WHITE PAPER

CO_2 MONITORING FOR GREENHOUSE APPLICATIONS

Introduction

The levels of carbon dioxide in combination with temperature, humidity, and light intensity are the most important factors for the quality and productivity of plant growth in greenhouses. Constant monitoring of these environmental parameters provides data to the grower to better understand how these factors affect growth and how to increase crop productiveness.

CO_2 is one of the key ingredients of photosynthesis, it is essential for plant growth. Monitoring CO_2 in a greenhouse allows optimisation of environmental conditions, resulting in more efficient plant growth and higher crop yield. Different plants need different levels of CO_2 in the air to maximise development.
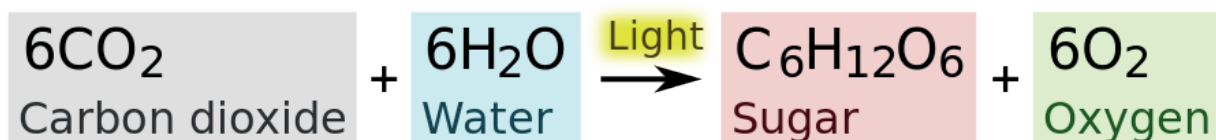
CO_2 and photosynthesis

Carbon dioxide (CO_2) is a natural gas, in high concentrations, it is dangerous for humans, but essential for plant development.

Photosynthesis is the process which involves a chemical reaction between water and carbon dioxide (CO_2) in the presence of light to make sugars for plants, and as a by-product releases oxygen in the atmosphere. Carbon dioxide is a colourless and odourless gas in the atmosphere but has an important role in sustaining life.

The plant growth rate is greatly influenced by the CO_2 concentration in the greenhouse, therefore CO_2 levels need to be monitored and controlled for optimal development. The CO_2 concentration needed depends on the plant type, with the optimal growth level being 1 000 ppm (parts per million) for most crops.

Active photosynthesis can bring down the greenhouse CO_2 concentration to a level of 200 ppm, which is low enough to negatively impact the plant growth. Too low CO_2 level limits growth but a too high level of CO_2 is not beneficial either. Plants are more sensitive towards high CO_2 concentrations than humans and show damages like burnt leaves at elevated CO_2 levels.

Monitoring in greenhouses can be a difficult task to accomplish effectively and without wasting resources and time for installation and maintenance of the devices. Therefore IoT and wireless monitoring solutions offer a great alternative to the wired systems. Wireless sensors can provide 24/7 remote monitoring for a variety of parameters including CO_2.

$$6CO_2 \text{ (Carbon dioxide)} + 6H_2O \text{ (Water)} \xrightarrow{\text{Light}} C_6H_{12}O_6 \text{ (Sugar)} + 6O_2 \text{ (Oxygen)}$$

Things to remember:

- Increase in photosynthesis results in increased growth rates and biomass production.
- If CO_2 levels are monitored and adjusted plants have an earlier maturity and more crops can be harvested annually. The decrease in time to maturity can help in saving heat and fertilization costs.
- Never allow CO_2 to exceed plant requirements. Have an alert system when CO_2 level reaches 2 000 ppm and below 200 ppm;
- Always monitor the CO_2 levels through sensors and adjust to the required level.
- In addition monitor growing condition like lighting, temperature and humidity to make CO_2 monitoring more effective.

Wireless CO_2 monitoring

Wireless monitoring solutions consist of base stations with a connectivity to the cloud or built-in local web servers for data storage and analysis and wireless sensors that measure different environmental parameters such as CO_2.

Applying sensors in greenhouses provides constant monitoring of the chosen parameters. Wireless monitoring solutions offer centralized critical real-time data gathering and the ability to use software for data viewing, analysis and comparison any time from any device.

Operating costs associated with monitoring are going down thanks to wireless sensors technologies that help make installation process easy, quick and cost-effective – no extensive planning or preparation needed. In addition, wireless sensors can send alerts when certain parameter thresholds have been crossed. Thus informing to take preventive action and avoid damage related to unforeseen circumstance.

The Internet of Things technologies offer wireless sensors that can function up to 2 years without battery replacement and can provide multiple kilometre receiving range that allows sensors to be deployed within large areas.

Compared to the cabled systems, the installation wireless monitoring systems are fast, affordable and easy. Moreover, it is easy to relocate the measurement points when needed by just moving sensors from one location to another within a communication range of the base station.

It has never been easier and more cost-effective to implement industrial IoT solutions!

Features and benefits for wireless monitoring systems:

- Easy and quick installation;
- Affordable full solution systems;
- 2-year sensor battery life;
- At least 3km/1.9mi line-of-sight receiving range;
- 100 sensors per base station;
- 24/7 monitoring;
- E-mail alert functionality;
- Real-time data readings;
- Advanced data analysis software;

Get started today! IoT wireless monitoring systems are an affordable, easy and time-saving way to monitor greenhouse environment.

Get started today! Visit **www.aranet.com**

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