# A STUDY OF POLYCARBONYL COMPOUNDS IN MAGNEGASES

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### Abstract

In this paper we study the structure and thermochemical proper-
ties of some new polycarbonyl compounds, with particular attention
devoted to the study of $(CO)_n$ complexes, which are expected to be
present in magnegases$^{TM}$. The latter are anomalous gases produced
by *Hadronic Reactors$^{TM}$ of molecular type* [2] (Patented and Interna-
tional Patents Pending) which expose atoms to the extremely intense
electronmagnetic fields existing at atomic distances from electric arcs
in such a way to create a toroidal distribution of the orbitals of indi-
vidual atoms, whether isolated or part of a valence bond. Polarized
atoms, dimers and molecules then attract each other via opposing
magnetic polarities resulting into stable clusters which constitute a
new chemical species called *Santilli's magnecules* [2]. Some of the nu-
merous open problems in the study of this intriguing new chemical
species are pointed out.

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# 1 Introduction

In a recent paper [1], we overview the new chemical species of *Santilli's magnecules* [2, 3] which has been observed in magnegases$^{TM}$, the new gas produced by Hadronic Reactors$^{TM}$ of Molecular type, also called Plasma-ArcFlow Reactors$^{TM}$ (Patented and International Patents pending).

One of the hypotheses on the origin of bonds between diatomic molecules in magnecules is that atomic orbitals are polarized into a toroidal distribution when under the influence of very strong external electromagnetic fields as available at atomic distances in PlasmaArcFlow$^{TM}$ reactors. In this way, individual polarized atoms attract each other via opposing magnetic polarities. Therefore, the magnetic polarization and related bond here considered exist even for diamagnetic molecules such as $H_2$ [2].

The isochemical approach developed by Santilli and Shillady [2, 3] has been used to study diatomic molecules [4, 5, 6, 7], in order to extend the standard quantum chemical framework, and to achieve better numerical results on their ground state energies and bond lengths. This Santilli-Shillady isochemical model of diatomic molecules uses additional short-range attractive two-parametric Hulten potential interactions between valence electron pairs which is assumed to be due to nonlinear, and other effects originating in the deep overlapping of wavepackets of atomic electrons in their singlet valence bond at short distances. The attractive Hulten potential leads to a specific correlation between two electrons called isoelectronium [2, 3]. The isoelectronium correlations may be responsible for the anomalous magnetic moments of the molecules, and thus for the specific bonds in magnecules.

Recent results on two-dimensional two-electron quantum tunnel effects with dissipation applied to diatomic H-H system [8] support the isoelectronium-like correlation between two electrons, in the two-dimensional case. Consequently, we expect that isoelectronium-like correlations between the electrons due to the isochemical approach and to the tunnel effects can give an important contribution to the bonds between molecules in magnecules.

In addition to the main hypothesis of magnecules, it is instructive to analyze some other possible compounds which may be present in magnegases that could have a kind of conventional *polycarbonyl* structure. Since the mass-spectra of magnegases$^{TM}$ have not been identified as known compounds among about 130,000 chemical species, we conclude that the detected high mass species might be of some *unusual* types of polycarbonyl compounds,

which are absent in computer database of the mass-spectrometer. Noting that most of extensively studied aldehydes and ketons (hydrocarbonates containing C=O group) are *liquids* at room temperatures it is quite natural that they are not present in magnegases$^{TM}$ in a big percentage. So, we are led to consider those carbonyl compounds which are expected to be *gases* at room temperatures.

In the present paper, we focus on some polycarbonyl compounds and their complexes which may be present in magnegas. An important note is that we do not study the origin of the specific bonds in magnecules that can be made elsewhere. Instead, we study some compounds formed by typical bonds. Consequently, our consideration is an attempt to identify chemical structures of some components of magnegas within the framework of typical chemical bonds. Clearly, such a consideration is helpful in identifying real structures of magnegas, since one can compare properties of the polycarbonyl compounds to currently available experimental data on magnegases$^{TM}$. We believe that such a consideration is a necessary step toward the unraveling of the intriguing features of magnegas.

