Parameter Validation of the Miri Time-Lapse Incubator by the Universitair Ziekenhuis Brussel

Abstract

This paper examines the actual data gathered by researchers from the *Universitair Ziekenhuis Brussel* in validating their Miri Time-Lapse incubator for temperature and gas parameters. Data shows that temperature recovery is less than a minute while gas recovery for both CO_2 and O_2 gases was within 5 minutes, with the lids of all six (6) chambers opened for 30 seconds. The Miri TL exhibited an excellent performance in terms of stability and recovery for both temperature and CO_2/O_2 gas concentrations.

I. Introduction

The incubator plays a vital role in providing a stable and safe culture environment for optimal embryo development and positive clinical outcomes. Several important variables within the culture system include pH of the culture medium, temperature, media osmolality and the quality of air. All of this potential source of stressors can be impacted by the incubator, making it a critical piece of equipment in the laboratory.[1] Hence, control of variables, such as recovery and stability of temperature, gas concentration and humidity (if applicable) is critically important.

This paper presents the different parameter tests done by Ronny Janssens and Elke Coeman from the Universitair Ziekenhuis Brussel[2] in validating their Miri Time-Lapse Incubator. This paper is released with the sole permission from the group and has no conflict of interest with Esco Medical.

Figure 1. *The Miri Time-Lapse Incubator from Esco Medical.*

[1] (Swain J. E., 2014)
[2] (Coeman & Janssens, 2016)

II. Temperature Validation

One primary function of an IVF incubator is to maintain a suitable and appropriate temperature for gamete function and embryo development. It has been established that temperature is an important parameter that can impact various aspects of gamete and embryo function.[3] Hence, maintaining an accurate and stable temperature within the incubator is crucial in reducing environmental stress.

The Miri TL was subjected to a rigorous test to measure the temperature stability and recovery of the different chambers. The temperature parameter was validated for the following tests:

- Maximum temperature drop after opening the lid for 30 seconds
- Measured temperature stability over time
- Effect of opening one chamber to the temperature of another chamber

A. Maximum temperature fluctuation after opening the lid for 30 seconds

The temperature for each chamber was set at 37.0^{0}C. All lids of the six (6) chambers were opened for 30 seconds, and temperature recovery was recorded every minute for a total period of 5 minutes. Temperature recovery was measured on both the bottom plate of the chamber and on the Culture Coin. Based on Figure 2, temperature recovery measured on the bottom surface for all chambers was within a minute after closing the lids with a maximum temperature drop of 2.11^{o}C. It has to be noted that although it is not common practice to open all chambers simultaneously for as long as 30 seconds, still the system was able to recover quickly in less than a minute.

