

Construction of an experimental apparatus to simulate the greenhouse effect and global warming for educational use

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Abstract

This article describes the construction of a complete experimental apparatus to simulate the greenhouse and global warming for educational use. These demonstrations are fundamental for people understand the importance of greenhouse effect to keep that life continues on earth and, know about climate change and the causes of global warming. For development of this devise we used an Arduino UNO, temperature and pressure sensors, and low cost products. The experimental results showed that the average atmosphere temperature increases with the increasing concentration of carbon dioxide (CO₂). Moreover, this apparatus can be used in classroom to demonstration these important global phenomena.

Keywords: Experimental apparatus; Greenhouse; Global warming; Arduino.;

1. Introduction

The study of climate change has attracted much interest in the last years, in view of their increasingly modification [1,2]. This change has caused many environmental disasters, because of that, the medium temperature of earth is increasing and if this scenario does not change in a little time other change will have happened. One of the main factors has been causing this, is the strikingly high atmospheric greenhouse gas concentrations [3].

A balanced environment is essential for the continuity of human life on Earth [4]. However, the impacts of human activities on nature have been accentuated, especially since the Industrial Revolution, which occurred in the 18th century [5]. Furthermore, the rulers do not create efficient Environmental policy. Other point, environmental policy and economic growth are often described as existence in conflict with one another. In other words, an increase in economic activity is understood as being inevitably bad for the environment, while environmental policy is considered as imposing a drag on growth [6].

In this context, the main goal of the present paper is to show the development of an experimental apparatus that simulates the greenhouse effect and global warming. This device can be used by the teacher in the classroom. Thus, students will be able to understand better the greenhouse effect and the importance of preserving the environment. In short, this article focused on the design, construction and instrumentation of an experimental test apparatus and evaluate its performance.

2. Experimental

Arduino is a well-established experimental technique base on the measurement of the many signals resulting from the several sensors. In this work, we used temperature and pressure sensors [7,8,9]. These sensors were installed in two different inert environments. While the radiation inside on the sample surface the signals are detected by sensors and, Arduino was used to monitor and store the signal profile of the sensors. An experimental apparatus with two inert environments is shown in figure 1.



Figure 1. Experimental apparatus linked to the computer, experimental data are collected in two different inert environments simultaneously. SOUCE: Own author, 2020.

These environments are delimited by semi glass ball and sensors are installed inside them. The radiations from the lamps, focuses with the same intensity in both superficies. One of them is linked to a gas cylinder with carbon dioxide (CO₂). In this atmosphere, the concentration of CO₂ can be increase. Finally, this device can recall temperature curves as a function of time.

3. Result and discussion

The first configuration, we used one environment with semi glass ball for simulate the Earth’s atmosphere and other without this protection. The result of that measure is shown in figure 2.

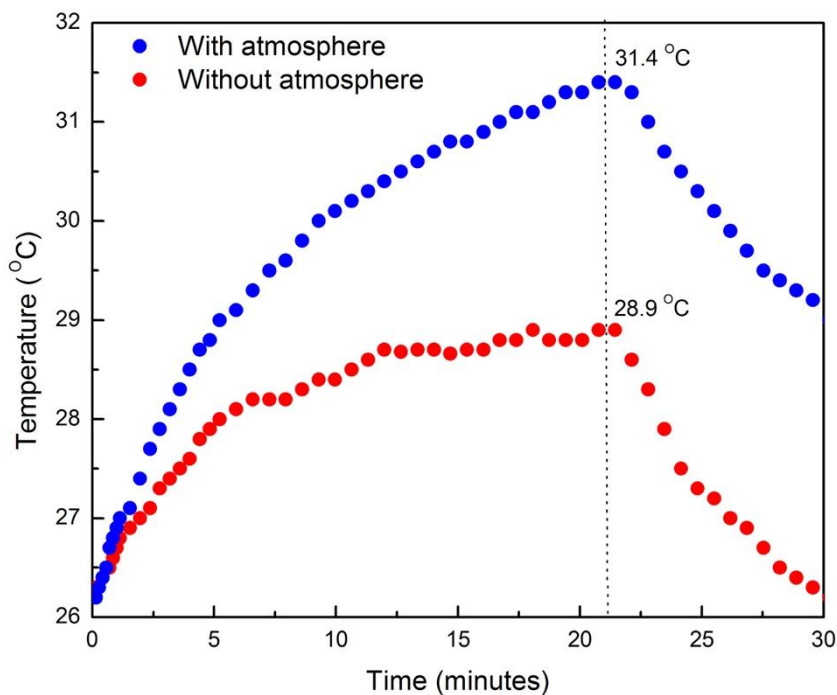


Figure 2. Temperature curves for the two environments, one with and one without semi glass ball, represented by blue and red curves respectively.

