

Performance Evaluation on of Esco "Tri Gas" CelCulture® CO₂ Incubator

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I. Introduction

Physiological *in vivo* oxygen concentrations can range from 1% to 13%, yet most research in cell cultures is done at ambient 21% O₂. Scientists in a variety of emerging fields are coming to understand the value of O₂ control in addition to CO₂ and temperature control in their daily applications. The advantage of embryo culture in a Trigas incubator is to achieve a relatively hypoxic environment (5% O₂) for embryo and cell culture.

Esco CelCulture® CO₂ incubator is equipped with tri –gas (O₂, CO₂, N₂) to meet major design of having the overall system controls gas, temperature, and humidity. Tri-gas is definitely better. Tri-gas mix can be achieved by using either a pre-mixed gas supplied by the distributor or by using CO₂ and N₂ gases. Nitrogen gas suppresses the ambient oxygen for below ambient cell culture requirement over a nominal range from 2%-20% oxygen.

The aim of this study is to evaluate the performance of Esco's Tri-gas Incubator using N₂ gas injection and monitoring the recovery time for %RH, %CO₂, and %O₂ during the test.

II. Method**Procedure**

For the overall test, two units of CO₂ Incubator P16 and P99 were used on this experiment. These two units fitted with the RH, CO₂, and O₂ sensor to monitor the value during the test. Data recorded using Vaisala probe. O₂ tri-gas test using N₂ gas injection to reduce the oxygen concentration.

2.1 Performance testing

For this test, two methods were established to evaluate the pattern of RH, CO₂, and O₂ to reach the set points. N₂ and CO₂ gases are injected into the chamber of the CO₂ incubator during its first operation. Secondly, N₂ gas is injected into the chamber of the CO₂ incubator when it already reaches the set point for RH (95%) and CO₂ (5 %). Both gases will operate under 15 Psi.

2.2 Recovery time testing

The effectiveness of the system will be verified using the recovery time of RH, CO₂ and O₂ level to reach the set points. To demonstrate this, reading will take for the three parameters. Reading should be taken at the interval of 30 seconds, 1 min, 2 mins, 3 mins, and 10 mins subsequent to the door opening and record the recovery time at each interval time. The data obtained will be reflected.

III. Result

3.1 Performance testing

The % RH level will decrease the impact of the N₂ gas injection into the CO₂ incubator chamber. But, it will be back to normal when it reaches the set point value several times. Detailed results are shown below.

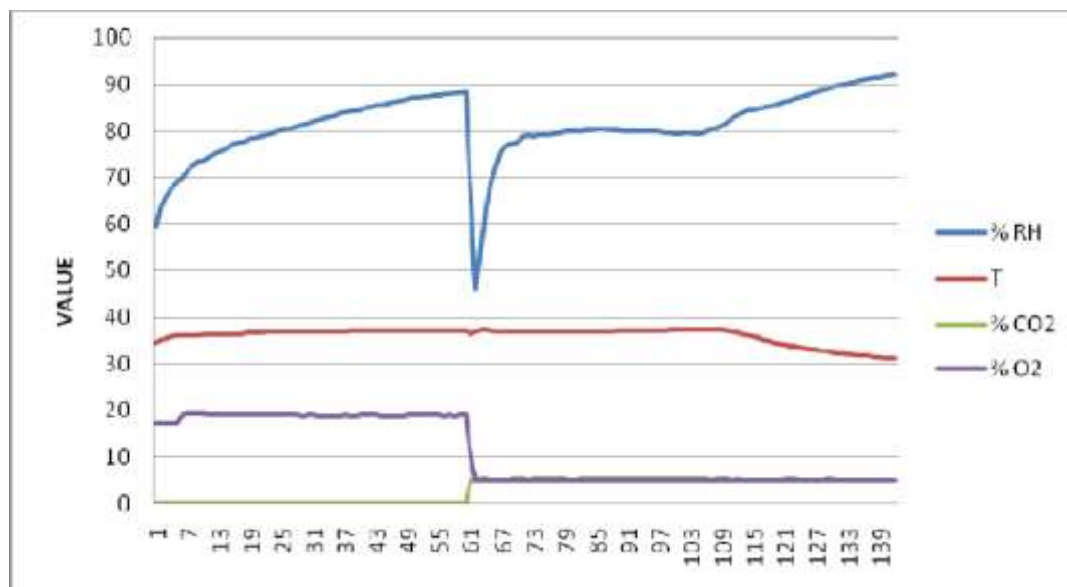


Figure 1. Performance on P16 with N₂ gas injection when CO₂ Incubator reaches humidity of 90%

