TECHNICAL NOTE

TN-111

Oxygen Levels in Purged Sun Ovens

Background

Reedholm supplies 300°C ovens for reliability assessment of packaged test structures. Most applications use dry air even when heating to >200°C, but a recent potential customer inquired about operation with continuous nitrogen purge to eliminate oxygen from the chamber. This technical note was put together showing that the requirement of <100ppm O_2 concentration was easily met. In fact, there is no problem with Sun oven achieving the requirement of <100ppm as long as the purge flow rate was ≥65 standard cubic feet per hour (SCFH).

Experiment

Data plotted in figure 2 (raw data is in table 1 on the next page) were taken for much longer than necessary for O_2 concentration to stabilize. Flow was 65 SCFH where standard conditions are 14.7psi and 70°F.

As shown, the chamber leveled out at ~25 to 30ppm, and temperature had no correlation with O_2 concentration.

Sun Oven Model EC10

The EC10 is provided for applications up to 300°C as specified under Reedholm P/N 70026. This oven is not customized for Reedholm use. Thus, Sun can assure temperature uniformity and oxygen concentration.

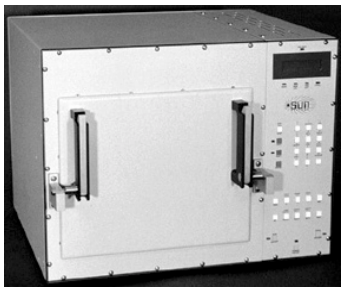

Figure 1-EC10 Sun Oven

Oxygen Analyzer

An oxygen analyzer built by Illinois Instruments, model 6000, was used to monitor O_2 concentration.

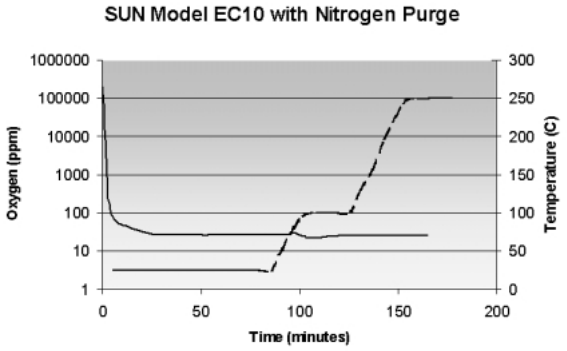

Figure 2 - Oxygen Concentration and Temperature

EC1.3W Evaluation

Additional tests were done with the EC1.3W oven capable of 400°C operation used for electromigration.

Effect of Smaller Diameter Vent Pipe

To achieve <100ppm O_2 concentration, the 0.5" ID brass vent pipe was changed to 0.375" ID, the size used on models EC1A, -11A, -10, & -11). Also, flow rate for the larger volume oven (1.3ft^3) had to be increased to 100 SCFH to achieve similar O_2 concentration. Results are in figure 3 and table 2 on the next page. After ~15 minutes, O_2 concentration was ~55ppm. Reducing the vent pipe to 0.25" ID resulted in the same concentration, ~55ppm, with flow of 50 SCFH.

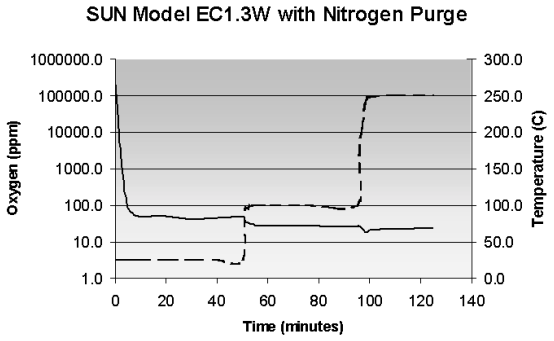

Figure 3 - Oxygen Concentration and Temperature

Projection for Smaller Ovens

Although not checked with smaller vent pipes, O_2 concentration of the EC10 and EC11 models should be similarly reduced with smaller vent pipes. That the EC11 has two additional heater elements is not a factor because the chamber is airtight in the region where the heaters are installed.

SUN Model EC10 with Nitrogen Purge			
Elapsed Time (minutes)	Oxygen Concentration (ppm)	Temperature (C°)	
		Set	Actual
0	207000.0	25.0	25.0
1	26900.0	25.0	25.0
2	2700.0	25.0	25.0
3	341.0	25.0	25.0
4	117.0	25.0	25.0
5	82.0	25.0	25.0
6	68.7	25.0	25.0
7	59.3	25.0	25.0
8	54.8	25.0	25.0
9	51.1	25.0	25.0
10	47.1	25.0	25.0
20	32.3	25.0	25.0
30	27.0	25.0	25.0
40	26.3	25.0	25.0
50	26.3	100.0	25.0
51	24.8	100.0	52.0
52	25.5	100.0	80.0
53	25.7	100.0	97.5
54	26.1	100.0	99.8
55	25.9	100.0	100.0
75	26.8	100.0	100.1
95	27.1	250.0	99.9
96	30.3	250.0	131.0
97	29.7	250.0	156.0
99	28.5	250.0	196.7
101	25.7	250.0	225.6
103	23.2	250.0	246.0
105	22.4	250.0	249.1
125	25.7	250.0	250.0
145	25.5	250.0	250.0
165	26.1	250.0	250.0

Table 1- Data Taken During First Experiment

SUN Model EC1.3W with Nitrogen Purge			
Elapsed Time	Oxygen Concentration	Temperature (C°)	
		Set	Actual
0	209000.0	25.0	25.0
1	31000.0	25.0	25.0
2	5090.0	25.0	25.0
3	735.0	25.0	25.0
4	170.0	25.0	25.0
5	87.0	25.0	25.0
6	68.6	25.0	25.0
7	59.6	25.0	25.0
8	54.2	25.0	25.0
9	50.5	25.0	25.0
10	48.3	25.0	25.0
20	52.3	25.0	25.0
30	41.5	25.0	25.0
40	45.2	25.0	25.0
50	47.2	100.0	25.0
51	39.8	100.0	95.2
52	32.8	100.0	96.5
53	31.5	100.0	99.3
54	29.5	100.0	99.8
55	28.2	100.0	100.0
75	28.0	100.0	100.1
95	27.1	250.0	99.9
96	28.0	250.0	168.7
97	22.8	250.0	205.1
98	18.7	250.0	237.6
99	17.8	250.0	245.4
100	21.1	250.0	248.8
110	22.4	250.0	250.1
125	24.5	250.0	250.1

Table 2- Data Taken During Second Experiment