The temperature curve for the atmospheric environment exhibited a greater warming than the environment without atmospheric. This result highlights the importance of the atmospheric for life on Earth.

Atmosphere with carbon dioxide and without this gas, as can be seen in figure 3, the obtained curves confirms the temperature increase of two degrees Celsius due the injection of a CO₂.

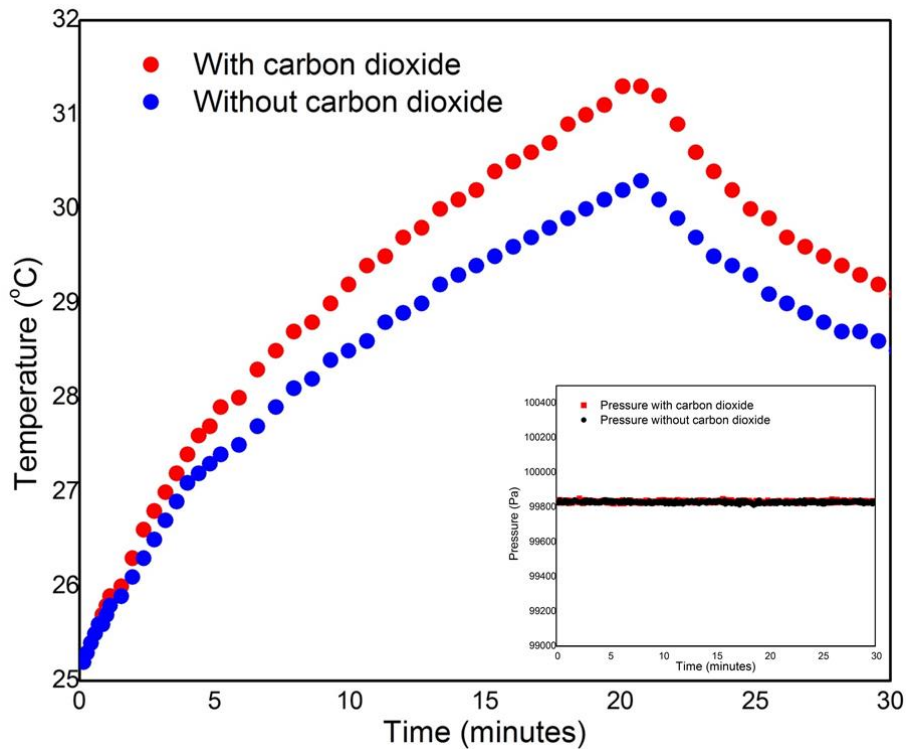


Figure 3. Temperature curves for the two inert environments, one with and one without carbon dioxide, represented by red and blue curves respectively. The insert shows internal pressure of the two environments during the measurement.

The insertion of figure 3 shows the internal pressure in both environments during measurement are same. According to these results, the increasing carbon dioxide affects the average system temperature. The inserte of figure 3 shows the internal pressure in both environments during measurement are same, these results showed that the pressure did not change due to carbon dioxide, And, that the temperature increase was due to the carbon dioxide increase.

All collected data in this experiment with this configuration exhibit a characteristic signal by the contribution of the carbon dioxide. Here, with results that reflect a consensus, the increased concentration of CO₂ and other greenhouse gases in the atmosphere form a serious threat to the average temperature of the Earth. In other words, climate change is caused by global warming, and it is produced by human activity. In this context, our experimental apparatus is an important didactic tool that allows the diffusion of these phenomena and teachers can use it in the classroom to demonstrate who climate change happen.

4. Conclusion

In this paper a low cost greenhouse and global warming simulation experimental apparatus for educational purposes was successfully fabricated. One Arduino UNO, temperature and pressure sensors were used to collect the experimental data. The measurements of the temperature curves of the two inert environments, one with and one without carbon dioxide, showed the impact of this gas in the environment’s mean temperature.

At the end of the development of the experimental apparatus and based on the results obtained, it can be concluded that this device is a didactic tool and suitable for teachers use in classroom to demonstration of

greenhouse effect and global warming.

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