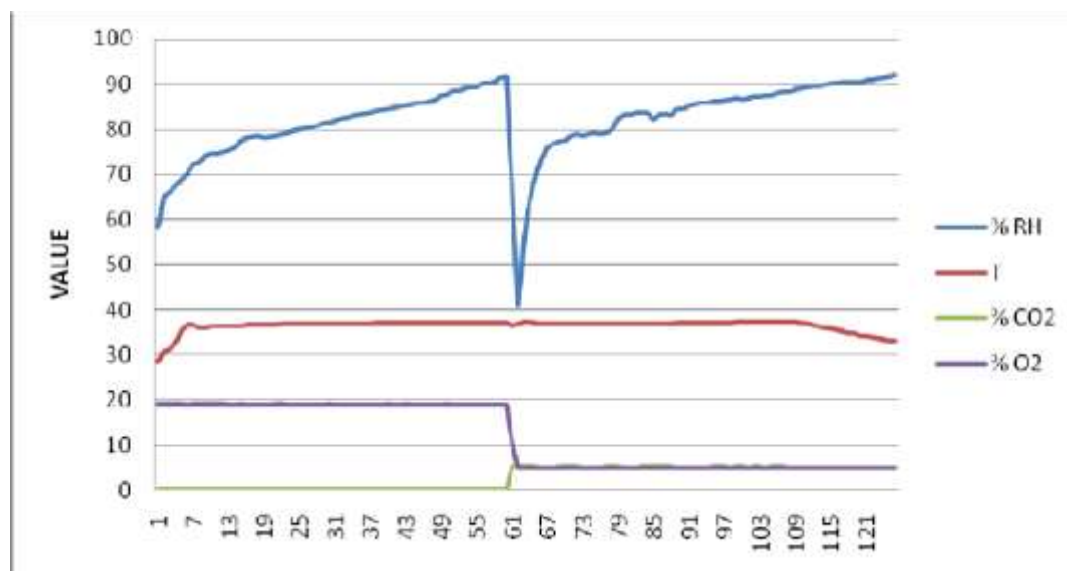


Figure 2. Performance on P99 with N₂ gas injection when CO₂ Incubator reaches humidity of 90%

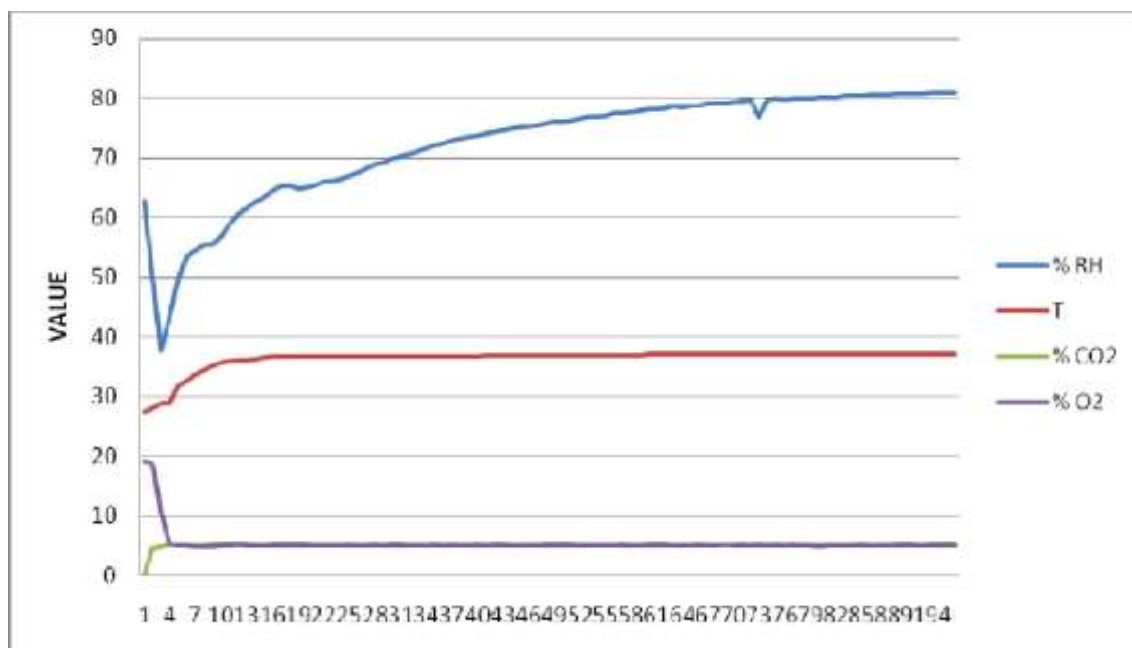


Figure 3. Performance on P19 with N₂ gas injection on the first operation of the CO₂ Incubator

