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Contributions to Keep the Atmosphere Balanced: Suitable-Reductions of HC and CO Emissions Controlling CO2 from Mobile Sources, Using COBMA

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Abstract - The main ideas explained in previous papers presented to RTESE´20 [1], [2], on gasoline **Combustion Optimization by Magnetic Action (COBMA)** are complemented and reinforced in this paper. Not aimed at gasoline consumption saving but**,** to reducing air pollution suitably and mitigating CO2 emissions in an effective way, **COBMA** emerges as an option for a global response to face the Climate-Change threat. Previously a context characterized by natural evolution of the earth´s atmosphere, chemical and thermodynamic processes, among others, and their interaction, according to natural laws strictly fulfilled to keep the atmosphere balanced is described. Then, theoretical fundamentals to design a magnetic minimizer are explained; In gasoline, a non-polar fluid, changes due to direct magnetic action cannot be explained by Classical Physics theory. These changes belong to the reign of Quantum Physics which allows us to understand the observables rationale of phenomena characterized by microscopic quantities. It is the case of a hydrogen atom exposed to a uniform external magnetic field, interacting with atom´s fine and hyperfine structures, splitting its energy levels through what is known as Zeeman Effect. These alterations allow to obtain the energies of the transitions when its energy levels change. The evaluation of the transitions maximum energy allows to find the maximum energy change per hydrogen atom and total maximum energy provided to hydrogen atoms in the volume of fuel comprised between a couple of permanent Neodymium Magnets. Using concepts and laws of Physics as well as General Chemistry; considering the isooctane molecule representative of a gasoline molecule, calculation of the magnetic field induction B, between the magnets, design variable, can be performed. Finally, CO2 emissions reductions from a Hyundai and a Renault car using **COBMA** are compared and analysed, to conclude that emissions tests are indispensable when designing a **Magnetic Efficient Balanced** (**MEB)** minimizer is required.

Keywords: Magnetic Field Energy Density, Magnetic Induction, **MEB** Minimizer, Zeeman´s effect, **COBMA,** Climate-Change Threat, Global Comprehension

1. Introduction

Before analyzing the comparison of the gases emissions results obtained for two different light vehicles: a Renault and a Hyundai car, after installing, in each of them, a magnetic minimizer with the same magnetic induction arrangement, it is essential correlate this kind of minimizers´ context, characterized by its physical-chemical processes and results, with the earth's atmosphere context characterized by analogous physical-chemical processes that have regulated its evolution over million years. These contexts´ correlation could be made, in fact, guiding the fossil fuels combustion from the constancy of the atmosphere elements composition and the stability of the increase variation rate of CO2 over hundred millennia understood as a more general condition of stable equilibrium of the atmosphere due to the CO2 variations harmony. We have several considerations to make this contexts connection. These are the following:

1. The earth´s atmosphere, throughout its history has undergone a redox evolution. [3] Combustion of a fossil fuel, as gasoline, at a small scale, is the result of analogous processes as well. The earth´s magnetic field is related with earth-atmosphere balance and protects it; earth-atmosphere balance is somehow related with the reversals of the earth´s magnetic field [4], and even more with the earth magnetic field decrease. [5] The earth´s magnetic field has been a present agent through all Earth´s Atmosphere evolution. A magnetic field is also present in the process Combustion Optimization by Magnetic Action (COBMA). Both earth´s atmosphere and fossil fuels combustion are regulated by redox reactions. In both a magnetic field is present.

2. Earth and its atmosphere can be treated as interacting Thermodynamic Systems [6] whose changes are regulated by the laws of Thermodynamics, especially, the first Law of Thermodynamics [6]. The fosil fuels combustion is an interconexion process, regulated by chemical redox reactions, responsible of the changes of both thermodynamic systems. Fossil fuels are chemical energy deposits from past million years interactions between Earth and its atmosphere through its elements natural cycles.

3. According to information provided by physics, chemistry and Paleoclimatic sciences on the earth´s, atmosphere evolution, since the earth´s birth, 4600 million years ago, till preindustrial era, modern anthropogenic unprecedent impact on the climate change has been evaluated and, somehow, has revealed the extreme need of high efficiency of theoretical and experimental knowledge applications and its correspondent actions to minimize current and future anthropogenic impact by the using fossil fuels.