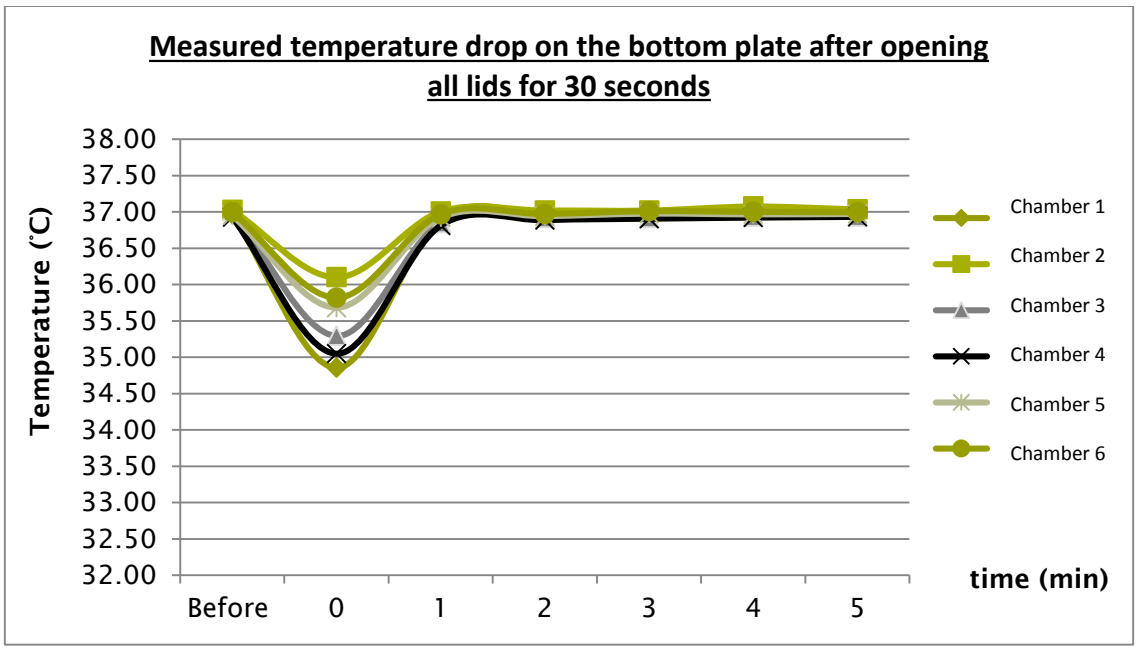

Figure 2. *Graph showing temperature recovery of the Miri TL after lids were opened for all six (6) chambers for 30 seconds.*

[3] (Sun, Eang, & Keefe, 2004)

On the other hand, Figure 3 shows a minimal drop of 0.32°C on the temperature of the Culture Coin after subjecting the incubator to the same treatment: all lids were opened for 30 seconds.

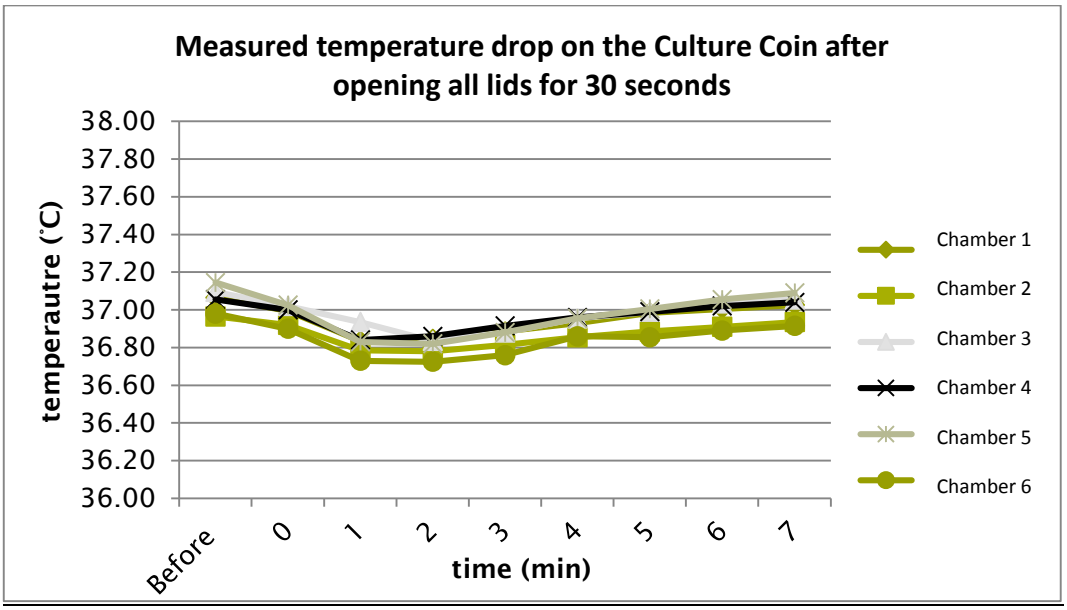

Figure 3. *Graph showing temperature drop on the Culture Coin after lids were opened for all six (6) chambers for 30 seconds.*

B. Measured Temperature Stability over Time

The temperature for each chamber was set at 37.0°C. The temperature stability for chambers 3, 4 and 6 was measured for 14 days. Measurements were made every day for the first 5 days, and then 2 to 3 days afterwards.

Figure 4 shows that the Miri TL, over a period of 14 days, has demonstrated temperature stability with a maximum deviation of 0.09°C from the set point.

