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Studies on the New Fuels with Santilli Magnecular Structure and Their Industrial Applications

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Abstract. Professor R. M. Santilli, the Italian-American physicist, for the first time in the history of Science, presented the theoretical and experimental evidence on the existence of the new chemical species of “magnecules" [1]. This new species mainly consist of individual atoms, radicals and conventional molecules bonded together with stable clusters under the new attractive force primarily originating from torroidal polarization of orbitals of atomic electrons under strong magnetic field. The main contribution in this area was the production of Magnegas^{TM}, new clean fuels developed by Prof. Santilli, which are produced as byproducts of recycling nonradioactive liquid feedstock such as antifreeze waste, engine oil waste, town sewage, crude oil, etc., and generally vary with the liquid used for their production. A new technology, called Plasma Arc Flow^{TM}, flows the waste through a submerged electric arc between conventional electrodes. The arc decomposes the liquid molecules into their atomic constituents, and forms a plasma in the immediate vicinity of the electrodes at about $10{,}000^0$ F. The technology then moves the plasma away from the electrodes, and controls its recombination into environmentally acceptable fuels. In fact, the exhaust of magnegases shows: absence of carcinogenic or other toxic substances; breathable oxygen up 14 percent; and carbon dioxide down to 0.01 percent. Since, in addition, the new fuels can be produced everywhere, and have environmentally acceptable exhausts, Magnegases offer promising possibilities to satisfy our ever increasing energy needs, as well as to contain the alarming environmental problems caused by fossil fuels. Thus, it was thought worthwhile to present some of the industrial applications of environmentally benign fuel consisting magnecular bonds [2, 3, 4, 5]. Also in the present communications, some of the experimental evidences of Santilli’s new chemical species i. e. Magnecules which had been published recently have been summarized [6, 7, 8].

Keywords: Magnecule, MagneGas, MagneHydrogen, Torroidal polarization, Cplex-isoelectronic theory.
PACS: 82.80Ha, 07.55Db, 21.10Dr

HISTORIC BACKGROUND

In memoir [1] of 1998, the Italian-American physicist R. M. Santilli presented mathematical, theoretical and experimental evidence on the existence of the new chemical species of “magnecules" defined as clusters of individual atoms (H, O, C, etc.), diatomic radicals (HO, CH, etc.) and ordinary molecules (H_2, CO, H_2O, etc.) bonded together by attractive forces between opposing magnetic polarities of torroidal polarizations of atomic orbitals, as well as the polarization of the magnetic moments of nuclei and electrons. Santilli suggested the name “magnecules" in order to distinguish the new species from conventional “molecules". The symbol “−" is widely used to denote a valence bond (such as H-H) while the symbol “×" is used to denote a magnecular bond (such as H × H). The main theoretical argument of Ref. [1] is that the torroidal polarization of the electron orbitals creates a magnetic field (due to the rotation of the electrons within said toroid) which does not exist for the same atom when the electron orbitals have the conventional spherical distribution. When two so polarized atoms are at a sufficiently close distance, the resulting total force between the two atoms is attractive because all acting forces are attractive except for the repulsive forces due to nuclear and electron charges. However, the latter forces can be averaged to zero in first approximation since the individual atoms have a null total charge. Memoir [1] also provided considerable experimental evidence for the existence of magnecules in liquids, and comments on the expected existence of magnecular bonds in solids.

Aringazin [9, 10, 11] on the Schrodinger equation of the hydrogen atom under a strong, external, static and uniform magnetic field ($B \gg B_0 = 2.4 \times 10^9$ Gauss) have confirmed the torroidal configuration of the electron orbits are crucial for the existence of the new chemical species of Magnecules, in agreement with that studied by Santilli. This physical picture is at the foundation of the new chemical species of magnecules proposed by Santilli. As a result of the action of a very strong magnetic field, atoms attain a great binding energy as compared to the case of zero magnetic field. In their studies, they have provided the mathematical formulations of modified Coulomb potential approach provides qualitatively correct behavior and suggests *a single Landau-type orbit* shown in Fig. 1 for the ground state

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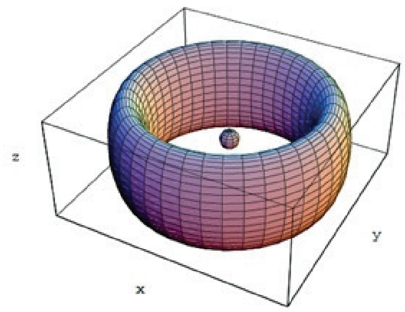

FIGURE 1. Schematic view of the hydrogen atom in the ground state, at very strong external magnetic field $\overline{B} = (0, 0, B)$, $B \gg B_0 = 2.4 \times 10^{-9}$ Gauss, due to the modified Coulomb approximation approach. The electrons moves on the Landau orbit of small radius $R_0 \ll 0.53 \times 10^{-8}$ cm, which is shown schematically as a torus. The vertical size of the atom is comparable with R_0. Spin of the electron is aligned antiparallel to the magnetic field.

charge distribution of the hydrogen atom. This is in full agreement with Santilli's study of the hydrogen atom in strong magnetic field.