4. The study of evolution of the earth´s atmosphere primal elements and processes results in a better comprehension of the essence of the climate changes, its evolution, and limits. This knowledge, consequently, reinforces the idea to present a more comprehensive view of the Climate-Change through the idea of balance of the Earth´s Atmosphere and sheds light to continue in this path to solve the current anthropogenic Air Pollution-climate change problem.

Additionally, to these considerations we continue with complementary information about: Earth´s atmosphere evolution; Chemical and Thermodynamic Processes and Its Interrelationships; implications from our Understanding of the Climate Change-Air Pollution problem, as it is emphatically stated in previous paper [7], and partially in RTESE20´papers [1], [2]; the physics and chemistry behind a magnetic Minimizer of Gases Emissions and finally, the analysis of results and conclusions.

1.1 Earth's Atmosphere Evolution:

Science has made possible to calculate the age of the universe, from the Hubble constant [8], as 13,7 billion years, short scale [9]. This has been verified by the probe WMAP. It is of fundamental importance to refer to this starting point when universe came to existence and space and time to be referred to it, not only as a reference for the appearance of hydrogen and the main constituent elements of the original atmosphere and of its evolution until today, but also for the determinant energies and temperatures of the processes that started since the Big Bang took place. 10^{-43} s after the Big Bang, the universe was both too hot and too dense for elements to be formed. This is the earliest time at which we can say anything meaningful about the development of the universe. At this instant, the entire spatial extent of the universe. is much smaller than a proton and its temperature is 10^{32} K, approximately. 10^{-34} s after, the universe has undergone a tremendously rapid inflation, increasing in size by a factor of 10^{30}, causing the formation of matter. The universe has become a hot soup of photons, quarks, and leptons at a temperature of about 10^{27} K, which is too hot for protons and neutrons to form. 10^{-4} s after, quarks can combine to form protons and neutrons and their antiparticles. The universe has cooled to such an extent by continued expansion that photons lack the energy needed to break up these new particles. Particles of matter and antimatter collide and annihilate each other. There was a slight excess of matter left, which, failing to find annihilation partners, survived to form the particles that we know today. 1 min after, the universe has now cooled enough so that protons and neutrons, in colliding, can stick together to form the low mass nuclei ^{2}H, ^{3}He, ^{4}He, and ^{7}Li. The predicted relative abundances of these nuclides are just what we observe in the universe today. ***This is of fundamental importance because shows that nature points out to keep the proportion of its elements and laws. Hydrogen is still the most abundant element of the universe.*** 379 000 years after, the temperature had fallen to 2970 K, and electrons could stick to bare nuclei when the two collide, forming atoms. Atoms of hydrogen and helium, under the influence of gravity, begin to clump together, eventually starting the formation of galaxies and stars, but until then, the universe is relatively dark. [10]

1.2 The other main earliest elements [11]

Carbon: Research by Rice University Earth scientists suggests that virtually all of Earth's life-giving carbon could have come from a collision about 4.4 billion years ago between Earth and an embryonic planet like Mercury.

Nitrogen: Dr Dennis Harries of the Friedrich-Schiller-Universität in Jena, Germany, believes there were high concentrations of ammonia in some parts of the solar nebula which formed the Sun and solar system 4.6 billion years ago. Under the right conditions, nitrogen can be produced out of molecules of ammonia. Nitrogen may have arrived on Earth in ancient meteorites after the planet had already formed, according to a new study.

Oxygen: An international astronomy team has made the earliest known discovery of oxygen in the universe more than 13 billion years, or just 600 million years after the Big Bang.

It looks like oxygen was first produced somewhere around 2.7 billion to 2.8 billon years ago. It took up residence in atmosphere around 2.45 billion years ago," says geochemist Dick Holland, a visiting scholar at the University of Pennsylvania. "It looks as if there's a significant time interval between the appearance of oxygen-producing organisms and the actual oxygenation of the atmosphere.

The history of the earth's atmosphere from its primitive state to the present shows that the great changes in atmospheric chemistry, through periods of millions of years, have given rise to great transformations that are the essence of its evolution and have meant the appearance and disappearance of many species over the planet since millions of years ago.

1.3 Chemical and Thermodynamic Processes and Its Interrelationships

From the point of view of understanding the Climate Change problem from thermodynamics, it is better to approach it from the 1st law, considering the atmosphere as part of the interacting Atmosphere-Earth system and not from it as an independent entropic system. The complexity of such approaching and the inconvenience of using it prevented us to do it.