Moreover, the structure of the polycarbonyl compounds studied in this paper can be taken as a basis for the study of more general magnecules. The fact that one of the suggested structures of magnecules, $CO \times CO \times \cdots \times CO$ [2], where $\times$ denotes a (magnetic) bond and CO is carbon monoxide, is known in practical chemistry, carbon monoxide complex $(CO)_6$, serves us as a strong *experimental* ground to focus on the polycarbonyl compounds. Another interesting experimental fact is that some polycarbonyl compounds are known to be *gases*, at room temperatures, so that they can be present in magnegases$^{TM}$.

In Sec. 2 we present some examples of polycarbonyl compounds. In Sec. 3, we study the structure and combustion of $(CO)_n$ complex. In Sec. 4, we consider possible hydrogen bonds between $(CO)_n$ complexes. In Sec. 5, we consider some other possible types of polycarbonyl compounds. In Sec. 6, we briefly outline the properties of the carbonyl C=O bond which are helpful in understanding of the behavior of polycarbonyl compounds under the influence of external electromagnetic field.

Our general remark is that the term "polycarbonyl compound" can be treated in a rather general form, without specifying the character of some bonds (conventional, or unconventional), but stressing only the presence of several C=O groups. Indeed, even the bond between C and O in the mag-

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necules CO×CO× · · · ×CO [2], could not be of a conventional type, with some electronic effects playing an important role with interesting properties.

## 2    Some examples of polycarbonyl compounds

We start by some characteristic examples of polycarbonyl compounds, i.e. the compounds containing several carbonyl groups C=O.

Cobalt hydrocarbonyl, $HCo(CO)_4$, containing both H and CO, is a gas, at room temperatures. Such type of a compound is known as somewhat unusual because a neutral metal is bonded to carbon monoxide CO, which mostly conserves its own properties. Another example is magnesium carbonyl, $(CO)_5-Mn-Mn-(CO)_5$ (melting point is 66$^o$C), where the bond Mn−Mn is about 40 kcal/mol. Also, it is interesting to note that nickel carbonyl, $Ni(CO)_4$, shown in Fig. 1, formed from Ni and CO at $T = 80C$, is a gas at room temperatures, and dissociates, $Ni(CO)_4 \rightarrow Ni + 4CO$, at $T = 200C$.

$$
\begin{array}{c}
C \\
\| \\
O \\
| \\
C=O - Ni - O=C \\
| \\
O \\
\| \\
C
\end{array}
$$
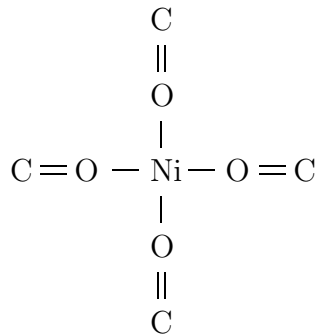
Figure 1: $Ni(CO)_4$. Dissociation of this gas, $Ni(CO)_4 \rightarrow Ni + 4CO$, occurs at temperature $T = 200^oC$.

Thus, the binding energy of the bond between Ni and each CO is about 30 kcal/mol, which is within the range given by the estimation [1],

$$B[magnecule] > 25...30 \text{ kcal/mol}, \tag{1}$$

of the average binding energy between the molecules in magnecule. In general, various carbonyl compounds can be produced from, e.g., some glicoles

(containing the group -C-OH).

As mentioned in ref. [1] there is a case in which an explosive compound, potassium carbonyl, $6CO + 6K \rightarrow K_6(CO)_6$, is produced. Such a compound is used to obtain unusual carbon monoxide (carbon monoxide complex), $(CO)_6$. This compound is believed to exist due to a polymerization, namely, the structure $(CO)_6$ is thought as being given by a sequential joining of separate CO (monomers) to a linear chain of CO molecules (polymer) owing to the C-C bonds.

# 3 $(CO)_n$ complex

## 3.1 Structure

In Fig. 2 we present a linear chain of CO molecules (polymer) as a possible structure of $(CO)_6$.

$$
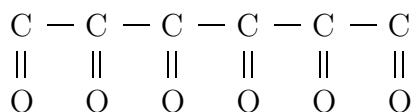\begin{array}{cccccccccccc}
C & - & C & - & C & - & C & - & C & - & C \\
\| & & \| & & \| & & \| & & \| & & \| \\
O & & O & & O & & O & & O & & O
\end{array}
$$

Figure 2: Possible polymer structure of $(CO)_6$ complexes.

