A Solution for Reducing the Pollution of the Atmospheric Air

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Here we show how polluted smoke can be compacted and transformed into a glass similar to amorphous *silica glass*, by means of gravitational compression produced in a compression chamber, where gravity is strongly increased by using gravity control technology based on the discovery of correlation between gravitational mass and inertial mass [1]. Possibly this process can be a way of storing of CO_2, a major contributor to global warming.

Key words: Gravitational Compression, Amorphous carbonia, Storing of CO_2, Global Warming.

1. Introduction

Recently, it was shown that under *extreme pressure* (40-48 GPa), carbon dioxide gas (CO_2) forms crystalline solids (a-CO_2)* and can become a glass similar to amorphous *silica glass* [2, 3]. But there is a problem. When the a-CO_2 is depressurized; it quickly reverts to CO_2. Thus, at present a-CO_2 cannot exist outside of a pressure chamber. However, experts predict that possibly by adding silica, the a-CO_2 can remain solid under Standard Temperature and Pressure (STP).

The discovery of the a-CO_2 could lead to a way of storing of CO_2, a major contributor to global warming.

The increase in global emissions of carbon dioxide (CO2) from fossil-fuel combustion and other smaller industrial sources – the main cause of human-induced global warming – increased by 1.4% over 2011, reaching a total of 34.5 billion tonnes in 2012 [4].

Every time we burn fossil fuels, carbon dioxide is released into the atmosphere. In the natural carbon cycle (the natural circulation of carbon among the atmosphere, oceans, soil, plants, and animals), carbon dioxide is re-absorbed by plants and trees. However, we are burning fossil fuels so quickly that plants and trees have no chance of re-absorb the excess of carbon dioxide released into the atmosphere. The effect of this extra carbon dioxide in the atmosphere is that the overall temperature of the planet is increasing (global warming).

Here we show how CO_2, and others pollutants contained in polluted smoke, can be compacted and transformed into a glass similar to amorphous *silica glass*, by means of gravitational compression produced in a compression chamber, where gravity is strongly increased by using gravity control technology (BR Patent Number: PI0805046-5, July 31, 2008 [5]) based on the discovery of correlation between gravitational mass and inertial mass [1]. After solidified, the CO_2 and the others pollutants contained inside polluted smoke can then be easily stored in the Earth's interior.

* Amorphous carbonia. Also called *a-carbonia*, is an exotic amorphous *solid* form of carbon dioxide that is analogous to amorphous *silica glass*.

2. Theory

In a previous paper, I showed that gravitational mass, m_g, and *rest* inertial mass, m_{i0}, are correlated by means of the following expression [1]:

$$\chi = \frac{m_g}{m_{i0}} = \left\{1 - 2\left[\sqrt{1+\left(\frac{\Delta p}{m_{i0}c}\right)^2} - 1\right]\right\} \qquad (1)$$

where m_{i0} is the *rest* inertial mass of the particle and Δp is the variation in the particle's *kinetic momentum*; c is the speed of light.

In general, the *momentum* variation Δp is expressed by $\Delta p = F\Delta t$ where F is the applied force during a time interval Δt. Note that there is no restriction concerning the *nature* of the force F, i.e., it can be mechanical, electromagnetic, etc.

For example, we can look on the *momentum* variation Δp as due to absorption or emission of *electromagnetic energy*. In this case, it was shown previously that the expression of χ can be expressed by means of the following expression [6]:

$$\chi = \frac{m_g}{m_{i0}} = \left\{1 - 2\left[\sqrt{1 + \left(\frac{\Delta p}{m_{i0}c}\right)^2} - 1\right]\right\} =$$

$$= \left\{1 - 2\left[\sqrt{1 + \left(\frac{Un_r}{m_{i0}c^2}\right)^2} - 1\right]\right\} =$$

$$= \left\{1 - 2\left[\sqrt{1 + \left(\frac{Wn_r}{\rho c^2}\right)^2} - 1\right]\right\} \qquad (2)$$

where U is *the electromagnetic energy absorbed or emitted by the particle;* n_r is the index of refraction of the particle; W is the density of energy on the particle (J/kg); ρ is the matter density (kg/m^3) and c is the speed of light.

