DICKSON
Environmental Monitoring + Compliance Experts

White Paper

The Importance of Maintaining CO_2 Levels in Life Sciences Manufacturing and Research

THE CHALLENGE

Life science research and applications heavily rely on in vitro cell culture techniques. Carbon dioxide (CO_2) is a critical component of these experiments, as a CO_2-rich atmosphere helps cell culture media maintain a stable pH for optimal cell growth.[1] These conditions are vital for researchers and developers to accurately mimic physiological conditions to ensure cell viability. When these highly controlled variables exceed their parameters, cellular behavior and metabolic processes can significantly change, resulting in inaccurate results and incomplete research.

The Role of CO_2 in Cell Culture

CO_2 is a key element in cell culture media, as it dissolves to form carbonic acid and bicarbonate — the latter being an essential pH buffer.[1] Optimal CO_2 levels not only reduce cellular stress, but also contribute to enhanced cell growth, proliferation, and metabolic productivity.[1] Among the experiments and processes most impacted by CO_2 excursions, the most important applications in the biotech and life sciences industries include:

Antibody Production

The production of antibodies, particularly monoclonal antibodies, is paramount in biotech and pharmaceutical industries. These antibodies are extensively used in diagnostics and to treat a variety of bacterial infections, viral illnesses, cancer, and other conditions.[2] Because antibodies are produced on such a large scale for widespread applications, maintaining CO_2 levels is critical for promoting cell growth, increasing antibody yield, and ensuring proper antibody structure.[2]

Tissue Engineering

The production of engineered tissues requires a highly controlled and mimicked in vitro environment to achieve successful seeding, stimulation, and growth.[3] CO_2 levels play a significant role in these processes, regulating cell metabolism, differentiation, and matrix synthesis.[3] Proper atmospheric CO_2 control ensures stable pH levels in the media, promoting cellular viability and tissue maturation.

Viral Vaccine Research

Cell culture systems are a favorable environment for vaccine research and production, as viruses tend to grow more quickly in cellular hosts and these cell lines can be easily stored for future testing.[4] To cultivate virus-infected cells, precise CO_2 levels must be maintained in incubator chambers, allowing optimal virus replication, antigen expression, and subsequent vaccine production.[5] Thus, significant deviations in CO_2 concentrations can alter viral growth kinetics and reduce vaccine yield.[6]

Reproductive Technologies

In assisted reproductive technologies like in vitro fertilization, gamete and embryo culture conditions are meticulously controlled. Preimplantation embryos must maintain a stable pH to achieve homeostasis and proper development.[7] By directly regulating pH in the culture media, CO_2 plays a pivotal role in oocyte maturation, fertilization completion, and embryo development.[7] Proper CO_2 levels ensure ideal culture conditions, thereby increasing the chances of successful pregnancy outcomes.

Cell and Gene Therapies

Next-generation therapeutics, like cell and gene therapies, are emerging as an effective and highly personalized treatment for hard-to-treat diseases.[8] Culturing and expanding primary or genetically modified cells is a fundamental step in these processes.[8] During the cellular growth period, CO_2 levels directly affect metabolic activity and gene expression patterns — with the potential to limit therapeutic potential. Maintaining optimal CO_2 concentrations helps preserve cell viability, functionality, and clinical efficacy.

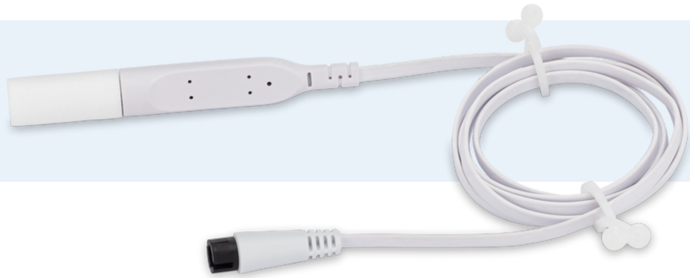
Toxicity Studies

In addition to biological research and pharmaceutical development, cell cultures are increasingly used to conduct toxicity studies and investigate the safety profiles of drugs, chemicals, and other critical compounds.[9] A controlled incubation environment is crucial for accurate analysis and results. Precise CO_2 control ensures that cells are not under unnecessary physiological stress, enabling a more reliable and accurate evaluation of substance toxicity.

No matter the application, cell cultures require stable environmental conditions to promote viability and maximize therapeutic efficacy. Maintaining consistent CO_2 levels ensures accurate results and increases efficiency, making CO_2 monitoring crucial for reproducible, valid, and impactful life science research and development.

THE SOLUTION

Introducing the Dickson CO_2 Triple Sensor



The Dickson CO_2 Triple Sensor meets the unique and highly complex needs of biotech and life science companies seeking to engineer state-of-the-art cell-based therapies and research. To help industry leaders achieve the best outcomes, the Dickson CO_2 Triple Sensor provides accurate and reliable readings within a complete cloud-based solution offering enhanced monitoring support:

Accurate Environmental Monitoring

The sensor continuously monitors three key environmental measurements — CO_2, humidity, and temperature — during experiments and processes to avoid excursions. These variances jeopardize cell viability, and eliminating them decreases the risk of inaccurate research and unusable results.

Real-time Monitoring & Alarms

Should any of these three variables exceed their prescribed parameters, the Dickson CO_2 Triple Sensor immediately notifies the right team members to resolve the problem before lasting cellular damage occurs. Dickson leverages real-time monitoring and alerts to simultaneously maintain ideal conditions in both the incubator chamber and media for optimal cell growth.

Increased Workflow Efficiency

Dickon's automated, continuous triple-variable monitoring increases efficiency by minimizing the labor-intensive processes of manual monitoring for each incubator chamber. By streamlining these time-consuming monitoring tasks, the Dickson CO_2 Triple Sensor can proactively help reduce product loss and prevent failed production and experiments.

The Dickson CO_2 Triple Sensor offers much-needed peace of mind to researchers and developers leveraging cell cultures for advanced therapeutics and diagnostics. Dickson equips life science leaders with the monitoring support they need to prevent environmental excursions, avoid costly losses, and stay on the cutting edge of clinical innovation.

Want to see the Dickson CO_2 Triple Sensor in action?

Schedule a demo today

About Dickson

DICKSON
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As an industry-leading innovator, Dickson enables its customers to manage compliance, protect billions of dollars worth of assets, and monitor their critical environments with confidence. Today, Dickson proudly serves over 80,000 customers worldwide and over 80% of Fortune 100 companies in highly-regulated industries including healthcare, pharmaceutical, aerospace, food & beverage, medical devices, and more.

Sources

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