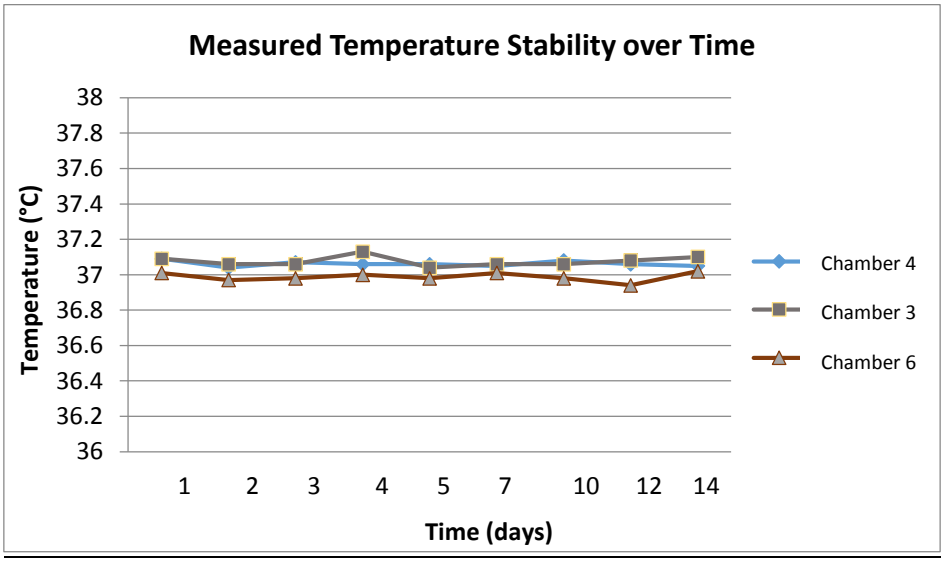

Figure 4. *Graph showing temperature recordings for chambers 3, 4 and 6 of the Miri TL for 14 days.*

C. Effect of opening one chamber to the temperature of another chamber

The temperature for each chamber was set at 37.0^{0}C. One chamber was opened for 30 seconds and temperature was subsequently measured every minute for 5 minutes for chambers 1 and 6. The results showed no significant difference in terms of variance from the set point. This demonstrates that each chamber of the Miri TL is entirely independent of each other and opening any lid will have no impact on the rest of the system.

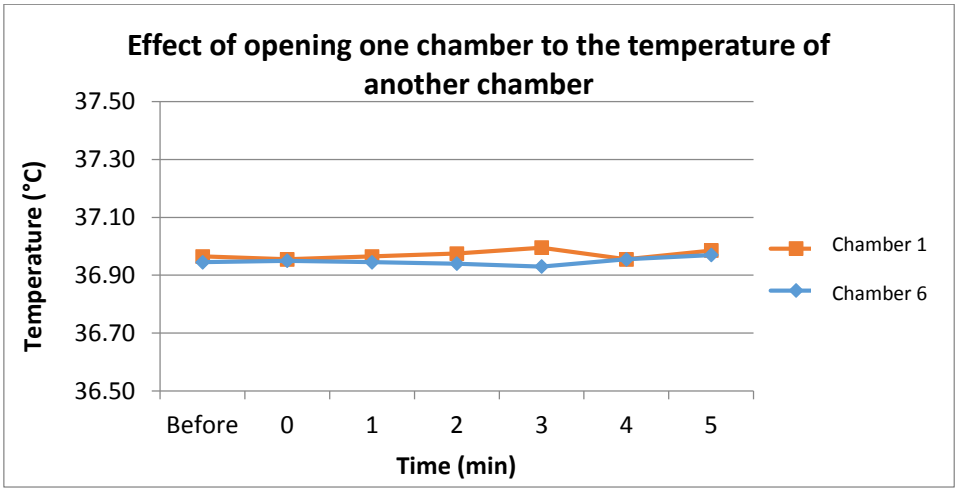

Figure 5. *Graph showing temperature recordings for chambers 1 and 6 of the Miri TL after one chamber was opened for 30 seconds.*

III. Gas Monitoring and Recovery

Regulation of CO_2 concentration is a very important factor as this gas helps regulate the pH of the culture media. The pH of the culture media can significantly impact gamete function and embryo development.[4] Hence, the importance of regularly checking your measured gas outputs.