2. Our Comprehension of the Real Climate-Change Problem and Its Implications.

As we explained in papers presented to RTESE´20 [1], [2], and previous paper to be presented to RTESE´22 [12], is of great importance to emphasize in this stage on the path to solve Air Pollution-Climate Change problem. The poor understanding of it delays its solution and can even prevent it from ever being solved. Therefore, is very important to understand Climate fundamentals and evolution. Scientist James Lovelock states the importance of knowing the earth´s nature to acquire the will to change our way of life and help to save the planet [13].

It is useless for comprehension and solution to state that Climate Change is a complex problem. Even though it would be precisely formulated it could not be solved if its essential nature is not grasped and synergistic work is not achieved. Climate Change is a complex Science problem that needs interdisciplinary work to be accurately formulated This is a long process to accomplish. The presence of non-linear processes in the climate system limit truthfulness in mathematical models, result in uncertainties that finally give rise to probabilistic estimates of climate change [14]. Therefore, is useless attempting to acquire global comprehension of the Climate change through this way and meanwhile air pollution and CO2 concentration in the atmosphere increasing continuously. While problem is precisely formulated, emissions must be mitigated in a first stage to get optimism, Comprehension, Synergistic work, and proper mitigation.

Comprehension of real Climate-Change Problem implies, beyond of its complex scientific nature, to grasp its simple essence from the law of Action-Reaction, being aware that the impact (action) of human activities on the climatic system is returned through climatic changes (reaction) that can put at risk the continuity of life on the planet; show respect for this simple, natural, and universal law; of any way we must not accelerate or retard the natural rhythm of natural processes but help to maintain them and compensate and prevent the damage we have done and continue doing while using fossil fuels. We also must adapt to Climate Change, taking on account the natural processes and respecting natural laws. Human infrastructure and consequently human life are threatened by a changing climate.

Life on Earth affects climate, and this affects life. Climatic conditions can be helpful to some species and lethal to another. Climate has changed in earth during million years. In some periods they have been gradual. Through all the history of earth there have been abrupt changes in its atmosphere that have given rise to chemical, geological, biochemical, magnetic, and other great transformations related with the earth and in its atmosphere.

The real and current environmental problem is **the non-effective and opportune mitigation of emissions to the atmosphere from human activities that are impacting the earth climate system**.

The main characteristic of natural CO2 evolution at the earth´s atmosphere scale could be the best guide to find the path to minimize it. This main characteristic is a general equilibrium condition, visualized as periodical and harmonious decreases and increases of CO2 amounts over large periods of time. Whether or not the reason for this harmonious behavior is understood, it is a law that should be considered and taking on account, simply due to respect or even for convenience. The changes in emissions from fossil fuels combustion due to through Redox reactions, at scale of vehicles, are correlated to analogous changes in past, present and future at the earth´s atmosphere scale [15]. If the earth´s Atmosphere composition have remained stable over million years and natural CO2 concentration rate has been oscillating to a maximum value of 300 ppm over 400000, we must reduce the current concentration rate caused by excessive gases emissions from mobile sources. This could be a solution. At least a mitigation while implementation of clean energies and electric cars be globally implemented. This means a drastic reduction of CO2 as soon as possible to avoid reaching the inflection point where the stable equilibrium will be broken.

Our real environmental problem nature is a fact; Air Pollution and Climate Change are two sides of the same coin [16]. Air Pollution is considered by WHO and other authoritative institutions as a climate driver [17]. UN pose the convenience of tackling both problems at the same time [18]. This favours our insistence of using **COBMA**. The Swedish Environmental Protection book Agency points out the coincidence of GHG and pollutants and the benefit of a combined strategy to reduce both simultaneously [19].

However, when using fossil fuels from mobile sources, pollutants cannot be reduced at will. Reduction of CO and HC implies CO2 emissions increase. However, using a MEB minimizer allows to control CO2 emissions increase as it has been shown from several emission tests results with CO an HC suitable reductions.