In the particular case of *heterogeneous* mixture of matter[†], (powder, dust, clouds, smoke, *heterogeneous plasmas*[‡], etc), subjected to incident radiation or *stationary electromagnetic fields*, the expression of χ can be expressed by means of the following expression, which is derived from the above equation [6]:

$$\chi = \frac{m_g}{m_{i0}} = \left\{1 - 2\left[\sqrt{1 + \left[\left(\frac{n_r n^3 S_\alpha S_m^2 \phi_m^2 E^2}{2\mu_0 \rho c^2 f^2}\right)\frac{1}{(c/n_r f)}\right]^2} - 1\right]\right\} =$$

$$= \left\{1 - 2\left[\sqrt{1 + \frac{n_r^4 n^6 S_\alpha^2 S_m^4 \phi_m^4 E^4}{4\mu_0^2 \rho^2 c^6 f^2}} - 1\right]\right\} \qquad (3)$$

where S_α is the maximum area of cross-section of the body; ϕ_m is the average diameter of the molecules of the body; $S_m = \pi\phi_m^2/4$; E is the instantaneous electric field applied on the body; μ_0 is the magnetic permeability of the free space; f is the oscillating frequency of the electric field and n is the number of atoms per unit of volume in the body, which is given by

$$n = \frac{N_0 \rho}{A} \qquad (4)$$

where $N_0 = 6.02 \times 10^{26}\, atoms/kmole$ is the Avogadro's number and A is the molar mass(*kg/kmole*).

Note that $E = E_m \sin \omega t$ .The average value for E^2 is equal to $\frac{1}{2}E_m^2$ because E varies sinusoidaly (E_m is the maximum value for E). On the other hand, $E_{rms} = E_m/\sqrt{2}$. Consequently we can change E^4 by E_{rms}^4 , and the equation above can be rewritten as follows

$$\chi = \frac{m_g}{m_{i0}} = \left\{1 - 2\left[\sqrt{1 + \frac{n_r^4 n^6 S_\alpha^2 S_m^4 \phi_m^4 E_{rms}^4}{4\mu_0^2 \rho^2 c^6 f^2}} - 1\right]\right\} \qquad (5)$$

Electrodynamics tells us that $E_{rms} = vB_{rms} = \left(\frac{c}{n_r}\right)B_{rms}$. Thus, by substitution of this expression into Eq. (5), we get

$$\chi = \frac{m_g}{m_{i0}} = \left\{1 - 2\left[\sqrt{1 + \frac{n^6 S_\alpha^2 S_m^4 \phi_m^4 B_{rms}^4}{4\mu_0^2 \rho^2 c^2 f^2}} - 1\right]\right\} \qquad (6)$$

For *polluted smoke*, at first approximation, we can assume $\rho \cong 2kg/m^3$[§]; $n \cong 2 \times 10^{25}\, atoms\ /\ m^3$ and $\phi_m \cong 1.5 \times 10^{-10} m$. By substitution of these values into Eq. (6), we obtain

$$\chi = \frac{m_g}{m_{i0}} = \left\{1 - 2\left[\sqrt{1 + 1 \times 10^{27}\frac{S_\alpha^2 B_{rms}^4}{f^2}} - 1\right]\right\} \qquad (7)$$

Now, consider the system shown in Fig.1. The *spherical compression chamber* with $2m$ diameter $(S_\alpha = 3.14m^2)$ is filled with polluted smoke. Thus, if an oscillating magnetic field with frequency $f = 1Hz$ is applied on the smoke, then the value of χ , given by Eq.(7), is

$$\chi = \frac{m_g}{m_{i0}} = \left\{1 - 2\left[\sqrt{1 + 1 \times 10^{28} B_{rms}^4} - 1\right]\right\} \qquad (8)$$

[†] From the macroscopic viewpoint, a *heterogeneous* mixture is a mixture that can be separated easily (sand, powder, dust, smoke, etc.). The opposite of a heterogeneous mixture is a *homogeneous* mixture (ferrite, concrete, rock, etc).

[‡] *Heterogeneous plasma* is a mixture of *different ions*, while *Homogeneous plasma* is composed of a single ion specie.

[§] The chemical composition of the *polluted smoke* depends on the burning material and the conditions of combustion, but always contains CO_2, CO and SO_2, whose densities (@ NTP (20°C 1atm)) are respectively: (1.842kg.m^{-3}, 1.165 kg.m^{-3}and 2.279kg.m^{-3} [7]).