The Miri TL was again subjected to a rigorous test to measure the CO_2 and O_2 gas stability and recovery for all six (6) chambers. The Miri TL was validated for the following tests:

- Maximum change in CO_2/O_2 concentration after opening the chamber for 30 seconds
- Stability of CO_2/O_2 concentrations over time
- Effect of opening one chamber to the CO_2/O_2 concentration of another chamber

A. Maximum change in CO_2/O_2 concentration after opening the chamber for 30 seconds

The CO_2 and O_2 gas concentrations were set at 6.0% and 5.0%, respectively. All lids of the six (6) chambers were opened for 30 seconds and gas recovery was recorded every minute for a total period of 5 minutes. Based on Figures 6 and 7, gas recovery for both CO_2 and O_2 gases were within 5 minutes and is relatively rated as an excellent incubator performance considering that it is not common practice in the lab to open all chambers simultaneously for as long as 30 seconds. It is expected that gas recovery should be better if only one chamber was opened, which is a more realistic approach than the test done by the group.

[4] (Swain J. , 2012)

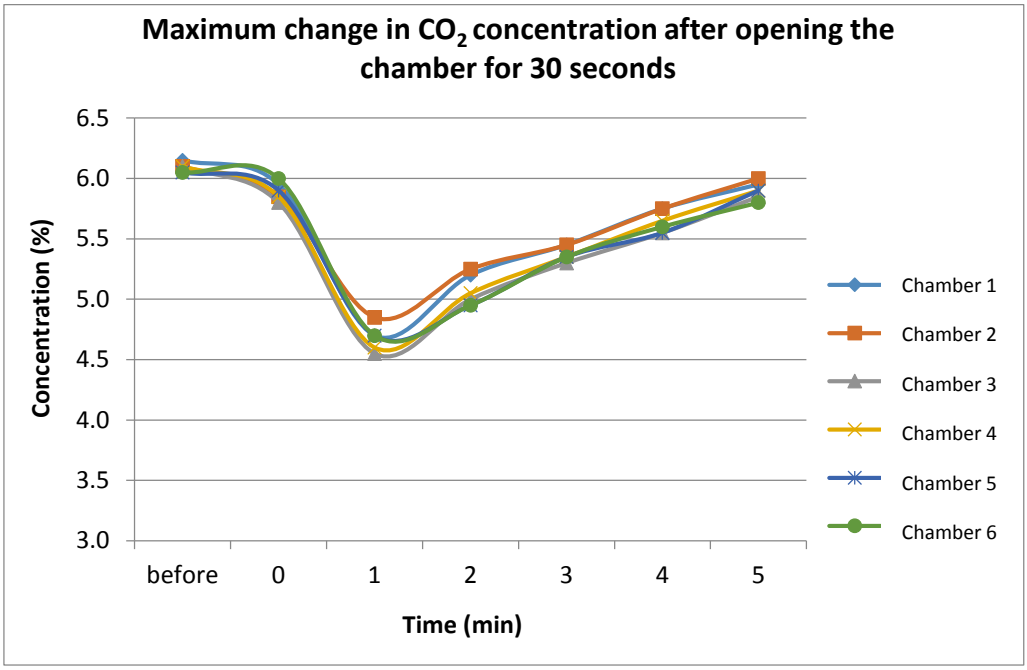

Figure 6. *Graph showing the CO_2 gas concentration after lids for all chambers were opened. Data were recorded every minute for a total period of 5 minutes.*