Owing to C-C bonds, a typical polymerization, e.g., of propylene, $CH(CH_3)CH_2$, is characterized by binding energies of about 73...83 kcal/mol, with the reaction heat of about $\Delta H = -20$ kcal/mol per each molecule of the linear chain of polypropylene.

We see that the typical value of the binding energy of $C-C$ is much bigger than 30...35 kcal/mol. However, some other types of intermolecular interaction between CO can also make a contribution here because of the specific electronic structure of CO molecule, and the real structure of $(CO)_6$ may be *different* from that shown in Fig. 2. So, we could expect lower values of the binding energy between CO molecules in $(CO)_6$, recalling that the above mentioned $Ni(CO)_4$ dissociates at $T = 200C$.

Also, it is known that in tricarbonyl compounds (see Fig. 3), the central carbonyl group C=O is highly reactional since it is weakly bonded to the two

neighbor C=O groups, and it can be easily decarbonylized (releasing of the central C=O group as carbon monoxide gas) by using catalysis with, e.g., AlCl$_3$. For the same reason the central carbonyl group C=O in tricarbonyl compounds easily reacts with water, becoming the HO-C-OH group due to the reaction C=O + H$_2$O → HO-C-OH.

$$R - C - C - C - R'$$
$$\parallel \quad \parallel \quad \parallel$$
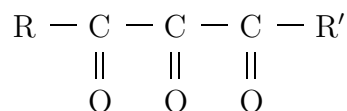$$O \quad O \quad O$$

Figure 3: A view of Tricarbonyl compounds.

It is important to note that there may be also *cyclic* polycarbonyl structures (with all C atoms single bonded to each other to form a circle) which are characterized by higher stability than the linear ones so they could be either gas or liquid, at room temperatures.

## 3.2 Combustion

We should note that the bond C=O in $(CO)_6$ evidently is weaker than its counterpart in a single carbon monoxide C=O. Moreover, some energy is related to a dissociation of $(CO)_6$ to 6CO.

In general, this could lead to a different value of the combustion reaction heat of $(CO)_6$ per CO molecule. Namely, the reaction

$$(CO)_6 + 3O_2 \rightarrow 6CO_2 \tag{2}$$

could give a different value of the reaction heat $\Delta H$ than that of the reaction

$$6CO + 3O_2 \rightarrow 6CO_2. \tag{3}$$

Below, we make a crude estimate by taking the average value of the binding energy of C=O bond in Fig. 2 equal to that in ketons, 179 kcal/mol (see Table 1), since most ketons are characterized by carbonyl group bonded to two C atoms as schematically shown in Fig. 4.

We assume also that each C-C bond in Fig. 2 requires 82.6 kcal/mol (see Table 1). There are five bonds C-C in Fig. 2 so we have 5×82.6=413 kcal/mol.

| Diatomic molecules | | Diatomic molecules | |
|---|---|---|---|
| H–H | 104.2 | C=O | 255.8 |
| O=O | 119.1 | $N \equiv N$ | 225.8 |
| Manyatomic molecules | | Manyatomic molecules | |
| C–O | 85.5 | O–H | 110.6 |
| C=O in $CO_2$ | 192.0 | O–O | 35 |
| C=O in formaldegide | 166 | C–H | 98.7 |
| C=O in aldehydes | 176 | C–C | 82.6 |
| C=O in ketons | 179 | C=C | 145.8 |
| C=N | 147 | C≡C | 199.6 |

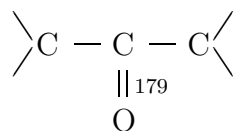Table 1: Average binding energies, kcal/mol [9]. $T = 25C$.
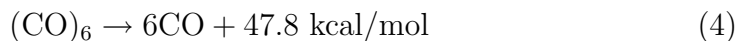


Figure 4: Carbonyl group C=O in ketons.

