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Gasoline combustion process under strong DC magnetic field

Grimaldi S°

Institute of Neurobiology and Molecular Medicine CNR Rome Italy

Abstract

Since Faraday, it has been well known that combustion are affected by magnetic field. One magnetic effect is caused by Lorentz force acting on charged particles , the other is a force acting on paramagnetic chemical species present during combustion.
The question of weather magnetic fields affect combustion processes or not is of considerable interest in fuel engineering and biomagnetics. Combustion is oxidation reaction which involves both burning with flames in the air and cell respiration in the living bodies. In the present work the effect of strong DC magnetic field on combustion of gasoline are studied.

Introduction

The effect of electric fields on combustion is well established [1, 5]. However, few studies have been conducted about the effect of magnetic fields on combustion, and the fact that magnetic fields can influence combustion was first realized over one hundred and fifty years ago. As early as 1846, Faraday applied a magnetic field to a flame on a wax taper and observed its tendency to form an equatorial disc [3,]. He also found that the flames were more luminous when placed in an external magnetic field. Faraday attributed the change in the flame shape to the presence of charged particles in the flames interacting with the magnetic fields. Later, researchers found that the interaction between flame ions and the magnetic fields were much too small to cause the flame deflection.
Von Engel and Cozens [4] showed that the change in the flame shape could be attributed to the diamagnetic flame gases in the paramagnetic atmosphere. The changes in the flame behavior were attributed to a pressure gradient caused by the difference in magnetic permeabilities.
Over the past twenty years there has been a renewed interest in this area. Much research on the relation between combustion and magnetic fields has taken place in Japan. The nature of the studies has varied over a wide range, such as the influence of the magnetic fields on advancing gas flows, combustion reactions in premixed and diffusion flames, emission intensities of various radicals observed in flames, material synthesis and separation, and an extension of similar studies on these systems under a micro-gravity environment.
Recent studies [6-7, 9-17, 19-20] have shown that inhomogeneous magnetic field causes a significant effect on advancing gas flows and in chemical reactions. Flow of gases such as carbon dioxide, nitrogen and argon were observed to be blocked or perturbed when they traveled in the direction of a magnetic field of increasing strength, while a mixture of oxygen and aqueous aerosol has been found to be attracted towards a stronger field and behave as a magnetic fluid [6, 10-12, 14]. Various theories have been proposed regarding the possible reasons for the observed behavior. Nevertheless, the observed effects have primarily been attributed to the diamagnetic and paramagnetic nature of the gases involved. Diamagnetic materials develop a net dipole moment in the presence of an external magnetic field which opposes the applied field and the degree of repulsion increases with the strength of the applied magnetic field. Whereas, paramagnetic material such as molecular oxygen, possess randomly oriented dipole moments that align with the applied

magnetic field and thus experience a weak attraction towards the applied field. Most gases such as carbon dioxide, nitrogen, hydrocarbons such as methane, butane, propane and the products of combustion are diamagnetic in nature and are repelled by an applied magnetic field while oxygen and air being paramagnetic in nature are attracted towards the applied magnetic field. Thus, initial studies proposed that the magnetic field concentrated the oxygen molecules within the air 8 gap of the magnets and this trapped oxygen gas exerted a force on all other gases.

Results and discussion

In the present work the effect of strong DC magnetic field on combustion of gasoline are studied. A device constitute of two sets of face to face several permanent magnets (Ageostan BS Italy) assembled in a nord sud fashion were made. In the channel between the two device the magnetic field were uniform and the intensity were 2T. Since gasoline can contain up to 2% of water, in a first set of experiments gasoline were run into the device, with the aim to detect if magnetic field could destabilize water emulsion from gasoline and consequently let water to separate from the combustible.

200 milliter of gasoline were run thru the magnet at constant speed of 200 milliter per hr and water content analyse by infrared spectroscopy. No differences in water content between magnets treated gasoline and untreated gasoline was reported.

In a second set of test the device were applied on an Euro 2 engine and car were run under strictly controlled condition in a subsequent test the same car with the same engine were run at the same constant speeds (80 Km/hr) and the result corrected for weather data (temperature, pression, umidity, wind). Each test (for a total of four set of tests) were run for exactly 400 Km. At the end of each run emission test for gasoline vehicle (MVEG) were performed.

Results demonstrate that on the Euro 3 (Tab.1)engine (equipped with magnets a decrease up to 16% of NOx and up to 9 % of particulate (PM) was detected, together with 1.4% fuel economy. A completely different results were obtained when de magnetic device were mounted on an Euro 2 engine (Tab.2).

Final remarks

NOx are known to be mainly formed at high temperature in a non efficient combustion.

Despite from the decrease in NOx formation obtained by gasoline treatment with magnets in the Euro 3 engine, is possible to argue, that the magnetic field is improving gasoline combustion, unfortunately the results obtained with the magnetic treatment on the Euro 2 engine indicate little effect on magnetic field on gasoline combustion.

Tab. 1

Euro 3 engine

HC [g/km]	**CO** [g/km]	**NOx** [g/km]	**CO2** [g/km]
-28,75%	**-7,54%**	**-16,05%**	**0,95%**

Tab. 2

Euro 2 engine

HC [g/km]	**CO** [g/km]	**NOx** [g/km]	**CO2** [g/km]
-4,10%	**-0,58%**	**1,31%**	**-1,15%**

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