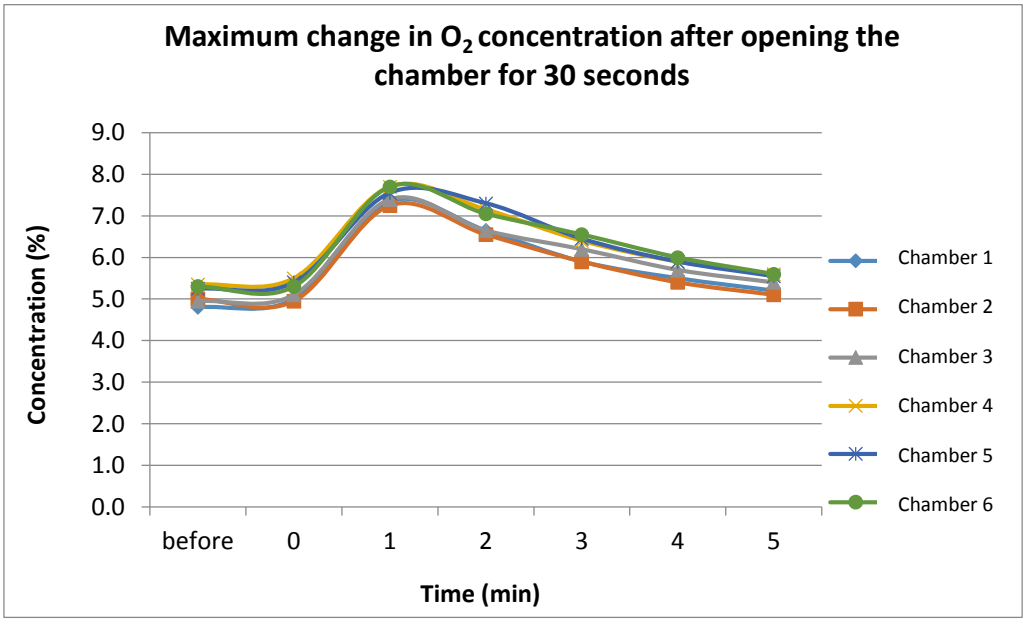

Figure 7. *Graph showing the O_2 gas concentration after lids for all chambers were opened. Data were recorded every minute for a total period of 5 minutes.*

B. Stability of CO_2/O_2 concentrations over time

The CO_2 and O_2 gas concentrations were set at 6.0% and 5.0%, respectively. Both CO_2 and O_2 gas concentrations were measured for a total period of 14 days. Figures 8 and 9 shows a 6.0 % ± 0.4 maximum deviation for CO_2 gas and 5.0 % ± 0.5 maximum deviation for O_2 gas, respectively.

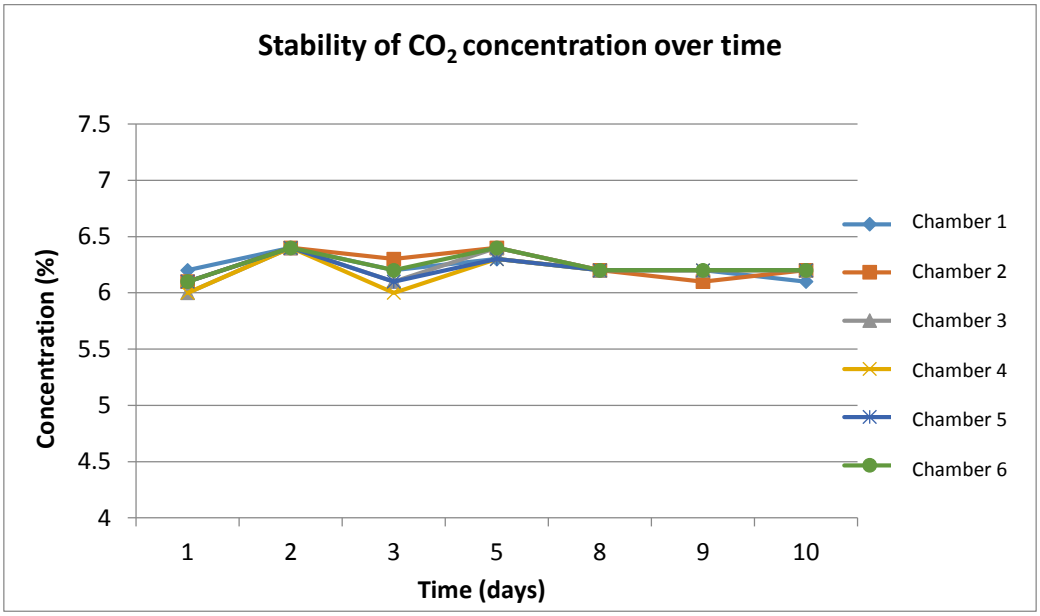

Figure 8. *Graph showing the CO_2 gas concentration recordings for all chambers of the Miri TL for 14 days*