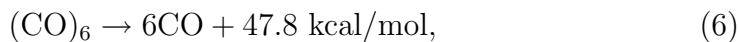There are six C=O bonds in Fig. 2 so we have 6×179 = 1074 kcal/mol. On the other hand, six separate $C = O$ molecules have in total 6×255.8 = 1534.8 kcal/mol due to their bonds. Hence, the balance is 415+1074-1534.8=-47.8 kcal/mol, and the dissociation

$$(CO)_6 \rightarrow 6CO + 47.8 \text{ kcal/mol} \tag{4}$$

appears to be an exothermic reaction, with about 47.8/6 ≃ 8 kcal/mol per each CO. This conservative estimate shows that carbon monoxide gas consisting of $(CO)_6$ complexes might give bigger energy release than that of the carbon monoxide gas consisting of separate CO molecules. Namely, instead of the reaction

$$CO + O_2/2 \rightarrow CO_2 + 68.7 \text{ kcal/mol}, \tag{5}$$
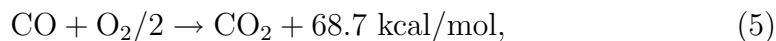
for the case of $(CO)_6$, we consider the sequence

$$(CO)_6 \rightarrow 6CO + 47.8 \text{ kcal/mol}, \tag{6}$$

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$$CO + O_2/2 \rightarrow CO_2 + 68.7 \text{ kcal/mol}, \tag{7}$$

which effectively could give $68.7 + 8 = 76.8$ kcal/mol per CO, instead of 68.7 kcal/mol, i.e. about 12% bigger heat released.

It is a consequence of the existence of $(CO)_6$ that there might exist lower and higher mass carbon monoxide complexes, $(CO)_n$, with $n = 2, 3, 4, \ldots$ For the general case of dissociation of conceivable $(CO)_n$ complexes of linear type depicted in Fig. 2,

$$(CO)_n \rightarrow nCO, \tag{8}$$

the dissociation energy per produced CO molecule thus is

$$\Delta H = \frac{1}{n} \left(82.6(n-1) + 179n - 255.8n\right) = 5.8 - \frac{82.6}{n} \text{ kcal/mol}. \tag{9}$$

It is interesting to note that this energy is about zero for $n = 14$, i.e. there appears to be no considerable difference in calculated combustion heat between the conceivable $(CO)_{14}$ gas and usual CO gas.

The above estimate can be formulated in terms of the binding energies $B[\text{C-C}]$ and $B[\text{C=O}]$, to get a general expression of the average dissociation energy of linear $(CO)_n$ ($n \geq 2$) per each CO,

$$\Delta H = \frac{1}{n}(B[\text{C} - \text{C}](n-1) + B[\text{C} = \text{O}]n - 255.8n) \text{ kcal/mol}, \tag{10}$$

where presently unknown precise values of $B[\text{C-C}]$ and $B[\text{C=O}]$ in the linear $(CO)_n$ complex can be evaluated from theory or experiment.

In fact, in the presence of one $C = O$ group the above C-C bond is known to be much weaker than the above used average value 82.6 kcal/mol, namely, $B[\text{C-C}] = 73$ kcal/mol. So the estimations (4) and (9) must be corrected. Inserting $B[\text{C-C}] = 73$ kcal/mol and $B[\text{C=O}] = 179$ kcal/mol into (10), we get the average dissociation energy of $(CO)_n$ ($n \geq 2$) per each CO,

$$\Delta H = \frac{1}{n}(73(n-1) + 179n - 255.8n) = -3.8 - \frac{73}{n} \text{ kcal/mol}. \tag{11}$$

This estimate shows that dissociation of $(CO)_n$ complex (8) is *always* exothermic (at any value of $n \geq 2$).

Returning to our example $(CO)_6$, the dissociation energy (11) gives the value $96/6 = 16$ kcal/mol per each CO produced. The reaction (4) now reads

$$(CO)_6 \rightarrow 6CO + 96 \text{ kcal/mol}, \tag{12}$$
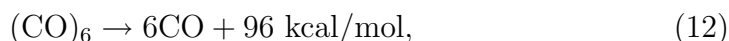
and appears to be highly exothermic, with about 16 kcal released per each CO. Therefore, in contrast to the combustion (5), this effectively yields 68.7+16=84.7 kcal/mol, as compared to 68.7 kcal/mol, *i.e. about 23% bigger heat released*, due to the dissociation of $(CO)_6$ to $6CO$.