Some of the important properties of magnecules include: increased energy density; increased energy output under thermochemical reactions; and other properties. Consequently, the new chemical species of magnecules has new industrial and consumer applications; the advancement in this area has been discussed briefly in the following section.

APPLICATIONS OF MAGNECULES

MagneGas^{TM}: In 2001, Santilli released monograph [2] in which the first industrial realization of the the new species of magnecules consisting of the gaseous fuel produced and sold worldwide under the trade name of MagneGas^{TM} (MG) by the U. S. publicly traded company Magnegas Corporation (see *www.magnegas.com*) was provided in detail. Plasma Arc Flow reactor use a submerged DC arc to achieve complete recycling of liquid waste into a clean burning combustible gas called MG, heat usable via exchangers, solid precipitates. Such kind of highly efficient and cost effective flow reactor was suitable to recycle antifreeze waste, oil waste, sewage and other contaminated liquids. The first application of MG is its use as a new clean fuel for automobile. When exhaust of MG was tested, interestingly it surpasses all EPA requirement even without catalytic convertor, emits no carcinogenic, CO or other toxic chemicals, reduced the CO_2 emission due to combustion of gasoline by about 40 percent, and emits 14-20 percent breathable oxygen. In the same monograph, the second very important application of MG depicted was in the metal cutting industry, wherein it was found that MG cuts the metal much smoother, without edges and at least 50 percent faster than conventional acetylene.

MagneHydrogen^{TM}: In a paper from 2003, R. M. Santilli [3] presented theoretical and experimental evidence on the existence of a new species of Hydrogen .i. e. he called MagneHydrogen. It was found that the prepared gas apparently consists of 99 percent Hydrogen, although spectroscopically its specific weight (or, equivalently, molecular weight) was estimated to be 7.47 times larger than that of conventional Hydrogen. The gasification is achieved via a submerged DC electric arc between carbon electrodes that, under sufficient powers (of the order of 300 kW or more) is capable of producing at atomic distances the high values of the magnetic field (estimated as being of the order of 10^{12} Gauss). Santilli obtained the new species MH via the use of conventional Pressure Swing Adsorption (PSA) equipment for the separation of Hydrogen from MG. From an industrial point of view, it is very important to be noted that, it is sufficient to achieve a species of MH with at least 3.3 times the specific weight of H_2 to have the same energy content of 1000 BTU/scf of Natural Gas (NG). In fact, under said conditions, MH would avoid the current needs to liquefy Hydrogen in order to achieve a sufficient range, since MH can be compressed like NG. Additionally, the magnecular structure of MH avoids the traditional seepage of Hydrogen through the walls [12], thus allowing long term storage that is currently prohibited by molecular Hydrogen due to current environmental laws.

Aquygen^{TM} gas: Santilli then provided in Ref. [4] of 2006 theoretical experimental evidence on a third industrial application of the new species of magnecules, here referred to the gas commercially produced via certain electrolyzers and essentially consisting of 2/3 Hydrogen and 1/3 Oxygen, which contains a small percentage of H and O magnecular

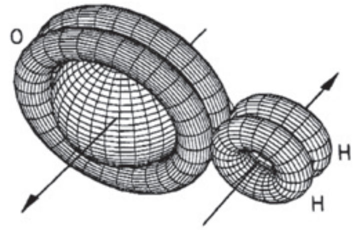

FIGURE 2. A conceptual rendering of the H-O-H molecule in which all electric polarizations have been removed, with the consequential collapse of the two polarized H-atoms one into the other due to their neutral charge and strongly attractive opposing magnetic polarities [4].

clusters. Under these conditions, Santilli suggested in Ref. [4] the name of HHO (although a similar gas produced via a different electrolyzer is known as Brown's gas). American company Hydrogen Technology Applications, Inc., which company is the owner of all intellectual rights and is currently producing and selling the HHO gas (Fig. 2) on a world wide basis under the commercial name of Aquygen^{TM}. Aquygen^{TM} gas supplements standard vehicle fuels such as gasoline and diesel, increasing BTUs while decreasing emissions. Aquygen^{TM} gas can also replace conventional soldering, brazing and cutting gases for use with standard equipment and techniques while producing superior results at less cost with no oxidation, no burn back, and minimal slag and, Aquygen^{TM} gas gives off no toxic fumes.

