. 3, compared with test results, the temperature was decreased slightly faster when the BeCoola was in operation. The test with one or two BeCoola units did not have a significant effect on the test results. The air temperature decreased from 31.2°C to 28.9°C using two BeCoola units and from 31.2°C to 29.2°C using one BeCoola unit. When BeCoola units were not running, the air temperature decreased from 31.2°C to 30.2°C. The details of the test results are given in Appendix I.

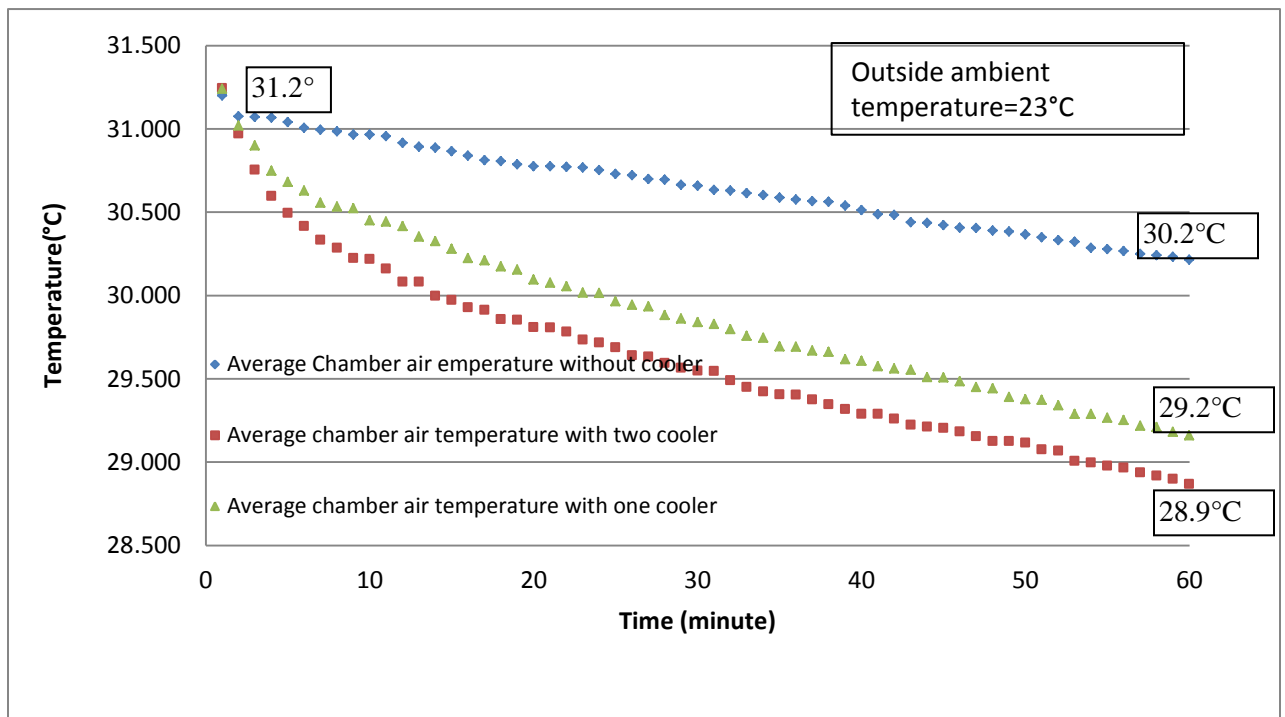


Figure 3 Chamber Average Air Temperature vs. Time

3 Long Time Testing and COP Calculations

In order to obtain a stable data/steady conditions, the testing on the BeCoola units was carried out for 16 hours using the environmental chamber. The coolers used in the test were BeCoola I and BeCoola II. The tests were carried out using same environmental conditions as the tests with BeCoola I and with BeCoola II and with both BeCoola I and II units. The air temperature used was average air temperature of three test points. The average air temperature in the chamber was set at 30 °C. The ambient temperature was about 23°C.

As shown in Fig. 4, the tests with one or two BeCoola unit did have a significant effect on results. The average air temperature decreased from 30°C to 22°C. The details of the test results are given in attached excel document