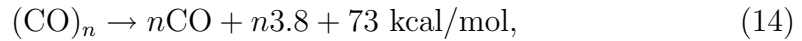In the general case of combustion of $(CO)_n$, we get

$$\frac{3.8 + 72/n}{68.7}100 \ \% \tag{13}$$

increase of the energy release per CO, as compared to the usual CO gas.

On the other hand, we see that one mole of $(CO)_6$ gives 6 moles of CO, thus the reaction entropy $\Delta S$ is expected to be of high value. As we mentioned in ref. [1], for carbon monoxide CO the reaction constant $K$ of its formation increases at higher temperatures (it is harder to dissociate CO at high temperatures than at low temperatures) because of high value of the reaction entropy. Similarly, we might conclude that it is harder to dissociate $(CO)_6$ at high temperatures than at low temperatures. Thus, $(CO)_n$ complexes could survive high temperatures, being metastable at room temperatures. We expect that the dissociation, $(CO)_n \rightarrow nCO$ occurs most effectively only at some small fixed temperature range depending on $n$.

In the general case, for one mole of $(CO)_n$ gas, we have the sequence of reactions,

$$(CO)_n \rightarrow nCO + n3.8 + 73 \ \text{kcal/mol}, \tag{14}$$
$$nCO + \frac{n}{2}O_2 \rightarrow nCO_2 + n68.7 \ \text{kcal/mol}, \tag{15}$$

so that the total heat released is

$$\Delta H = -n72.5 - 73 \simeq -(n+1)73 \ \text{kcal/mol}. \tag{16}$$

We see that the combustion of one mole of $(CO)_n$ gas gives *much bigger* heat, $\Delta H = -511$ kcal for the case of $(CO)_6$ gas, than one mole of CO gas characterized by $\Delta H = -68.7$ kcal/mol, *i.e. 511/68.7= 7.4 times bigger heat release per mole*. This is not only a mere consequence of the fact that one mole of $(CO)_n$ dissociates to $n$ moles of CO but also due to the dissociation heat presented in Eq. (14).

In any case, the above carbon monoxide complex, $(CO)_6$, is a direct confirmation that the conjectured CO×CO bond [2] really exists, as it is known

in practical chemistry. So the complex

$$CO \times CO \times \cdots \times CO \times CO, \tag{17}$$

where "$\times$" denotes a bond, is a good candidate of a magnecule.

# 4  Hydrogen bridges

The complex of type (17) would give a mass-spectrum which exhibits a periodicity in molecular masses. Indeed, the weakest bonds in (17) are evident (namely, those denoted by $\times$) so that the complex (17), under the influence of electronic beam in mass-spectrometer, should dissociate to an integer number of (ionized) CO molecules. However, the mass-spectra of magnegases does not reveal periodicity 28 a.m.u. as the smallest step. Instead, we observe almost randomly distributed masses of the charged fragments, with the minimal mass difference being 1 a.m.u. Thus, we are led to the assumption that there are some other types of magnecules in magnegases, in addition to (17). We expect the presence of H atoms in magnecules which could provide (multiple) hydrogen bonds.

As a possibility of hydrogen binding between polycarbonyl compounds, we conjecture a double hydrogen bond between two linear $(CO)_6$ as shown in Fig. 5.

$$
\begin{array}{cccccccccccc}
\delta\oplus\,C & - & C & - & C & - & C & - & C & - & C \\
\| & & \| & & \| & & \| & & \| & & \| \\
\delta\ominus\,O & & O & & O & & O & & O & & O \\
& & & \vdots & & & & \vdots & & & \\
& & & H & & & & H & & & \\
& & & | & & & & | & & & \\
\delta\oplus\,C & - & C & - & C & - & C & - & C & - & C \\
\| & & \| & & \| & & \| & & \| & & \| \\
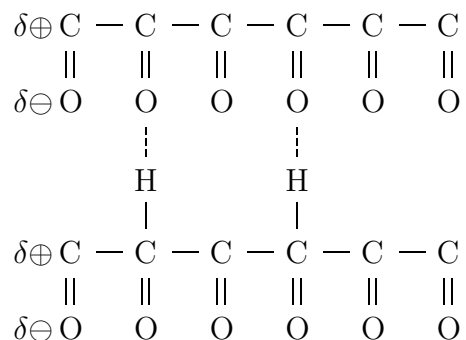\delta\ominus\,O & & O & & O & & O & & O & & O
\end{array}
$$

Figure 5: Conjectured hydrogen bonds between two linear $(CO)_6$.

