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A COMPREHENSIVE SOLUTION TO THE EXISTED CHALLENGES BY EFFICIENT, COMPETITIVE, MODERN "OZONE GENERATION SYSTEM"

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Abstract

The Paris Agreement besides issues related to mitigation of warming, adaptation to climate change, and climate finance, recognizes the fundamental priority of food security and hunger eradication and the particular vulnerability of food production systems, also recognizes that sustainable consumption and production rules and models, which are led by developed countries, play an important role in responding to climate change.

According to the Directive 2009/128/EC of the European Parliament and of the Council – the directive establishes a framework for achieving the sustainable use of pesticides by reducing the risks and impacts of pesticide use on human health and the environment and by promoting integrated pest management and the use of alternative approaches or techniques, such as non-chemical alternatives for pesticides. Also, the European Commission's plan calls for a 50% reduction in pesticide use over the next decade. The plan would also reduce the sale of antimicrobials to farm animals by 50% and the use of fertilizers by 20% by 2030. By 2030, the share of organic farming will also increase by 25% from the current 8%.

Keywords: ozone, eco-friendly, energy efficient, disinfection.

Introduction

The increasing use of toxic chemicals and pesticides in agriculture can further reduce crop quality and yield and affect soil productivity, especially in the world's most fragile regions. At the same time, our food systems account for about 34% of greenhouse gas emissions. Studies show that current pesticide reduction measures are adopted by some European countries.

Healthy, sustainable and inclusive food systems are critical to achieving global development goals, where agriculture and its development are one of the most powerful tools for poverty alleviation, as well as critical for economic growth: it accounts for 4% of global gross domestic product (GDP) and can amount to more than 25% of GDP in some less developing countriesis

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discussed [1].According to the United Nations Food and Agriculture Organization employment figures, agriculture remains the second source of employment (26.7% of total employment)[2].

Current food systems also threaten the health of people and the planet and create unacceptable levels of pollution and waste [3]. Today, the risks associated with unhealthy diets are also the leading cause of death worldwide. About 3 billion people in the world cannot afford healthy food [4].

Did the Green Revolution reduce hunger? On closer examination, if China is excluded from the analysis, the number of hungry people in the world will actually increase by more than 11 percent, from 536 million to 597 million [5].Increased hunger appears to have resulted from unequal access to food and food production resources [6].

Experts conclude that industrial (chemically intensive) farming destroys soil quality, decreases yields, because chemical fertilizers are not a sustainable source of soil fertility [7].In the long term, these methods contribute to groundwater depletion [8].

The rise of pests and growing resistance is not surprising given that 4.7 billion pounds of pesticides are used worldwide each year. Global pesticide use has increased 26-fold over the past 50 years [9].

Another aspect of the pesticide problem is the harm to human health. In addition to causing cancer, new evidence suggests that pesticides may act as "endocrine disruptors," some of which directly affect the reproductive system [10].

General Problems

According to a groundbreaking analysis by the Food and Agriculture Organization of the United Nations (FAO), the "hidden costs" of agriculture and food systems could be as high as $10 trillion a year - nearly 10% of global GDP [11]. Among them, more than 70% are related to unhealthy nutrition of the population.

Low-income countries suffer the most from the hidden costs of agricultural production. Such losses amount to more than 25% of their gross domestic product, up to 12% in middle-income countries and up to 8% in high-income countries [12].

The FAO report calls on governments and the private sector to more regularly and thoroughly analyze the hidden or "true" costs of agriculture and food systems through accurate and complete cost accounting, and then take action to reduce this damage [13].

Despite the colossal global pollution of the environment with pesticides, the negative impact on human health, the constant and increasing direct and so-called "hidden costs" of industrial and agricultural use, to provide sufficient and healthy agricultural products for the growing population, there is still no known alternative to pesticides, energy and A cost-effective, non-chemical alternative.

In 2021, agriculture accounted for 12% of total greenhouse gas emissions and 16% of total air pollutant emissions in the EU [14].

Meanwhile, chemical pesticides, commonly used to maintain crop yields, are a factor in biodiversity loss, poor water intake, degraded soils and increased pest resistance, and are also linked to the emergence of chronic diseases.

European-wide health costs due to pesticides and toxic chemicals were around €2.3 billion in 2017.

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The advantages of alternatives compared to traditional ones can be summarized as follows: yield increase by 50-100%, stable overall production level compared to industrial systems [15], resistance to pests and other environmental benefits.