We have done great damage to our planet. anthropogenic emissions due to the use of fossil fuels continue to pollute the air and increase the concentration of CO2 in the atmosphere, increasing the temperature of the planet. We cannot fully repair the damage we have done and continue doing to the planet if we use fossil fuels; however, we can mitigate it. In the case of air pollution and Climate Change, the concentrations of pollutants and CO2 can be minimized so that the rate of increase of CO2 may be of the same order of magnitude as the natural one. This can be achieved through a careful process of design, construction and installation of magnetic efficient balanced minimizers controlled by authorized institutions whose job is the protection of the environment. The optimization of fuel by magnetic action (**COBMA)** was a technique successfully used 8 decades ago and in the first decade of this century had its peak but unfortunately it was frustrated because the economic interest exceeded the interest of saving the planet. Today could be globally implemented, in all countries, under the control of an Institution whose job is to protect the planet. In this paper we use the typical isooctane molecule, representative of a gasoline molecule C_8H_{18} in calculations to determine the magnetic induction **B** of the MEB minimizer. In next papers we hope to use a proper software to include all the different types of gasoline hydrocarbon molecules and fine tune the magnitude of **B.**

3. On Physics and Chemistry behind a MEB Minimizer of Gases Emissions.

3.1 Zeeman Effect [20]

Atoms contain charges in motion, so it should not be surprising that magnetic forces cause changes in that motion and in the energy levels. In 1896 the Dutch physicist Pieter Zeeman was the first to show that in the presence of a magnetic field, some spectral lines were split into groups of closely spaced lines This effect now bears his name. In that time Quantum Mechanics has not been established and that is why some details were not explained completed. Electromagnetism could be only completely understood through Quantum Mechanics. Quantum Mechanics allows us to understand the rationale for phenomena observables characterized by microscopic quantities whose study and understanding are not within the reach of classical physics. Such is the case of the behavior of a hydrogen atom when it is exposed to a uniform external magnetic field, interacting with the fine and hyperfine structures of said atom, altering its energy levels through what is known as the Zeeman Effect. These alterations allow to obtain the energies of the transitions when energy levels change.

The evaluation of the maximum energy of the transitions is out after establishing the corresponding Hamiltonian operator [21] and evaluating the associated matrix. With this value and the expressions provided by classical physics and chemistry, we can calculate the value of the magnetic field density, the main design variable of the magnetic emission reducer.

3.2 Formulas [22]

$$\mu_B = \frac{B^2}{2\mu} \quad (1)$$

$$\mu_B = \frac{U_B}{v} \quad (2)$$

$$U_H = F(B) \quad (3)$$

$$C_8H_{18}\text{(Isooctane)} \quad (4)$$

$$U_B = 18\,\frac{m_G}{M_G} N_0 U_H \quad (5)$$

Equation 1 relates the magnetic field energy density μ_B, with the magnetic induction B and the magnetic permeability of fuel μ. Equation 2 relates μ_B with volume v and U_B; the total energy provided by the magnetic field to optimize the hydrocarbon molecules, within the volume v of fuel comprised between the magnets, changing them from the low energy state to the maximum energy state.

Equation 3 expresses maximum hydrogen atom energy as function of the magnetic induction B of the magnets. Equation 4 expresses de structural formula of gasoline. One mol has a molecular mass of 114g and contains 18 hydrogen atoms.

Equation 5 expresses total energy U_B in terms of Avogadro Number, energy U_H provided to a hydrogen atom, gasoline molar mass M_G and mass of gasoline m_G for volume v.

In the isooctane molecule representative of a gasoline molecule, the 6 outermost hydrogen atoms need less energy to combine because they are less bound. Therefore, in calculating the total energy provided by the external magnetic field to the atom, we could take only 12 of the 18 electrons in the molecule, Fig 1 [23].

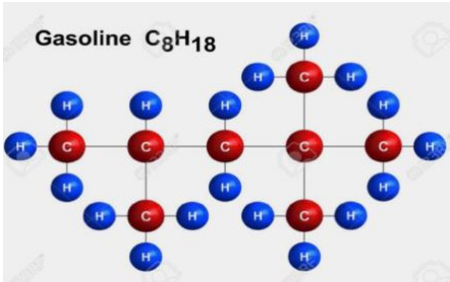

Fig 1. Gasoline Chemical Formula

Data:

$N_0 = Avogadro's\ number = 6.02 \times 10^{23} particles/mol,\ \ \mu_0 =$ Vacum or air permeabiliy

$\mu_0 =$ Vacum or air permeabiliy , $\mu_0 = 4\pi \times 10^{-7} \frac{mT}{A}$

$\mu =$ Gasoline magnetic permeabiliy

For diamagnetic and Paramagnetic materials $\mu \approx \mu_0$ [15]