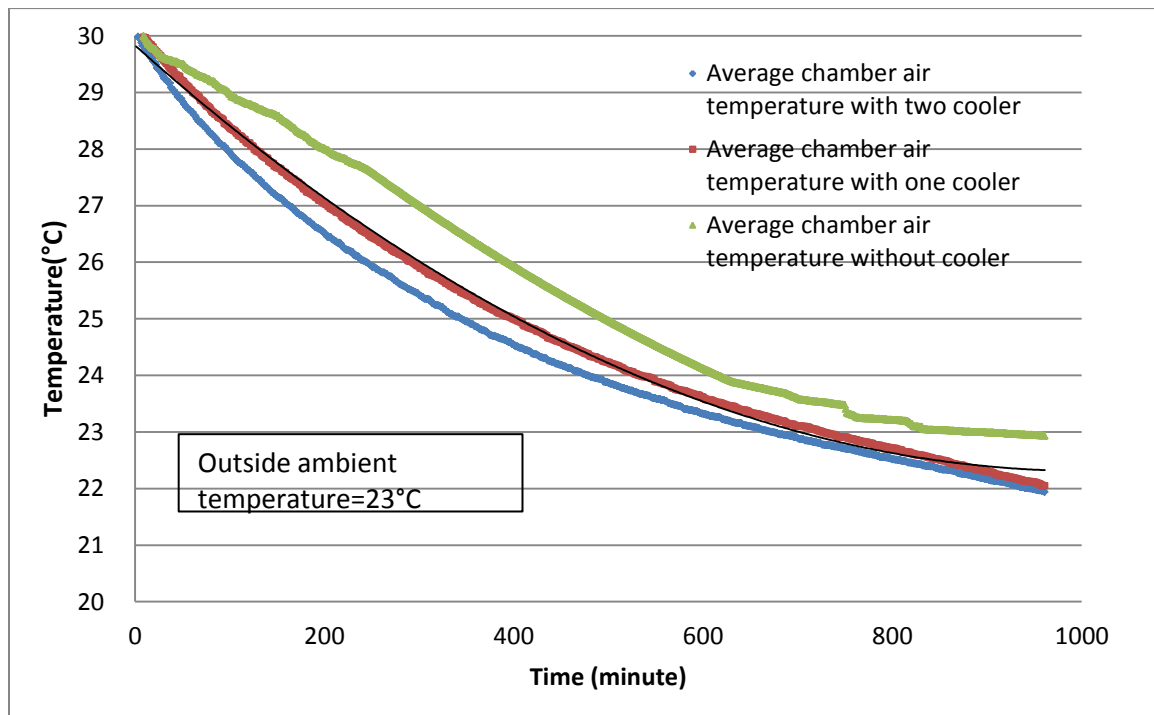


Figure 4 Chamber Average Air Temperature vs. Time

$$W_{\text{out}} = mc_p \Delta t / \tau$$

$$\eta = W_{\text{out}} / W_{\text{in}}$$

Where: m is the mass of air, kg; C_p is the specific heat of the air, J/(kg°C); Δt is the temperature drop, °C; W_{out} is the output power of BeCoola, W; W_{in} is the input power to the BeCoola, W; τ is the time, s.

The volume of the chamber is 33.6 m³. The period of the test is 16 hours. The temperature drop was 8 °C. The power input to the BeCoola is 2.2W. According to the above equations, the COP using the BeeCola unit is about 2.5.

Appendix I

Chamber Test for Becoola Unit			
Time	Average Chamber air temperature without BeCoola	Average chamber air temperature with two BeCoola units	Average chamber air temperature with one BeCoola
(minute)	(°C)	(°C)	(°C)
1	31.201	31.246	31.242
2	31.076	30.973	31.019
3	31.071	30.755	30.902
4	31.068	30.598	30.750
5	31.042	30.496	30.681
6	31.008	30.418	30.631
7	30.995	30.334	30.557
8	30.985	30.286	30.534
9	30.967	30.225	30.525
10	30.966	30.219	30.452
11	30.957	30.162	30.444
12	30.916	30.084	30.418
13	30.893	30.082	30.353
14	30.887	29.999	30.327
15	30.866	29.974	30.281
16	30.840	29.929	30.226
17	30.813	29.914	30.211
18	30.808	29.859	30.174
19	30.787	29.855	30.155
20	30.776	29.810	30.096
21	30.776	29.808	30.077
22	30.772	29.783	30.057
23	30.768	29.736	30.017
24	30.754	29.717	30.017
25	30.730	29.689	29.966
26	30.723	29.641	29.944
27	30.700	29.633	29.935
28	30.695	29.594	29.883
29	30.665	29.566	29.863
30	30.659	29.550	29.841
31	30.634	29.547	29.830
32	30.630	29.491	29.799

33	30.615	29.452	29.758
34	30.604	29.423	29.746
35	30.588	29.406	29.695
36	30.576	29.406	29.693
37	30.567	29.377	29.671
38	30.563	29.348	29.662
39	30.540	29.319	29.618
40	30.512	29.290	29.608
41	30.489	29.290	29.576
42	30.484	29.261	29.562
43	30.440	29.224	29.554
44	30.436	29.213	29.510
45	30.423	29.205	29.508
46	30.408	29.185	29.485
47	30.406	29.156	29.452
48	30.391	29.127	29.444
49	30.384	29.126	29.391
50	30.367	29.117	29.378
51	30.349	29.077	29.374
52	30.332	29.068	29.341
53	30.323	29.008	29.290
54	30.286	28.997	29.289
55	30.279	28.978	29.266
56	30.267	28.967	29.254
57	30.250	28.939	29.219
58	30.242	28.919	29.211
59	30.233	28.899	29.183
60	30.215	28.869	29.161