This association could survive room temperatures, and can exist in a gas state since each of the hydrogen bond provides about 5...10 kcal/mol, leading

to metastability of the compound. Here, we use the fact that the carbonyl C=O bond in ketons is highly polarized, as it is shown in Fig. 8.

It is remarkable to note that such an association would have total dipole moment as a vector sum of two big dipole moments; schematically, some three C=O bonds (e.g., 1, 3, and 5) in each $(CO)_6$ are directed up, and the other three (e.g., 2, 4, and 6) are directed down. Thus, it would attract more number of H atoms (by induced polarization) and CO molecules which are close to one of these two big dipoles. Also, this association would reveal a big adhesion to some solid surfaces by inducing a polarization of the surface molecules. Linear growth of this association is terminated by heat excitations and collisions of the complexes so bigger number of high mass structures are expected to appear automatically at lower temperatures.

More detailed studies on the geometry and total dipole moments of the $(CO)_6$ complex, and its possible associations via hydrogen bridges, are needed to make accurate estimates. It should be noted that C-C bonds in $(CO)_6$ are mostly symmetric so that they give low intensity infrared peaks. Raman spectrum would show presence of such symmetric bonds.

On the other hand, experimental measurements of the dielectric constant of magnegases$^{TM}$ could give us valuable information on the averaged total polarization of magnegas components (see Eq. (21) below).

In general, it is natural to expect various combinations of hydrogen bonds between several $(CO)_n$ complexes. The example shown in Fig. 5 illustrates only one possibility. Another simple example is given by two carbon monoxide CO molecules bonded by hydrogen bridge,

$$C = O \cdots H\!\!-\!\! C = O, \qquad (18)$$

or two carbon monoxide $(CO)_2$ complexes bonded to each other by hydrogen bridge, and several H atoms (weakly) bonded to $(CO)_n$ complex at O atoms.

We note that the presence of hydrogen bonds could be detected in a gas state NMR spectral analysis of magnegases. We note also that the usual contribution of hydrogen bonds makes some infrared peaks wider. The higher combustion energy release of the association shown in Fig. 5 could be also due to an internal tension of this structure.

# 5  C(CO)$_n$ complex

Another possible type of polycarbonyl compound of interest is the following. In Ni(CO)$_4$ shown in Fig. 1, we can replace the Ni atom with C atom, convert the C=O bonds and conjecture the existence of the compound C(CO)$_4$ depicted in Fig. 6. Note that infrared spectra of such a compound would reveal only the C=O bonds because of the almost symmetric character of all the C-C bonds. One can extend this compound by noting that the C atoms in each of four C=O could give *further* bonds with additional C=O molecules, thus providing more complicated structure, C(CO)$_n$, having high molecular mass. One can easily estimate the dissociation heat of C(CO)$_n$ by using the simple technique applied to (CO)$_n$ in Sec. 3. Namely, it equals

$$\Delta H = kB[\text{C} - \text{C}] + nB[\text{C} = \text{O}] - n255.8 \text{ kcal/mol}, \qquad (19)$$

where $k$ is number of C-C bonds, and $B$[C=O] and $B$[C-C] are average binding energy of C=O and C-C bonds in C(CO)$_n$ complex, respectively. Note that C(CO)$_n$ dissociates to carbon monoxide CO and pure carbon C.