$\mu = 4\pi \times 10^{-7} \frac{mT}{A}$

$Gasoline\ mol\ mass = M_G = 114\ g$

$Gasoline\ density = d_G = 0.68 \frac{g}{cm^3} = \frac{680Kg}{m^3}$

$D = Diameter\ of\ gasoline\ hose = \frac{3"}{8} = 0.95cm$

$A = Cross\ Section\ Area\ of\ gasoline\ hose = \frac{\pi D^2}{4} = \frac{\pi(0.95cm)^2}{4} = 0.7cm^2$

$l = length\ of\ gasoline\ volume\ comprised\ between\ magnets\ = 1.9cm$

$v =\ gasoline\ volume\ comprised\ between\ magnets\ = lA = 1.9cm \times 0.7cm^2 = 1.3cm^3$

$Gasoline\ mass\ of\ volume\ comprised\ between\ magnets = m_G = vd_G = 0.88\ g$

$U_H = 4.26 \times 10^{-24} \text{J} = maximum\ energy\ per\ atom$

$N_{18} = Number\ of\ Hydrogen\ atoms\ per\ gasoline\ molecule$

$N_{12} = Number\ of\ more\ stable\ Hydrogen\ atoms\ per\ gasoline\ molecule$

Calculations

From equations (1) and (2) it is found: (6) $\frac{B^2}{2\mu} = \frac{\mathrm{U_B}}{v}$

Replacing U_B in (6) for his value given in equation (5) it is found: (7) $\frac{B^2}{2\mu} = 18\ \frac{m_G}{M_G}\frac{N_0 U_H}{v}$

With (8) $\frac{m_G}{M_G} = \frac{0.88g}{114g} = 7.7 \times 10^{-3}$

Then (9) $B = \sqrt{\left(36\mu \times 7.7 \times 10^{-3} \times \frac{N_0 U_H}{v}\right)} = B = \sqrt{\left(0.277\mu \times \frac{N_0 U_H}{v}\right)}$

$$B = \sqrt{\frac{0.277 \times 4\pi \times 10^{-7} \frac{Tm}{A} \times 10^6 \times 6.02 \times 10^{23} \times 4.26 \times 10^{-24}\ j}{1.3 \times m^3}} = \sqrt{0.68}\ \mathrm{T} = 0.82\ \mathrm{T}$$

When using (8) as $\frac{B^2}{2\mu} = 12\ \frac{m_G}{M_G} \frac{N_0 U_H}{v}$, it is found:

$$B = \sqrt{\frac{0.185 \times 4\pi \times 10^{-7} \frac{Tm}{A} \times 10^6 \times 6.02 \times 10^{23} \times 4.26 \times 10^{-24}\ j}{1.3 \times m^3}} = \sqrt{0.45}\ \mathrm{T} = 0.67\ \mathrm{T}$$

It is a high B for maximum μ_B . If we consider only 10 hydrogen atoms per molecule, then we can lower that field magnetic induction to 0.62 gauss. The closer approximation to this value can be obtained with a couple of commercial magnets, 3250 gauss each, for a total induction B=6500 gauss. It could still be a B to get the effects we want. It is necessary to check it with the test results. For the Renault car leaded to excessive CO2 emissions, as it will be shown.

4. Objective: Based on theoretical and experimental knowledge, the main goal is to guide a MEB minimizer design, reinforcing the ideas explained in RTESE´20 145 and 149 papers.

5. Measurements:

5.1 2018 Measurements 2018

A car Hyundai Model 2012 was tested, with two Single Day Tests; without and with de device installed, after traveling 6 -7 Km. Carbon monoxide (CO) and hydrocarbons (HC) emissions results were obtained, under NTC 5375, from an ADC gas analyzer in the city of Cartagena, Colombia, using standard gasoline.

5.2 2019 Measurements.

A Renault car was tested with two Single Day Tests; without the device and with the device installed, after traveling 6-7 Km Carbon monoxide (CO) and hydrocarbons (HC) emissions results were obtained from a gas analyzer in the private auto mechanic workshop, Mekanos, in the city of Cartagena, Colombia, using standard gasoline.