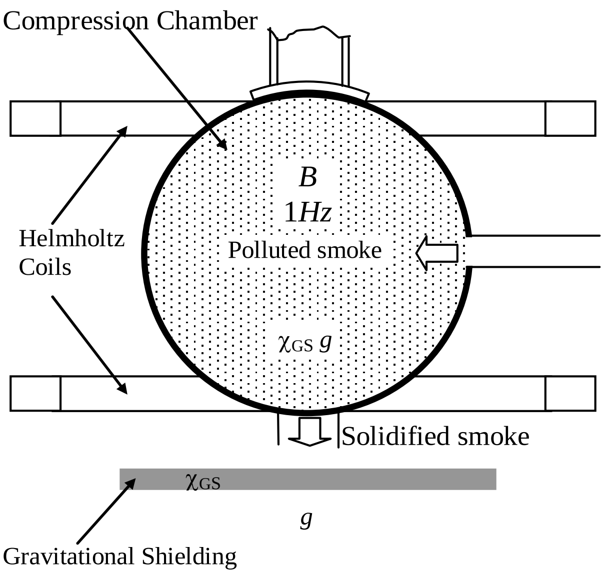

Fig. 1 – *Hyper Compressor* - A System for transforming polluted smoke into a glass similar to amorphous *silica glass*. (Developed starting from a process *patented* in July, 31 2008, PI0805046-5 [5]).

The *gravitational forces* between these smoke particles (*gravitational mass* m_{gs}), are given by

$$F = G\frac{m_{gsp}m'_{gsp}}{r^2} = \chi^2 G\frac{m_{i0sp}m'_{i0sp}}{r^2} \cong$$
$$= \chi^2 G\frac{\left(\rho_{sp}V_{sp}\right)\left(\rho'_{sp}V'_{sp}\right)}{r^2} =$$
$$= \left(\frac{\pi^2 G\rho_{sp}^2\phi_{sp}^6}{36}\right)\frac{\chi^2}{r^2} \qquad (9)$$

Therefore, each smoke particle is subjected to a pressure p, given by

$$p = \left(\frac{\pi^2 G\rho_{sp}^2\phi_{sp}^6}{36 S_{sp}}\right)\frac{\chi^2}{r^2} = \left(\frac{\pi G\rho_{sp}^2\phi_{sp}^4}{9}\right)\frac{\chi^2}{r^2} \qquad (10)$$

The thermal energy of the an ideal gas sample consisting of N *particles* is given by

$$U_{thermal} = \tfrac{3}{2}NkT \qquad (11)$$

For an ideal gas, the *internal energy* U consists only of its thermal energy, i.e., $U = U_{thermal}$. Thus, the thermal energy contained in the gas volume, $V_{gas} \approx NV_p$, (V_p is the volume of the gas particles), i.e., Its internal energy density is

$$u = \frac{U}{V_{gas}} \approx \frac{3kT}{2V_p} \qquad (12)$$

It follows from Classical Electrodynamics that the internal pressure p is related to the internal energy density u by means of the following equation:

$$p = \frac{u}{3} \qquad (13)$$

Thus, we can write that

$$p \approx \frac{kT}{2V_p} \qquad (14)$$

By comparing this equation with Eq. (10), we can conclude that for

$$\chi > -r\left(\frac{27\,kT}{\pi^2 G\rho_{sp}^2\phi_{sp}^7}\right)^{\frac{1}{2}} \qquad (15)$$

the gravitational compression surpasses the internal pressure due to the thermal energy of the smoke particles, and consequently it starts the contraction of the smoke upon itself. With the contraction, the distances among the particles are reduced, further increasing the gravitational attraction among them, and again reducing the distances among the particles, and so on. This phenomenon is known as *gravitational collapse*.

According to Eq. (14), the *minimum* value of χ in order to starts the gravitational collapse is obtained for $r = \phi_{sp}$ and $\phi_{sp} = \phi_{sp(\max)}$ (*maximum* size of smoke particles, $\phi_{sp(\max)} \cong 2.5\mu m$ [8]). The result is

$$\chi > -5.1\times 10^5 \qquad (16)$$

In order to obtain $\chi > -5.1\times 10^5$, according to Eq.(8), the magnetic field to be applied on the smoke must have intensity, given by

$$B_{rms} > 5\times 10^{-5}T \qquad (17)$$

During the contraction, after all the smoke particles are already together, forming a single body, the compression progresses, reaching a point where all the *molecules* are very close together. At this point, the pressure should surpass 40- 48GPa** . Then, *it is necessary nullify the magnetic field in the compression chamber*, because the contraction can go far beyond, causing dangerous effects.

Note that by injecting pure carbon powder into the compression chamber, instead of smoke,

** The necessary pressure to transform carbon dioxide gas (CO_2) into glass (a-CO_2).

one can start the *nuclear fusion of the carbon atoms*, when the pressure is sufficiently increased, based on the well-known *Carbon Fusion*.

