

**SOLUBLE MAGNESIUM (MOLECULES)
VERSUS
CORROSION IN ENGINES AND GAS TURBINES**

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Technical document RB-28

In relation to the heavy fuel oil combustion, the following facts are generally accepted worldwide:

Heavy fuel oil contains several metallic impurities, mainly Vanadium and Sodium, that promote the formation of corrosive compounds during the combustion because all of them are in liquid state at temperatures below 650°C :

- Vanadium pentoxide (melts at 600-650°C)
- Sodium vanadate (melts at 340-650°C depending on molar ratio V/Na)

If these kind of compounds are not neutralized, during the combustion a lot of corrosion will appear on the valves, turbo compressors of engines and gas turbines blades (besides solid encrustations).

Regarding the use of heavy fuel oil ADDITIVES CONTAINING MAGNESSIUM as a solution for the related corrosion problems during the heavy fuel oil or crude oil combustion, it is necessary to clearly understand the following concepts and proved facts:

Additives with Magnesium oxide or hydroxide with non-soluble micrometric particles in suspension, **CAN NOT BE USED IN ENGINES OR GAS TURBINES THAT BURN HEAVY FUEL OIL OR CRUDE OIL** since the Magnesium in-suspension solid micro particles can produce damages.

Depending on the specific needs and requirements, the "[rb bertomeu](http://www.rbbertomeu.es)" additives are supplied with up to 30% wt/wt of Magnesium and varying percentages of other components.

In order to avoid corrosion in ENGINES and GAS TURBINES by using additives containing magnesium and **not making any damage by scratching or hitting the metallic parts** in pumps, fuel injection nozzles, blades, rotors and turbines, is only possible when Magnesium is in form of Fatty acid Organic Salt SOLUBLE in HYDROCARBONS, as in the "**rb bertomeu**" additives where the Magnesium is in form of molecule-sized particles.

The chemical synthesis process by "rb bertomeu" produces the before-mentioned Magnesium Fatty acids Organic salts completely soluble in hydrocarbons where the magnesium particles are Mg²⁺ ions, with a radius of 72 picometers (1 picometer is 1,000 times smaller than a nanometer).

The surface reactivity of these magnesium ions over conventional materials (oxides and hydroxides of magnesium) is about 10 times higher if the particles are nanometric and 100 times higher if the particles are micrometric.

The "rb bertomeu" additives with soluble Magnesium are the most reactive agents known to neutralize the corrosion by Vanadium pentoxide and Sodium vanadates and cannot make any damage by hitting the gas turbine's blades because the Magnesium particles are molecules. Being the additive in molecular form, provides an active area (~ 1,800 m² / g Mg) between 10 and 100 times higher than the one in nanometer-sized and micrometer-sized particles, and thereby increasing by a proportional factor the chemical reactivity.

During the combustion, the SOLUBLE magnesium of the additives produced by "rb bertomeu" react with the Vanadium oxide and forms Magnesium Vanadate of high melting point (more than 1,200°C), which is solid and non-corrosive at the internal temperature of the engine or gas turbine exhaust.

The action of fixing heavy metals (Vanadium), is also translated into a decrease in the oxidation of SO₂ to SO₃ (formed from the fuel oil's Sulphur) by minimizing its catalytic action on the reaction; as a consequence, the formation of Sodium sulfate is reduced (Na₂SO₂) that melts at 888 °C and also diminishes the appearance of Sulphuric acid condensation when the combustion gases cool down and, along with it, cold corrosion.

The Magnesium (Mg) molecule, becomes integrated in the Vanadate molecule, which leaves the engine together with the rest of solid residues formed in the combustion (for example, MgV₂O₆ o Mg₃V₂O₈). The rest of the organic components of the "["rb bertomeu" beco F1/ASF](#)" additive, including the organic anion which has supported the atom of Magnesium in soluble form, are burned during the combustion in the engine, generating residual gases as CO₂ y H₂O, like the fuel oil itself, and not generating any solid residue.

More information in [RB-12 "Magnesium as a solution for the corrosion problems derived from the combustion of heavy fuel oil"](#) and [RB-7 "Fuel oil and its corrosive effects in the industrial combustion"](#).