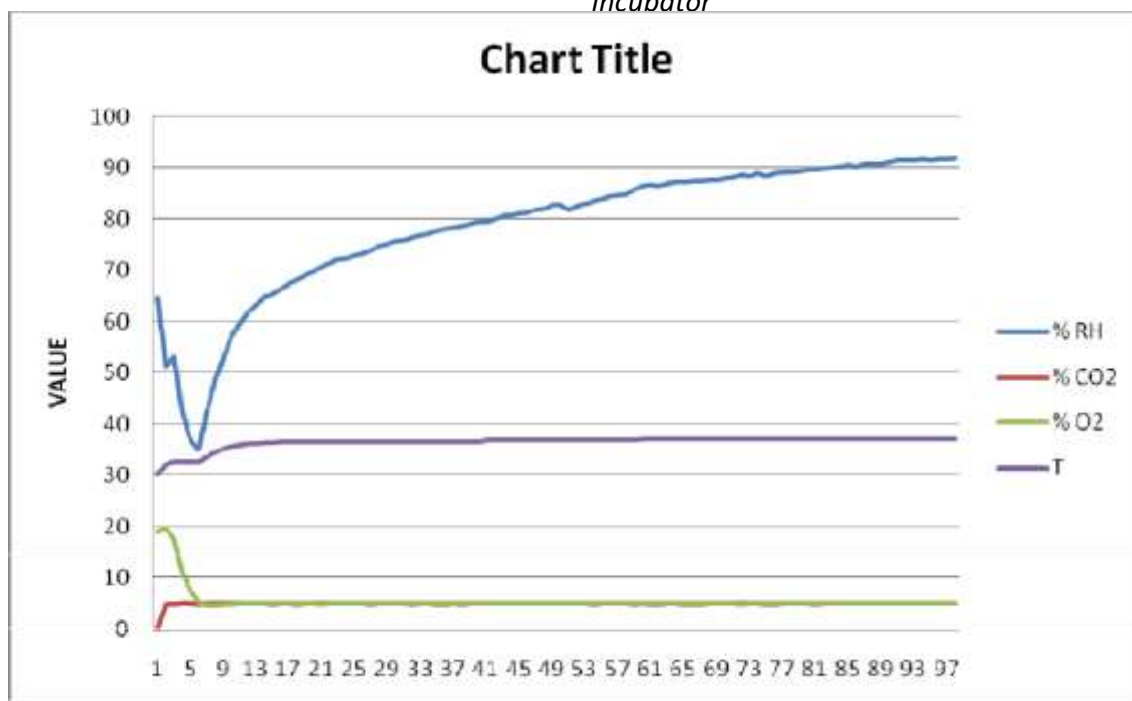


Figure 4. Performance on P99 with N₂ gas injection on the first operation of the CO₂ Incubator

Observation

1. In the first experiment, N₂ gas injected when the incubator reaches its humidity set point, both data obtained from two incubator show that the level of humidity will decrease significantly. It drops almost a half percent from the set point.
2. From figure 1 and figure 2, CO₂ Incubator has the ability to reach back to its humidity set point at the average of 4 hours after N₂ gas injection.
3. From the above figure, it shows that O₂, and CO₂ concentrations were stable.

3.2 Recovery time Test

Table 1 Recovery time on P16

Door Opening (minutes)	Recovery time (minutes)		
	% RH	% CO ₂	% O ₂
0.5	300	3	11
1	300	3	11
1.5	300	3	11
2	300	3	11
2.5	300	3	11
3	300	3	11
3.5	300	3	11
4	300	3	11
4.5	300	3	11
5	300	3	11

Table 2 Recovery time on P99

Door opening (minutes)	Recovery time (minutes)		
	% RH	% CO ₂	% O ₂
0.5	240	3	10
1	240	3	10
1.5	240	3	10
2	240	3	10
2.5	240	3	10
3	240	3	10
3.5	240	3	10
4	240	3	10
4.5	240	3	10
5	240	3	10

Observation

1. From the above tables, the CO₂ incubator can reach to its set point value.
2. Overall data shows that there are no significant differences for the recovery time of these two units to reach the set point for each door opening time. CO₂ concentration will be back to normal around 3 minutes, while the O₂ concentration takes more time to be back to normal set point i.e. around 11 minutes.

Conclusion

Esco's "Tri-gas" CO₂ incubator can reach the O₂ set point value with a recovery time of 11 minutes. Also, it is more efficient to inject N₂ gas first during the first operation of the CO₂ incubator.