Open Top Chamber (OTCs)

By

Genesis Technologies

We are specialized in manufacturing and providing complete engineering and designing solutions for Open Top Chamber (OTCs), growth chambers and glasshouse for environmental impact & growth study in controlled atmosphere.

Solution Includes....
Supply of OTC with Polycarbonate Sheet
CO_2/ O_2 Analyser
CO_2 Generator
N_2 Generator
O_3 Generator
Complete Piping (SS or Cu tube)
Data Logger / SCADA / PLC Control
Temperature, Humidity Sensor & Controller
Hot Air Blower & Sampling System

CO_2: Impact in Biosphere and Ecosystem

The concentration of carbon dioxide in the atmosphere has risen 30% since the onset of the Industrial Revolution in the late 18th century. Change has been a consistent feature of the earth's climate. Periods of relatively cool temperatures caused the ice ages. That warm period almost exactly matches the period over which modern agriculture has evolved.

For the first time in the history, climate appears to be changing as a direct result of human activity. People have released chlorofluorocarbons (CFCs) into the atmosphere, thereby degrading stratospheric ozone and increasing biologically harmful ultraviolet (UV) radiation that reaches the earth's surface. Through mining and combustion of fossil fuels, deforestation, maintenance of livestock nerds, and even through crop cultivation, people have released enormous quantities of carbon dioxide, methane (CH_4), and other "greenhouse" gases into the atmosphere. Samples from ice cores show that in past the fluctuations in global temperatures were strongly correlated with concentrations of atmospheric CO_2. Simulation models of global atmospheric circulation predict that greenhouse gases will cause a 2-8°C global temperature rise before the end of the 21st century.

International research organizations all over the world and the United States Environmental Protection Agency (USEPA) are cooperating to determine the effects of a likely global climate change on crop production. Under such studies are: I) direct and indirect effects of ultraviolet-B (UV-B) radiation on crop, and ii) the direct and indirect effects of increased CO_2 and temperature on different crop plants.

Ultraviolet-B (UV-B) radiation damages leaf tissues in crop seedlings. Leaves become stunted, stomata collapse, and photosynthesis decreases. Some crop varieties appear to be better able than others to withstand the adverse effects of UV radiation are. Leaves of tolerant varieties contain phenolic compounds, which are natural chemicals that filter out harmful UV-B radiation before it can damage sensitive tissues. Research is now in progress to predict possible regional losses in crop productivity if UV-B radiation continues to increase, and whether plant breeders can prevent those yield losses by developing new varieties that tolerate UV radiation.

In addition to its adverse direct effects on crop plants, UV-B may change the susceptibility and/or tolerance to disease. Although, there is no evidence as of yet that susceptibility to blast is affected by UV-B, it appears that the tolerance for blast decreases. In other words, disease frequency is not increased by UV-B, but the effects of disease on plant growth are enhanced by UV-B radiation.

GLOBAL WARMING:

Although, increasing atmospheric CO_2 stimulates plant growth, the beneficial effects on crop growth have been observed for levels only up to 500 ppm. Some plant species respond positively to CO_2 levels up to 1,000 ppm. Experts predict that atmospheric CO_2 will surpass 650 ppm before the end of the 21st century. Furthermore, the benefits of increased CO_2 would be lost if temperatures also rise. That is because increased temperatures shortens the period over which crop grows. Research is being conducted to identify means by which crop plants may better benefit from increases in atmospheric CO_2 while minimizing the adverse effects of warmer temperatures.

Plant growth and development and primarily governed by environmental conditions of the soil and climate of a country. The success and failure of agricultural crop productivity is generally related to the prevailing weather conditions. Weather plays an important role from germination of seeds to the maturity of the crops. Interestingly, the most important fact about climate is that it changes on every scale of time and space, every year, decade, century and in every region of the world.

