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 (CO$_2$) 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 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.

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]:

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

where $m_{i0}$ is the rest inertial mass of the particle and $\Delta p$ is the variation in the particle’s kinetic momentum; $c$ is the speed of light.

In general, the momentum variation $\Delta p$ is expressed by $\Delta p = F\Delta t$ where $F$ is the applied force during a time interval $\Delta t$. 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 $\Delta p$ as due to absorption or emission of electromagnetic energy. In this case, it was shown previously that the expression of $\chi$ can be expressed by means of the following expression [6]:

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* Amorphous carbonia. Also called a-carbonia, is an exotic amorphous solid form of carbon dioxide that is analogous to amorphous silica glass.
The average is the magnetic permeability of the free; given by Eq.(7), is

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

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

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

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 \((J/kg); \rho \) is the matter density \((kg/m^3)\) and \( c \) is the speed of light.

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

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

\[ = \left\{1 - 2 \left[ \frac{1}{\sqrt{1 + \left( \frac{n_m S_\alpha 2 \phi_m^4 E^4}{4 \mu_0^2 \rho^2 c^4 f^2} \right)}} - 1 \right] \right\} (3) \]

where \( S_\alpha \) is the maximum area of cross-section of the body; \( \phi_m \) 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; \( \mu_0 \) 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

\[ n = \frac{N_0 \rho}{A} \quad (4) \]

where \( N_0 = 6.02 \times 10^{26} \) atoms/k mole is the Avogadro’s number and \( A \) is the molar mass (kg/k mole).

Note that \( E = E_m \sin \omega t \). The average value for \( E^2 \) is equal to \( \langle E^2 \rangle \) because \( E \) varies sinusoidally \((E_m) \) 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:

\[ \chi = \frac{m_g}{m_{i0}} = \left\{1 - 2 \left[ \frac{n_m S_\alpha 2 \phi_m^4 E_{rms}^4}{4 \mu_0^2 \rho^2 c^4 f^2} \right] - 1 \right\} \quad (5) \]

Electrodynamics tells us that \( E_{rms} = \nu B_{rms} \). Thus, by substitution of this expression into Eq. (5), we get

\[ \chi = \frac{m_g}{m_{i0}} = \left\{1 - 2 \left[ \frac{n_m S_\alpha 2 \phi_m^4 B_{rms}^4}{4 \mu_0^2 \rho^2 c^4 f^2} \right] - 1 \right\} \quad (6) \]

For polluted smoke, at first approximation, we can assume \( \rho \equiv 2 \text{kg/m}^3 \); \( n \equiv 2 \times 10^{25} \) atoms/m\(^3\); \( \phi_m \equiv 15 \times 10^{-10} m \).

By substitution of these values into Eq. (6), we obtain

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

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

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

\( \dagger \) 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).

\( \ddagger \) Heterogeneous plasma is a mixture of different ions, while Homogeneous plasma is composed of a single ion specie.
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 \( m_{\text{gs}} \)), are given by
\[
F = G \frac{m_{\text{gs}} m'_{\text{gs}}}{r^2} = \frac{m_{\text{i0sp}} m'_{\text{i0sp}}}{r^2} = \frac{\rho_{\text{sp}} V_{\text{sp}} \rho'_{\text{sp}} V'_{\text{sp}}}{r^2} = \frac{\pi^2 G \rho^2_{\text{sp}} \phi^6_{\text{sp}}}{36} \frac{\chi^2}{r^2}
\]
Therefore, each smoke particle is subjected to a pressure \( p \), given by
\[
p = \left( \frac{\pi^2 G \rho^2_{\text{sp}} \phi^6_{\text{sp}}}{36} \right) \frac{\chi^2}{r^2} = \left( \frac{\pi^2 G \rho^2_{\text{sp}} \phi^6_{\text{sp}}}{36} \right) \frac{\chi^2}{r^2}
\]

The thermal energy of the an ideal gas sample consisting of \( N \) particles is given by
\[
U_{\text{thermal}} = \frac{3}{2} N k T
\]
For an ideal gas, the internal energy \( U \) consists only of its thermal energy, i.e., \( U = U_{\text{thermal}} \).

Thus, the thermal energy contained in the gas volume, \( V_{\text{gas}} \approx N V_p \), \( (V_p \text{ is the volume of the gas particles}) \), i.e., its internal energy density is
\[
u = \frac{U}{V_{\text{gas}}} \approx \frac{3 k T}{2 V_p}
\]
It follows from Classical Electrodynamics that the internal pressure \( p \) is related to the internal energy density \( \nu \) by means of the following equation:
\[
p = \frac{\nu}{3}
\]
Thus, we can write that
\[
p \approx \frac{k T}{2 V_p}
\]
By comparing this equation with Eq. (10), we can conclude that for
\[
\chi > -r \left( \frac{27 k T}{\pi^2 G \rho^2_{\text{sp}} \phi^6_{\text{sp}}} \right)^{\frac{1}{2}}
\]
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 \( \chi \) in order to starts the gravitational collapse is obtained for \( r = \phi_{\text{sp}} \) and \( \phi_{\text{sp}} = \phi_{\text{sp(max)}} \) (maximum size of smoke particles, \( \phi_{\text{sp(max)}} = 2.5 \mu m \) [8]). The result is
\[
\chi > -5.1 \times 10^5
\]
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
\[
B_{\text{rms}} > 5 \times 10^{-5} T
\]
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 \( 40-48 \text{GPa} \)\(^\dagger\). 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,
\(^\dagger\) 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:

\[
\begin{align*}
12C + 12C & \rightarrow 20Ne + \alpha + 4.62 \text{ MeV} \\
23Na + p & + 2.24 \text{ MeV} \\
24Mg & + \gamma + 13.93 \text{ MeV}
\end{align*}
\]

In the case of the smoke, when the pressure surpasses 40–48GPa it should be transformed into a glass similar to a-CO\textsubscript{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; \(\chi\) 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 and velocity \(c\) incides on a material with relative permittivity \(\varepsilon_r\), relative magnetic permeability \(\mu_r\) and electrical conductivity \(\sigma\), its velocity is reduced to \(v = c/n_r\) where \(n_r\) is the index of refraction of the material, given by [9]

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

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

\[
n_r = \sqrt{\frac{\varepsilon_r \mu_r}{1 + 2\sigma / \omega \varepsilon}}
\] (19)

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

\[
n_r \approx 10^5
\] (20)

which is greater than the maximum possible value of \(n_r\) for the smoke.

By substitution of \(n_r \approx 10^5\) and

\[
W = \frac{1}{2} e_0 E^2 + \frac{1}{2} \mu_0 H^2 = \frac{1}{2} e_0 E^2 + \frac{1}{2} \left[B^2 / \mu_0\right] = B^2 / \mu_0
\]

into Eq. (2), we get

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

Note that even considering \(n_r \approx 10^5\), the factor \(10^{-20}\) in Eq. (21) still is very small. Therefore, for \(B \ll 10^5\text{T}\), the value of \(\chi\) 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\textsuperscript{††} 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 \(-5,100\text{ tonnes}\), producing on the top of the compression chamber a pressure greater than \(10^6\text{ kg.cm}^{-2}\). Thus, if the gravitational shielding produces \(\chi_{GS} \approx 10^{-3}\), then the local gravity acting on the smoke will be reduced to \(\chi_{GS} g \approx 10^{-2}\text{ ms}^{-2}\), reducing the pressure upon the top of the chamber down to \(\approx 10^3\text{ kg.cm}^{-2}\).

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.

\[\text{††} \] 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].
References