The *carbon fusion* is a set of nuclear fusion reactions that take place in massive stars. The principal reactions are:

$$^{12}C + {}^{12}C \rightarrow \begin{cases} {}^{23}Na + p + 2.24\ MeV \\ {}^{20}Ne + \alpha + 4.62\ MeV \\ {}^{24}Mg + \gamma + 13.93\ MeV \end{cases}$$

In the case of the smoke, when the pressure surpasses 40- 48GPa it should be transformed into a glass similar to a-CO_2 or similar to amorphous *silica glass*. Under this condition, it ceases to be a *heterogeneous* mixture of matter, and therefore, the Eq. (3) no longer can be applied; χ must be expressed by Eq. (2), which is the general expression. However, it is necessary the following considerations.

Electrodynamics tells us that when an electromagnetic wave with frequency f and velocity c incides on a material with relative permittivity ε_r, relative magnetic permeability μ_r and electrical conductivity σ, its *velocity is reduced* to $v = c/n_r$ where n_r is the index of refraction of the material, given by [9]

$$n_r = \frac{c}{v} = \sqrt{\frac{\varepsilon_r \mu_r}{2}\left(\sqrt{1+(\sigma/\omega\varepsilon)^2}+1\right)} \qquad (18)$$

If $\sigma >> \omega\varepsilon$, $\omega = 2\pi f$, Eq. (18) reduces to

$$n_r = \sqrt{\frac{\mu_r \sigma}{4\pi\varepsilon_0 f}} \qquad (19)$$

Many smoke components have high electrical conductivities. Others, such as Carbon, CO_2, etc., have conductivities less than 1 S/m. The electrical conductivities of the Carbon and CO_2 plume are respectively, 0.061 S/m and 0.0166 S/m [10]. This shows that the electrical conductivity of smoke, σ, is less than $1S/m$, which is much greater than $\omega\varepsilon = 2\pi f\varepsilon$, in the case of $f = 1Hz$ and $\varepsilon = \varepsilon_0$. As we have already seen, in the case of $\sigma >> \omega\varepsilon$, the expression of n_r is given by Eq. (19). Thus, if we assume $\sigma \cong 1S/m$, then Eq. (19) will give the following value of n_r:

$$n_r \cong 10^5 \qquad (20)$$

which is greater than the *maximum possible value* of n_r for the smoke.

By substitution of $n_r \cong 10^5$ and

$$W = \tfrac{1}{2}\varepsilon_0 E^2 + \tfrac{1}{2}\mu_0 H^2 = \tfrac{1}{2}\varepsilon_0 c^2 E^2 + \tfrac{1}{2}\left(B^2/\mu_0\right) = B^2/\mu_0$$

into Eq. (2), we get

$$\chi = \left\{1 - 2\left[\sqrt{1+10^{-20}B^4} - 1\right]\right\} \qquad (21)$$

Note that even considering $n_r \cong 10^5$, the factor $\left(10^{-20}\right)$ in Eq. (21) still is very small. Therefore, for $B << 10^5 T$, the value of χ reduces to approximately 1. Consequently, the *solidified smoke* falls to the bottom of the compression chamber, where it can be easily removed for storage.

The function of the horizontal *Gravitational Shielding*[††] shown in Fig. 1 is to reduce the local gravity acceleration upon the smoke. Note that, for $\chi > -5.1\times 10^5$ the gravitational mass of the smoke becomes greater than $-5{,}100\ tonnes$, producing on the top of the compression chamber a pressure greater than $10^6\ kg.cm^{-2}$. Thus, if the gravitational shielding produces $\chi_{GS} \cong 10^{-3}$, then the local gravity acting on the smoke will be reduced to $\chi_{GS}\, g \cong 10^{-2} m.s^{-2}$, reducing the pressure upon the top of the chamber down to $\approx 10^3\ kg.cm^{-2}$.

In the case of the smoke be subjected to a *static* magnetic field we obviously cannot apply Eq. (3), we must apply Eq. (2), which is valid for oscillating and *static* fields. In this case, n_r in Eq. (2), is given by the *own* index of refraction of the smoke, n_r = 1.5, [11] (because Eq. (18) are not valid for *static* fields.

[††] In the last years, I have proposed several types of *Gravitational Shieldings*. One should choose the most appropriate for this case. See for example, the *Quantum Gravitational Shielding* [12].

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