The green revolution has made tremendous conditions to food production by prevailing weather condition but does not move forward as per expectation. The changes in weather fluctuation have been largely responsible for slowly down the production momentum of the green revolution of early 1960. The earlier high yielding varieties of cereal crops have become sensitive to weather vagaries and thus the yield of such varieties have gone down substantially. The atmosphere is becoming warmer day by day due to increase in pollutants such as CO_2, CH_4, CO, SO_2, SO_4, nitrous oxides and particulate matters in the atmosphere. The most important atmospheric pollutant is carbon dioxide and it's content is increasing rapidly all over the world due to burning of fossil fuels, coal, fire wood, etc.

The USA is the maximum producer of carbon dioxide. It produces about 160 billion tons of CO_2 annually, which is about 25 % of the total CO_2 produced in the world. Other main producers of CO_2 are China, India, Australia, Canada, Ukraine, Mexico, U.K., Brazil,

France, Spain, Germany, etc. The presence of CO_2 in the atmosphere causes the colossol warming of climate, and thus the change is rainfall pattern, a process on which crops are highly dependent. Hill storms, flood, severe winds blow and frosts are also expected under such conditions, which ultimately affects the productivity of the crops 1n a country.

Not many people think of it in this way, but food, climate, and the rising levels of atmospheric carbon dioxide are uniquely interrelated. Food production is a critical and an essential renewable resource. Without food, the human race would not survive. The production of this renewable resource, upon which all life depends, is possible only through photosynthesis, the most important of biochemical processes. An essential raw material, almost always in short supply, is the low level of atmospheric carbon dioxide. For example, an acre of corn crop, must process over 40,000 tons of air to produce the record yield of more than 130 bushels per acre recorded in the U.S. for 1995.

Globally, some 25 crops stand between people and starvation. The largest single food group is the cereal grains, of which corn is a leading member. They provide approximately 60 percent of the calories and 50 percent of the protein consumed by the human race. The legumes provide about 20 percent of the world's protein. Then balance of calories, protein and essential vitamins and minerals is obtained from tuber and root crops and various fruits, nuts and vegetables. Food animals, deriving their food either directly or indirectly from plants, provide 20 percent of the protein with 5 percent coming from fish.

The most determinant factor in agricultural (food) production is weather or the climate. For agriculture, climate must be managed both as a resource to be used wisely on the one hand or a hazard to be dealt with on the other. Food production is very much a function of climate, which in itself is unpredictable. In fact, the principal characteristic of climate is variability. Predictive climate changes derived from computer simulations are far from accurate and may be deceptive even with the most advanced modeling. Volcanoes, cloud covers regional characteristics and changing of atmospheric components cannot, if they ever will, be successfully factored into an accurate climate model.

Of all the natural climate hazards, drought is that which farmers fear most. The lack of water is the single greatest impediment to plant growth and global food production. This is illustrated by the fact that today, irrigated cropland-about 17 percent of the world's total, produces one third of the agricultural output

Concerning changing levels of atmospheric carbon dioxide, there are some well-known facts. First, there is a documented increase. The isolated test site at Mauna Loa in Hawaii shows more than a 12 percent increase in the mean annual concentration, from 316 ppm by volume of dry air in 1959 to the 1996 level of 360 ppm. The current annual rate of increase is about 0.5 percent or 1.6 ppm. Carbon dioxide source-sink models predict that the current level of atmospheric CO_2 will be doubled by the latter part of 21st century. Second, the increase is truly global. The earth's atmosphere is very effective in dispensing emissions from whatever the source, be it natural or man-made. Third, with the average level of CO_2 rising, there is an annual oscillation of the earth's atmospheric CO_2. The earth's atmospheric CO_2 level begins to fall in the spring and continues through the summer months as it appears to be sequestered by the vegetation of the Northern Hemisphere. In the late autumn, there is a resurgence of CO_2 into the atmosphere. The results in new heights by mid-winter. With the amplitude increasing by about 0.5 percent each year, it appears the concentration or amount of the earth's biomass is either increasing or is steady. It is not decreasing. Thus there are two ongoing global experiments inadvertently being conducted by the world' people. The outcomes of either we do not know.