6. Single Day Tests

6.1 Units Used for Tests Both without pretreatment

Fig 2. Magnetic Unit built for laboratory experiments (prototype)
Fig 3. Magnetic Unit Built in Cartagena by Mekanos Workshop

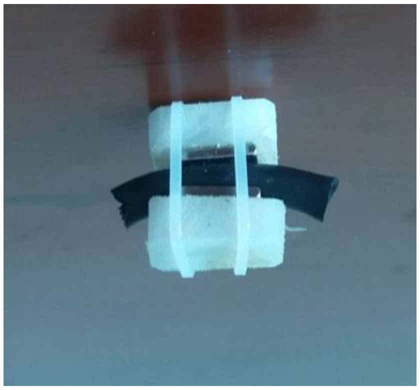

Fig 2: Unit Used for 2018 Tests

Fig 3: Unit Used for 2019 Test

6.2 Tests Results

Tests results were arranged according to tables 1 and 2 respectively.

Table 1. Results of Single Day Tests
Using Magnetic unit (Prototype) in a Hyundai car

Emissions	Hyundai Model 2012	
	Initial	Final
HC((PPM)	24	21
CO_2(%)	14.1	14.2
CO(%)	0.19	0.06
O_2(%)	0.31	0.31
Drive (Km)	0	6
Mileage (Km)	70000	70006
Magnetic Induction B= 6500 Gauss		

Table 2. Results of Single Day Tests
Using Magnetic unit (Prototype) in a Renault car

Emissions	Renault 2012	
	Initial	Final
HC((PPM)	28	2
CO_2(%)	12.1	13.3
CO (%)	0.32	0.00
O_2(%)	2.19	1.85
Drive (Km)	0	6
Mileage (Km)	24351	24357
Magnetic Induction B= 6500 Gauss		

7. Conclusions

According to the analysis of the results from Table 1 it is found that the prototype allows to meet the international standards for CO and HC emissions, with respective reductions of 68.4% and 12.5%, and 0.7% of CO_2 emissions concentrations increase for **Single Day Tests,** in the Hyundai car. According to analysis of the results from Table 2 the prototype allows to meet the international standards for CO and HC emissions, with respective drastic reductions of 100 % and 93%, and a considerable increase of 10% in CO_2 emissions concentrations. When this increase is compared with the correspondent 0.7% of car from Table 1, it is found that CO_2 emissions concentration increase for the Renault, using a device with magnetic the same induction **B** of 6500 Gauss, is about 14 times higher than for the Hyundai car. All this allows to conclude, as follows:

1. According to the analysis of the results from Table 1, it is found that the magnetic minimizer of 6500 gauss, installed in the Hyundai car is efficient to reduce CO and HC emissions with a low increase of CO_2 emissions for **Single Day Test.** Consequently, CO and HC emissions reductions are **suitable,** and the device behaves as a **MEB**.

2. According to the analysis of the results from Table 2, it is found that the magnetic minimizer of 6500 Gauss, installed in the Renault car is highly efficient to reduce CO and HC emissions obtaining drastic reductions but, a considerable increase of CO_2 emissions concentrations in 10% for **Single Day Test.** Consequently, for the Renault car, the magnetic minimizer with the same magnitude **B** of 6500 Gauss, gives rise to **unsuitable** CO and HC emissions reductions and the device does not behave as a **MEB**.

3. The previous conclusions confirm as a fact that CO and HC emissions cannot be reduced at will without increasing CO_2 emissions beyond the international commitments. [24] generally, a decrease in CO leads to an increase in CO_2 emissions [25], [26]. The chemical redox reaction of gasoline combustion limits and controls reductions of CO and HC in relation with CO_2 increases.

4. The design of a proper magnetic minimizer is a process that does not necessarily end with determination of magnetic induction B but one or more correlated test to fix the most precise and proper value of B, as was explained in papers to RTESE´18 [27] and RTESE´20 [1] where the procedure, in general terms was outlined as:

Initial Dimensioning of prototype→ Prototype Test→ dimension Adjustment and Tests if needed→ Final iterative dimensioning process as needed

5. Results and conclusions suggest regulations policies for limiting reductions of CO and HC emissions from transport sector, when using any minimizer device or procedure. This would make easier the global reduction of CO_2 emissions concentrations and help transport sector decarbonization. It is emphasized that regulations are not about standards maximum limits of CO, HC, and other pollutants concentrations. They are about maximum allowed reductions of CO, HC, and other pollutants emissions concentrations, using **MEB** minimizers or any other device or procedure. [28]

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