It is interesting to analyze such a kind of compounds in order to make accurate estimations of binding energies of the bonds. In particular, we expect that the energy $B$[C-C] in C(CO)$_4$ is smaller than $B$[C-C] in (CO)$_6$, hence we would have bigger combustion energy released per CO.

$$
\begin{array}{ccccc}
 & & \text{O} & & \\
 & & \| & & \\
 & & \text{C} & & \\
 & & | & & \\
\text{O} = \text{C} & - & \text{C} & - & \text{C} = \text{O} \\
 & & | & & \\
 & & \text{C} & & \\
 & & \| & & \\
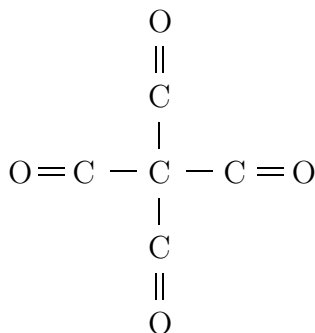 & & \text{O} & &
\end{array}
$$

Figure 6: A possible compound $C(CO)_4$.

The -O-O- group serving as a peroxide bridge could be present in (CO)$_n$ and C(CO)$_n$ as well, as shown in Fig. 7.

$$- \text{C} - \text{O} - \text{O} - \text{C} -$$
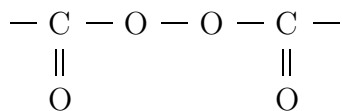$$\overset{\|}{\text{O}} \qquad\qquad\qquad \overset{\|}{\text{O}}$$

Figure 7: Possible peroxide group, -O-O-, in a linear chain of CO monomers.

In accordance with the mostly symmetric character of such bonds, they give low intensity infrared peaks. Thus, such bonds could not be observed in infrared spectra [2] of magnegases$^{TM}$. Again, Raman spectra would be of much help here as they allow to identify all symmetric bonds in compounds.

# 6   C=O bond

In order to analyze C=O bond as a group in compounds, we outline below properties of this bond in ketons. The structures of ketons is shown in Fig. 4. These properties are also characteristic of carbon monoxide and some other polycarbonyl compounds, as a consequence of high strength of the C=O bond, as compared to the bonds C-C, C=C, C-O, O-H, H-H, and O-O. In fact, only C≡C bond has a higher strength (see Table 1).

The bond C=O in ketons is known both as very strong and very reactive (high reaction rate). It should be noted that the energy of this bond (179 kcal/mol in ketons) is bigger than the sum of two single C-O bonds (2×85.5 = 171). This is in contrast with the double bond $C = C$ (145.8 kcal/mol) which is weaker than a sum of two single bonds C-C (2×82.6 = 165.2). Also, the bond C=O in ketons is of about 40...50% ionic character due to big resonance bipolar contributions, with oxygen O being charged negative and carbon C being charged positive, as shown in Fig. 8. This is due to different electronegativities of C and O (2.55 and 3.44, respectively). The infrared spectra of the carbonyl group in ketons is known to be at 1705...1740 cm$^{-1}$. Dipole moments of most ketons are about 2.7 D.

The above outline allows us to conclude that carbonyl bond C=O in carbon monoxide CO, ketons, and polycarbonyl compounds, is highly polarized and, therefore, this bond and its electron structure are highly sensitive to an external electromagnetic field. Note also that four electrons (two of C and
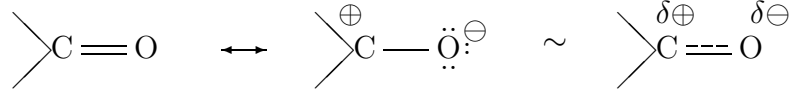
Figure 8: Bipolar structure of the bond C=O in ketons.

two of O), among ten electrons, are available to provide conventional bonds, and do not contribute the double bond C=O.

Note also that the constant dipole moment of the carbon monoxide C=O molecule is $\mu = 3.2$ Debay; for C-O bond it is $\mu = 1.5$ D, and for symmetrical H-H, O=O, and C-C bonds it is zero. A considerable numerical value of $\mu$ for C=O implies that CO molecules, as highly polarized molecules, tend to have a strong order in the presence of an external electromagnetic field despite a heat disordering.

In general, the total polarization of one mole of a gas is the sum of induced, $P_\alpha$, and constant, $P_\mu$, polarizations,

$$P = \frac{4\pi N_A}{3}\alpha + \frac{4\pi N_A}{3}\frac{\mu^2}{3kT}, \tag{20}$$

which can be estimated from the experimental value of the dielectric constant $\varepsilon$ of a gas,

$$P = \frac{\varepsilon - 1}{\varepsilon + 2}\frac{M}{d}, \tag{21}$$

where $M$ is molecular mass, and $d$ is density of a gas.