First is the so-called global warming resulting from increasing amounts of atmospheric CO_2 and other radioactively active trace gases. Second are the enrichment on improved photosynthetic capacity, and its effects on plant growth and development. This, in turn, increases food production, forestry output, and biological productivity with an improvement in water use efficiency. Meanwhile, these two experiments will likely continue well into the 21st century with the final results not fully realized. The topics of food security, the magnitude of climate change (global warming), and the beneficial biological effects of rising levels of atmospheric carbon dioxide are rent with both political and scientific controversy. There are those including the congress and those in the presidency of the U.S. that are still advocating immediate action with accompanying costs of billions of dollars for reducing the world's output of CO_2. Global initiatives concerning such were promoted at the Rio Earth Summit in 1992, and again in the recent Berlin Assembly in March 1995. These are not warranted. Global satellite readings of temperatures over the earth show there has been no warming. Thermometers taking temperatures in a real world environment are confirming these results.

To date, our knowledge of the climate effects of the rising CO_2 and other greenhouse gases in the atmosphere is inadequate for initiating any global attempt to change the climate. If the climate does change, some warming could be tolerated, and may even be beneficial with no reductions in food production. A warming trend would increase the lengths of the growing seasons, encourage farmer adaptations, and favor the introduction of new technologies and cultural practices. The results would be crops and food animals more resistant to environmental stresses. The prospects of climate change from increasing levels of atmospheric carbon dioxide do not frighten many agriculturists, farmers or foresters. There are many disparities among interests of farmers and other segments of our society. A rainfall of two or more inches in 24 hours may be newsworthy as an extreme or hazardous climatic event for politicians, environmentalists, and city folks. It could be highly beneficial in late summer to the producers of food, especially in the U.S. Corn Belt when vapor-transpiration greatly exceeds precipitation. There is no evidence that climate variability or hazardous events (floods, tornadoes, heat waves, frost and even volcanoes) would be more frequent as atmospheric carbon dioxide increases. Marked inter-annual variations have always been with us. The most recent disaster for the grain belt of the U.S. was the hot, dry summer of 1989. This resulted in the first major scare tactics of a global warming initiated by scientists, with hearings before congress and released to the press. The cold, wet summer of 1992 followed. Again, 1995 was a partial analog of that experienced in the summer of 1989.

Food scarcity, climate change and variability, and rising level of carbon dioxide are all resources vital to the people of the earth. Of these resources, the rising levels of atmospheric carbon dioxide must not be viewed as former senator and now Vice President Albert Gore has declared in his best selling book Earth in the Balance 1992: "the process of filling the atmosphere with CO_2 and other pollutants-is a willful expansion of our dysfunctional civilization into vulnerable parts of the world."

Such pronouncements are too often accompanied by projects of melting icecaps, coastal flooding, mega hurricanes, drought, disease, and famine. For the present, the direct effects of an increasing atmospheric CO_2 on food production and the outputs of range lands and forests are much more important than any effects thus far manifest for climate. A recent review of over 1,000 individual experiments with 475 plant crop varieties, published in 342 peer-reviewed scientific journals and authored by 454 scientists in 29 countries, has shown an average growth enhancement of 52 percent with a doubling of the current level of atmospheric carbon dioxide (Idso and Idso, 1994; Wittwer, 1995). Yet some scientists, especially those with ecological orientations take delight in glamorizing, along with a widely sympathetic press, in publicizing the few exceptions, which, in turn, become widely quoted in the scientific literature. The include tussock arctic tundra (Oechel and Strain, 1985); some grasslands where undesirable species may, under restricted conditions, outgrow the more desirable (Wedin and Tilman, 1996); and in some ecosystems where competition among species may create a lack of balance (Bazzag and Fajer, 1992).