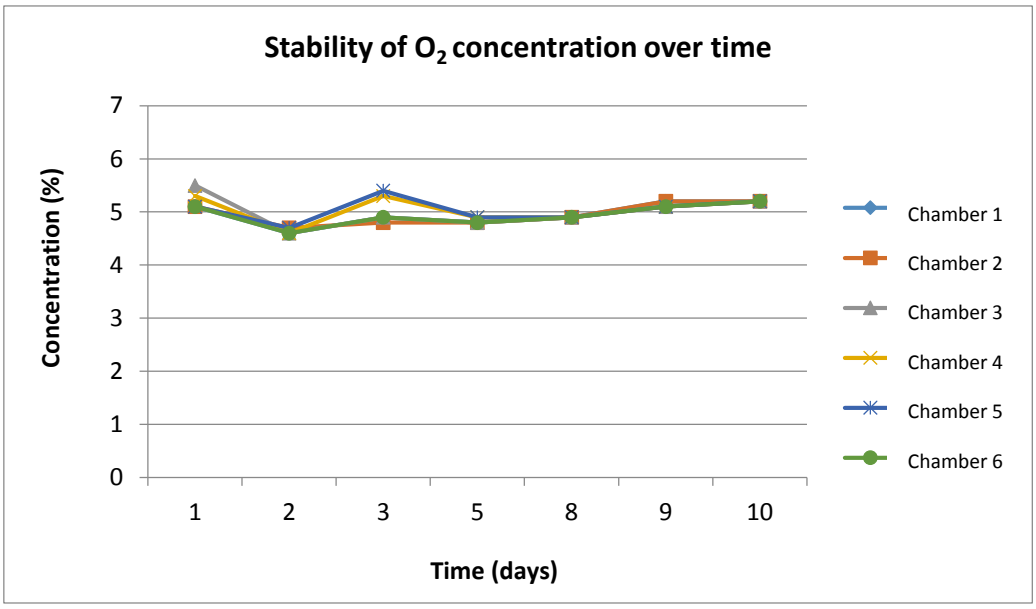

Figure 9. *Graph showing the O_2 gas concentration recordings for chambers 1, 2, 3, 4 and 5 of the Miri TL for 14 days*

C. Effect of opening one chamber to the CO_2/O_2 concentration of another chamber

The CO_2 and O_2 gas concentrations were set at 6.0% and 5.0%, respectively. One chamber was opened for 30 seconds and the CO_2 and O_2 gas concentrations for chambers 1 and 6 were subsequently measured every minute for 5 minutes. As shown in Figures 10 and 11, the results showed no significant difference in terms of variance from the set point. This demonstrates that each chamber of the Miri TL is entirely independent of each other and opening any lid will have no impact on the gas environment of the rest of the system.