We expect the presence of about 2...20 carbonyl groups C=O in a cluster so the total electric polarization of magnecule can be roughly estimated by vector sum of individual polarizations of CO if one identifies structure of the magnecule.

The observed high adhesive property of magnegases$^{TM}$ [2] could be interpreted due to high value of the electric dipole moment of the clusters containing several CO molecules acting in parallel.

# 7    Conclusions

In this paper, an attempt has been made to identify the structure of magnecules by analyzing the structure and properties of some polycarbonyl compounds. We stress that we have not tried to identify the origin of the specific bonds in magnecules. Therefore, the numerical values of the binding energies used in this paper are approximate, and should be estimated more precisely in accord to specific models of magnecules. Nevertheless, we have shown possible reasons of increased combustion energy content of some polycarbonyl compounds viewed as candidates to magnecules, as compared to that of usual carbon monoxide CO and hydrogen $H_2$ gases. More experimental data and further theoretical study are needed to identify the structure of magnegases and analyze their combustion.

It is intriguing to note that, despite measurements of magnegases conducted over a two years period by using most of available detection methods and equipment (such as IRD, GC, MS, GC-MS, GC-MS/IRD, FTIR, and other methods), the true and detailed chemical composition of magnegas remains wastly unknown at this writing, thus stimulating new research [2].

In fact, according to conventional infrared spectroscopy, magnegas$^{TM}$ produced from water as liquid feedstock is essentially composed of $H_2$ and CO in about equal volume percentages, plus traces of $O_2$, $H_2O$, and $CO_2$. Its exhaust from internal combustion engine) is essentially composed of: 50% to 60% of $H_2O$ (as water vapor); 10% to 15% of $O_2$; 10% to 15% of C (estimate); 3% to 7% of $CO_2$; the remaining components being inert atmospheric gases.

These data can be naively interpreted as follows. 50% to 60% of $H_2O$ in the exhaust means that there were 50% to 60% of 2H in magnegas; 10% to 15% of C in the exhaust means that there was incomplete combustion of magnegas (otherwise, we would not have pure carbon in the exhaust), and that C is released from magnecules; 10% to 15% of $O_2$ in the exhaust means, again, that there was incomplete combustion of magnegas; 3% to 7% of $CO_2$ in the exhaust disproves the expectation according to conventional quantum chemistry that about 50% of magnegas from water is constituted by $CO_2$, because in this case the $CO_2$ percentage in the exhaust should have been of the order of *ten times bigger*.

By putting all available information together, including the anomalous energy content of magnegas, and as sated in ref. [2], available data establish that magnegas produced from water as a feedstock is indeed composed 50%

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H *atoms*, 25% C *atoms* and 25% O *atoms*, although these atoms are clustered into magnecules composed of individual and unbounded H, C and O atoms, radicals OH and CH, single and double bonds C-O, as well as conventional molecules $H_2$, CO, $O_2$, $CO_2$, $H_2O$, and other molecules in relative percentages unknown at this time. The erroneous reading of 50% CO in magnegas can be readily explained by the fact that the detecting frequency can trigger the *creation of* CO *by the instrument*, e.g., via the conversion of all single and double C-O bonds, which are notoriously unstable, into the triple valence and stable CO bond.

Stated in different terms, the study of gases created under extreme magnetic fields establishes that any detection of a conventional molecular component by infrared or other currently available spectrometers, by no means, implies that such a molecular component actually exists in the original gas, because said molecular component can be created by the instrument itself at the time of the detection and not be present in the original gas.

More generally, measurements of magnegases are intriguing inasmuch as they reminds us that available analytic methods and equipment were conceived to detect conventional *stable molecules*. As such, the same methods and equipment are basically insufficient for true experimental measurements of magnecules beyond the level of personal beliefs, because magnecules are not as stable as molecules and they can experience decomposition as well as mutation into conventional molecules triggered by the available detecting means themselves, whether the latter are given by photons or electron beams.

## Acknowledgments

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