Globally, it is estimated the overall crop productivity has been already increased by 10 percent because of CO_2 and may account for much of what has been attributed to the Green Revolution. Meanwhile, changes in climate in specific fields where crops actually grow and are cultivated remain defiantly uncertain. Conversely, the effects of an enriched CO_2 atmosphere on crop productivity in large measure, are positive, and leave little doubt as to the benefits for global food security. With this note, it is a sad commentary that most of the current and modern textbooks on plant nutrition omit inadvertently or otherwise, any mention of the role of carbon dioxide as a fertilizer or essential nutrient. This was true 35 years ago (Norman, 1962) and remains to this day. Textbooks still ignore the fact that different levels of CO_2 may have pronounced effects on plant growth and may interrelate and compliment various levels of other nutrients applied to crops in the rooting media. The complimenting effects are also manifest with respect to water requirements and positive interrelations with temperature, light, and other atmospheric constraints.

Contrastingly, the rise level of atmospheric CO_2 does not make the U.S. the world's worst polluter. It is the world's greatest benefactor. Unlike other natural resources (land, water, energy) essential for food production, which are costly and progressively in shorter supply, the rising level of atmospheric CO_2 is a universally free premium gaining in magnitude with time on which we can all reckon for the future. The effects of the increasing atmospheric level of CO_2 on photosynthetic capacity for the enhancement of food production and the output of rangelands and forests, appear far more important than any detectable change in climate. Elevated levels of atmospheric CO_2 also provide a cost-free environment for the conservation of water, which is rapidly becoming another of the world's most limiting natural resource, the majority of which is now used for crop irrigation.

Instrumentation for controlling & Monitoring of CO_2 level

The non- dispersive infrared (NDIR) gas analyzer used for measuring CO2. It (Insert) achieves high accuracy and provides multiple function and ease of operation through the use of a microprocessor. It is available in 19-inch rack, panel or tabletop mountings. Zero and span calibrations are easily accomplished by pressing the appropriate key on the front panel. The NDIR system has single beam optical system, which provides superior performance to conventional double beam analyzers. It is easy to maintain and offers excellent long-term stability. The system is ideal for continuous measurement of CO2 level.

Measurable Gas Components

Single component, multiple range analyzer: CO2,
Range- 0 to 2500 PPM

Measuring System:

Nondispersive infrared absorption (NDIR) method, singe light source-single beam
OUTPUTS: Analog 4 to 20mA DC, and 0 to 1mV or 0 to 1V or 0 to 5V or 0 to 10VDC selectable RS-232C

System Features:

Microprocessor controlled
Single source, single beam optics
Direct readout in engineering units
Linear output · Low sensitivity to vibration
1 or 2 components, multiple ranges
Self diagnosis function
No optical alignment required
RS-232C interface
Automation, Control and Data Generation

Open Top Chamber (OTCs) can be constructed with MS/SS body with a covering of Polycarbonate sheets.
Independent chamber is connected with Cu piping. Independent CO2 (through CO2 cylinders) and oxygen (Air compressor) supply are provided with controlled manner.

An independent line are drawn from each chamber and connected to CO2 controller to set and monitor of the desired CO2 level. A PLC-SDADA based platform is designed to control and monitor continuous operation of CO2 level.
Each chamber has the facility to monitor temp & humidity (inside the chamber) with an external control facility for temp & humidity option.

Several solenoid valves & gas regulators are used to deliver set level.
PC based recording / data generation system works with PLC-SCADA platform to record the data.
CO2 level can be controlled and monitor from the PC. The necessary relays are also provided.
The graphical presentation of CO2 is also possible.
Time event program can be set from the CO2 controller to monitor CO2 level of each chamber and can be analyzed through CO2 analyzer in different time (set) interval.

Growth Gas Generator (CO2 Generator)

Growth Gas Generator is a fixed horticultural appliance for Non - Domestic use. 1.25 kW output.

Growth Gas Generator is a dedicated CO2 production unit, designed specifically for the small domestic greenhouse or indoor growing area. It burns readily available Propane Gas to produce copious amounts of CO2 and can easily be controlled by a timer to ensure that CO2 is produced at the right time of day.

You will need to find a stable base on which to stand your Generator. It will be best located away from walkways and busy areas to ensure that it does not get knocked over. For peace of mind the generator is best screwed onto a larger metal base and holes are provided in the feet for this purpose.

Best location for gas distribution is near centre of growing area but this is not too important provided that there is plenty of air circulation by fan.

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