In agriculture, the purpose of poisonous chemicals and pesticides is to fight pests, fungi and other diseases. This is especially true for industrial production [16]. Deodorization, water and air disinfection, disinsection, deodorization, decontamination of sewage and gas-chemical emission and organic waste, long-term storage of agricultural and food products, use of non-ecological poison-chemicals and pesticides are very expensive procedures, the so-called It causes "hidden costs" and has a direct negative impact on the economic results of the business.

Methodology

Ozone is produced by means of ozone generators, which are mainly of two types. The first type is the use of ultraviolet radiation, and the second type is an electrical discharge between two electrodes. The main problems of mass production of ozone generators in the world are: high cost of technology and high energy consumption, and it takes the place of expensive irreplaceable or spare technology.The company "Hydrogen Technology" has created a competitive simple, durable, energy-efficient and economical "ozone generation system", and received the patents of the National Intellectual Property Center of Georgia P 2021 7302 B, and (WIPO) [17].

There are the objects of the present invention to provide an ozone generating system that can be operated for a long time in a reliable manner without damaging an electrode due to the current released during the electric discharge, capable of being operated with reduced voltage of power supply and can be operated in an efficient way with consumption of relatively less energy.

To achieve the above objectives, the apparatus for producing ozone according to the present invention comprises: an ozone generating camera having gas inlet and outlet means; first and second electrodes disposed within the ozone generating camera in a consentric relationship with each other and spaced apart by a dielectric barrier, the barrier made as a tube made of a material transparent to the ultraviolet light; the tube having electric terminals at its ends and being filled with a gas for creating plasma within the tube upon applying electric voltage to said terminals; the first electrode being made as a wire wound around said dielectric barrier; and the second electrode being made as a plasma created within said tube upon applying electric voltage to said terminals at its ends of said tube; the plasma being capable of radiating ultraviolet light and creating white noise consisting of various frequencies.

The apparatus further comprises electric powering means for applying voltage to said first and second electrodes, the voltage having the chaotically modulated distorted sine waveform so as to have Fourier series of harmonic frequencies and to establish resonance with frequencies generated by said plasma created within said tube.

We construct a simplified theoretical model not chaotic modulation but as nesting sine function and analysis it with Fourie series numerical model:

$$g(t) = Asin[\omega ct + Bsin(\omega mt + \phi)] \qquad (1)$$

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Where: A: Amplitude of the carrier signal; B: Amplitude of the modulating function; ωc: Frequency of the carrier signal; ωm: Frequency of the modulating function; ϕ: Phase angle.

Directly finding the Fourier series representation of this function might be complex due to the nested sine functions, we can use numerical methods or approximations to find coefficients for each term. First the Bessel function was used to express the modulated term $\boldsymbol{B\sin(\omega mt+\phi)}$ as a Fourier series.Then, we substitute this into the original function and proceed with finding its Fourier series representation.

The modulating term $Bsin(\omega mt + \phi)$ can be expanded as: $Bsin(\omega mt + \phi) = \sum cnJn(\alpha t)$ where $Jn(\alpha t)$ is the Bessel function of the first kind of order n, and cn are the Fourier-Bessel coefficients.
To find the Fourier-Bessel coefficients cn, we'll use the formula:

$$Cn = 2/T \int_0^T B \sin(\omega nt + \theta) Jn(\alpha t) dt \qquad (2)$$

where T is the period of the function.

We compute the Fourier-Bessel coefficients cn using Simpson's rule for numerical integration. This simplified theoretical model gives results that show that additional frequencies in energy supply for the device give us terms with resonant in Fourie series with higher amplitudes and well fit with an experimental investigation for effective energy supply for our ozone generator.

In invention one of the two electrodes, particularly as the inner one, plasma is used. This type of electrode is a gas comprising evenly distributed ions and electrons constituting the plasma confined in a dielectric glass tube so as to not escape. It has high electrical conductivity and an electric current does not enter the inside of plasma.

It is apparent that the plasma itself is an efficient source of ultraviolet radiation. It has been observed that due to the effect of ultraviolet radiation, the dielectric material, such as the quartz tube, changes its properties, namely its electrical conductivity, which establishes more favorable conditions for gas discharge within the ozone-generating device according to the present invention. This eventually minimizes the voltage at which the ozone generator operates. Minimizing the voltage at which an ozone generator operates is of very great importance, for this not only minimizes the high-voltage stress on all components for longer life, but is also safer, minimizes arcing and external corona, and decreases the cost of the electrical power source. Ideally, the discharge occurs at the voltage as low as possible at which the discharge is stable and homogeneous, and the average output power and therefore the amount of ozone generated is controlled by adjusting the voltage rather than the frequency.