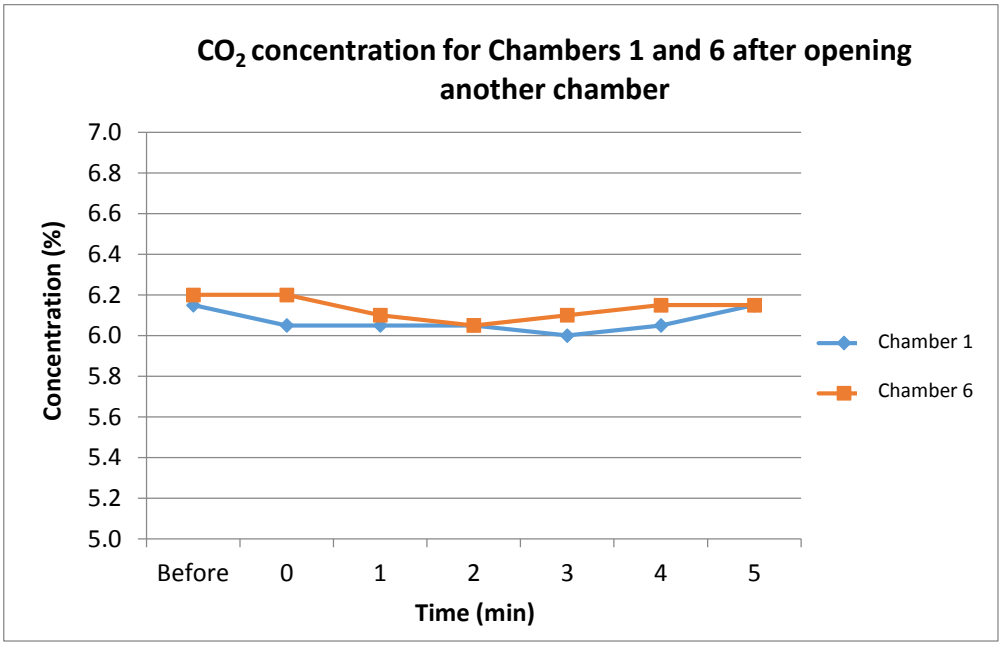

Figure 10. *Graph showing the CO_2 gas concentration for chambers 1 and 6 measured over a period of 5 minutes after one chamber was opened for 30 seconds.*

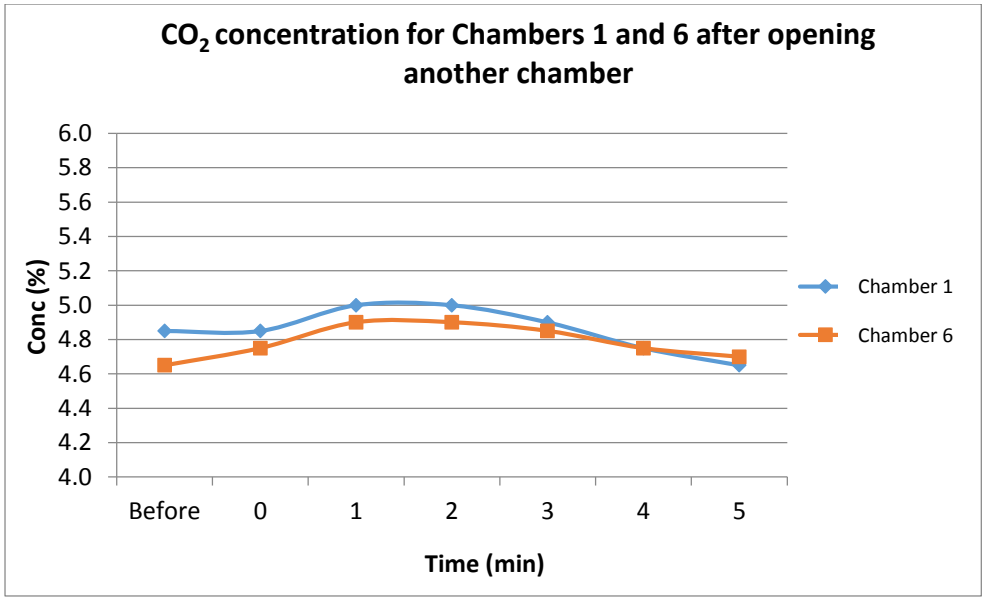

Figure 11. *Graph showing the O_2 gas concentration for chambers 1 and 6 measured over a period of 5 minutes after one chamber was opened for 30 seconds.*

Conclusion and Recommendation

Based on the data gathered, it can be concluded that the Miri TL has an overall reliable and stable performance in terms of stability and recovery for both temperature and gas parameters. With all lids opened, the incubator was still able to achieve a less than a minute temperature recovery and approximately 5-minute gas recovery. However, gas recovery is expected to be lower if only one chamber was opened.

Our recommendation is to do a gas recovery test with only one chamber opened, which is more realistic in a laboratory situation.

References

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