Cplex-isoelectronic theory : pericyclic chemistry and aromaticity: M. O. Cloonan presented in Refs. [13, 14], applications of Santilli magnecules and its underlying hadronic chemistry to particular forms of pericyclic reactions and related new structures using Cplex-isoelectronic theory. The Cplex-isoelectronic theory of pericyclic chemistry and aromaticity is in line with the old electronic theory of Robinson and Ingold , thus illustrating the expected capability of the new species of Santilli magnecules to produce new chemical substances (i.e., chemical substances not entirely based on valence bonds).

RECENT EXPERIMENTAL CONFIRMATIONS OF MAGNECULAR STRUCTURE

Yang *et al.* [6] recently published important research papers in which the experimental confirmation of new chemical species of MagneHydrogen^{TM} has been reported. The first independent experimental verification of the new species of Santilli MagneHydrogen was achieved via the use of a VSA station for the separation of MH from MG, the use of a GC-TCD for the measurement of the percentage of Hydrogen in the separated gas, and the use of conventional methods for the measurement of molecular weight. Experimentally it was confirmed that MH posses about 97.5 percent pure Hydrogen, while having 3.89 times the specific weight of H_2, and a consequential energy content of 1167 BTU/scf. The second experimental verification of Santilli MagneHydrogen was achieved using a Vacuum Swing Adsorption (VSA) for the separation of MH from MG, and GC-TCD for the measurement of the conventional Hydrogen content, and a highly accurate balance for the measurement of the molecular weight of MH. It was established that the above identified species has the molecular weight of 2.71 a.m.u., thus being 35 percent heavier than conventional Hydrogen [8]. The conceptual structures of some of the heavier species consisting of magnecular structure has been depicted as below in Fig. 3. The theoretical confirmation of MagneHydrogen consisting individual hydrogen atom bonded together and having stable clusters under a new internal attractive forces originating from the torroidal polarization of orbitals of atomic electrons when placed in strong magnetic fields has been done by Zodape and Bhalekar [15, 16] recently. The additional experimental confirmations of the new species of Santilli magnecules as presented in the original memoir [1] of 1998 has been recently published by Yang *et al.* [7]. Some important results on the basic of their studies are as follows:

1. Magnecules consists of weakly bonded individual atoms, dimers, and conventional molecules; and are stable at ambient temperature;
2. Magnecules progressive reduced with the increase of the temperature; and termination of magnecular structure at a suitable Curie temperature;
3. Magnecules shows anomalous adhesion to disparate materials; etc.

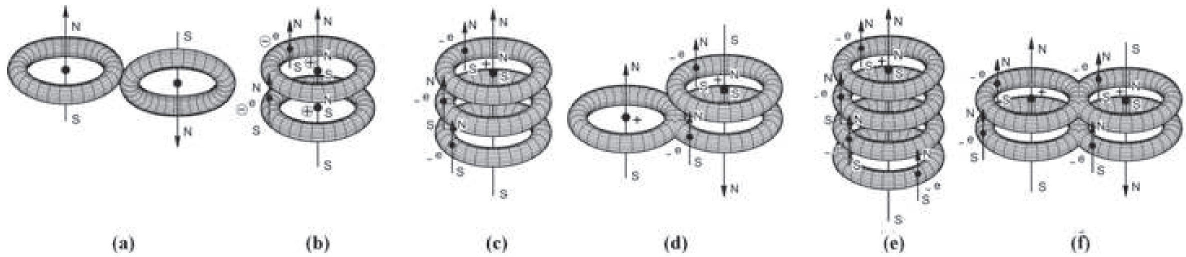

FIGURE 3. A conceptual rendering of the cluster MH_2 in which MH is predicted as being composed by part of the molecular species H-H (**a**) and part by the magnecular species H×H (**b**); the cluster MH_3 in MH which is predicted as being composed by magnecular species H×H×H (**c**) and H-H×H (**d**); the cluster MH_4 in MH which is predicted as being composed by the magnecular species H×H×H×H (**e**), H-H×H-H (**f**) and H-H×H×H (not shown for simplicity).

The new kind of clean source of energy having lot of potential to solve energy crises is of nuclear type develop through hadronic mechanics/chemistry [17]. Beside the pioneering work of Prof. Santilli in the field of hadronic mechanics/chemistry, now-a-days many scientist are working on the applications in this field [18, 19, 20].

CONCLUDING REMARKS

Fuels synthesized under intense electric and magnetic fields can indeed release energy in larger amounts than conventional molecules. The experimental confirmations of MGF exemplify a revolution in the sector of sustainable, efficient, and clean fuels that do not emit harmful toxins or radioactive waste. These intriguing discoveries have a significant degree of application potential in the industrial and technological sectors and, if properly implemented, may have a profoundly beneficial impact. Since, in addition, the new fuels can be produced everywhere, and have environmentally acceptable exhausts, magnegases offer serious possibilities to satisfy our ever increasing energy needs, as well as to contain the alarming environmental problems caused by fossil fuels.

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