It is well known that the wavelength of the ultraviolet radiation depends on the gas used for creating the discharge. For this purpose, the present invention utilizes hydrargyrum (mercury) gas for generating plasma within the quartz tube. The ozone-producing wavelength of the ultraviolet radiation is within the range of about 100 nm to about 128 nm. The ultraviolet light produced in this way further increases the ozone-generating efficiency within the chamber.

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Thus the present invention enables the use of a smaller, less expensive electrical supply source due to the favorable characteristics of the dielectric barrier between the electrodes obtained upon exposure to the ultraviolet irradiation from the plasma, i.e. the inner electrode.

The use of plasma as an electrode is advantageous also in that ablation on metallic electrode surfaces due to high instantaneous temperatures caused by the current released during electric discharge which occurs in conventional ozone-generating devices is avoided. Thereby, the purity of the ozone generated is higher and the entire device can operate more reliably for a longer time.

The strong beneficial effect occurring in the device according to the present invention is the establishment of resonance between the frequencies of the electric power supply and the electromagnetic frequencies inherent to the plasma. The intense electromagnetic radiation of random noise character is observed at the frequency of plasma oscillation. The plasma noise spectrum is of a complex nature. In practice, it can be compared to the so-called “white noise” which enables to add of a certain amount of noise in an excitable system of the ozone-generating device structure. Eventually, the plasma-generated noise induces oscillations that bring about the resonance with the electrical power supply voltage frequencies. For the above-described resonance to be established, the sine wave of the electric power supply voltage must have the Fourier series of harmonic frequencies. For this purpose, the signal must have a chaotic modulated sine waveform.

The advantages of our generator are the following: ozone generation by barrier and corona discharge and ultraviolet radiation; ozone formation is regulated by airflow, as well as electrical mode of operation; ozone production is carried out at “20” C0 instead of “0” C0; for special requirements, the ozone generator works on oxygen; the ozone generator is portable, the electric source is supplied by the vehicle; technology is protected by warranty and post-warranty services; the company is ready to license the technology; As it was above mentioned ozone is used in different spheres of Georgian national economy. See Table #1.

Table#1

Spheres of ozone using

Purification of natural and sewage water	Purification of gas Emissions	Agriculture and Food Industry	Medicine and Veterinary	Chemical Industry
Centralized drinking water treatment systems	Thermal Power Plant gas emission Cleaning from N2 and Sulfur	Preparation of water and feed for livestock	Ozone therapy and prevention of professional disease	Production of rare metals and their separation from the wastewater
Stand-alone drinking water treatment systems	Cleaning of the air space of paint and other industries	Disinfection of packaging premises and equipment	Application in Surgery and after Surgical prophylaxis	Synthesis of new polimers
Treatment of industrial wastewater	Sanitation of air space in industrial buildings	Storage and transportation of food	Sterilization of medical instruments and equipment	Organic Synthesis and Biotechnologies
Purification of biologically polluted water		Intensive Fish Farming	Sanitation of Air Space in Buildings to combat nosocomial infections	Bleaching of cellulose and fabric
Domestic application	Disinfection and deodorization of air space in buildings	Water treatment in swimming pools	Canning of Food	Deodorizing of air in refrigerators, vacuum cleaners, etc.

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The ozone generation systems of the "Ozone Georgia" brand created by "Hydrogen Technology" were used by us in different directions, of the Georgian economy, particularly in agriculture: wastewater treatment, water bottling plants, product storage facilities, greenhouses, refrigerators, pig farms, wineries - for pitcher disinfection, to deodorize wineries, to replace pesticides and other poisonous chemicals in viticulture, to replace poisonous chemicals in hazelnut plantations, to disinfect hives in beekeeping, horticulture, silk production, in bread factories, meat factories, lemonade factory, distillery, also in swimming pools, cars wash, Bibliotheque, bookstore, barber shop, even for Covid-19 elimination (see also: chrome extension://efaidnbmnnnibpcajpcglclefindmkaj/https://docs.bvsalud.org/biblioref/2020/04/1095104/potential-use-of-ozone-in-sars-cov-2-covid-19.pdf), etc…

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