

# PHYSICO-CHEMICAL CONSIDERATIONS ABOUT THE “TOEM” DEVICE BEHAVIOUR AND THE SCALI EFFECT

## *The “TOEM” device description*

Such a device is an apparatus suitable to modify, by a physical action, the physico-chemical properties of hydrocarbon fuels in their liquid phase, as gasoline or Diesel oils, or in the vapour one, as LPG, at the ambient temperature.

By such an action, the fuels exhibit a higher reactivity, which practically means a better combustion with an increase in the engine yield, and the consequent pollution reduction.

To obtain this result, the fuel, pushed by a circulating pump, or in any other way pressurised, flows through the “TOEM” device, where is heated to 30÷65°C, then crosses a strong magnetic field, finally going to the cylinders.

## *About the “Scali” and “Piccardi” effect*

The physico-chemical effect, acting in the TOEM device, can be defined as the “*Scali*” effect, because the work performed by *Franco Scali*, of Siena University, in setting up the TOEM apparatus. Some experiments on fuels “magnetisation” were also attempted in the past times, but only empirically, without any reliable efficiency. Franco Scali improved the magnetic field geometry, and discovered that an increased temperature raises peculiarly the magnetic field effect on fuels.

Such a Franco Scali discovery is to bring back us, possibly, to a phenomenon actually under deeper investigation, about the super-order conditions in liquid and vapour, by the “quantum-physic” viewpoint.

The first studies on such a phenomenon, are due to *Giorgio Piccardi* (Firenze, 1895†1972), of Firenze University, who, in 1930, had a knowledge of a English patent, granted in 1929 for a device claimed to avoid the boilers scaling, named “Descaling Bulb BCD”, made by a simple glass bulb, argon gas filled, with a little mercury drop added, that can give a very feeble fluorescence when shaken. Giorgio Piccardi obtained, on request, some of such bulbs, to start deeper and systematic research. Can be of some interest to know that such an effect was well known to the scientists from the late XVIII century, and some of such bulbs can be also found in the “Experimental Philosophy Theatre”, setted up in the Padova University, by Giovanni Battista Poleni at the first half on the 1700 years. These bulbs, when submerged in water, and by the water flow shaken, becomes electrically action, but able to avoid scaling.

The first results of Piccardi’s studies were presented in 1931, and many other investigations were published in the scientific journal as “*La Gazzetta Chimica Italiana*”, or “*La Chimica e l’Industria*”, still the official journal of the Società Chimica Italiana (Italian Chemical Society), till the Piccardi’s death.

Piccardi alone, or with some assistant, investigated not only the scaling inhibition operated by such devices, but also many other phenomena produced by what he called “the treated water”, in the biology and chemistry field. For instance the influence of such water treatment on precipitation of a bismuth oxichloride, or arsenic sulphide and other mineral colloids as gold, ferric hydroxide, and so on. In the biologic field he experimented the inhibition action on microorganism growth. In his works he pointed out that the observed phenomena dependent from many parameters, as, for in-

stance, how was water treated (i.e. electrically, magnetically, and so on), the atmospheric condition, and from, also, the solar activity, that he called “floating phenomena”. Giorgio Piccardi pointed out the existence of three activation states: the first one he named “C” type, for the not activated water, and “T” and “R” types respectively. He also observed that activated water was able to transfer his own activation condition to any other water through the container walls, but with different results when the same walls were dielectric, as the glass, or conductive, as metal. Piccardi also remarked that the referred phenomena were not restricted to water alone, but were also pertinent to polar liquids.

On the Saturday April 29, 1939, Piccardi held a conference at the General Chemistry Institute of Genova University, where he stated the main properties of activation conditions referred to the water, as follows:

- 1) *The activation is not instantaneous, but requires a certain amount of activating action time.*
- 2) *The activation acquired properties, last for a long time, as to four days. (But also were referred longer periods, from twenty days to many months, depending from chemical ions dissolved and the involved energy, added our).*
- 3) *The water doesn't miss his new acquired properties by distillation or freezing.*
- 4) *When acting through a dielectric wall, on “C” type water, the activated “R” or “T” water type, produces “R” or “T” type water respectively.*
- 5) *When the wall is metallic, the “T” type water generates the “R” type, the “T” one.*
- 6) *Other liquids can have the same behaviour as the water.*

Piccardi pointed out that a lot of different actions can induce the activation conditions in the water, e.g. electric fields, magnetic fields, U.V. radiations, ultrasonic, short waves and, geologically speaking, quartz sand layers; also the “animal heat”. On the last item lie some Mesmer observations, in the XVIII century, and in the XX century by Reich.

Piccardi also investigated many physico-chemical parameters affected by the activation, particularly devoting his attention to the density, viscosity and surface tension. Many peoples and some researches, studying such phenomena, described variations in “*viscosity*”, talking about a “*smooth water*”, where we think more correct to speak about the surface tension; among them William Reich, who, between 1930 and 1950 years, investigated the phenomena by the physiological viewpoint.

After the Piccardi's death, many researchers, mainly in France and in Russia, investigated this field. It is still present in our memory the lot of debates raised about the “*water memory*” and about the “*polywater*”, concepts that the scientific community received with interest and scepticism at the same time. Biological aspects are also interesting, but not to handle here.

The Piccardi effects over the water, particularly on “hard water” (i.e. water rich in calcium bicarbonate), is still of large interest, because its application by many types of electrical, magnetical or electromagnetic devices, suitable for industrial or domestic uses, to avoid scaling.

However such an effect doesn't received adequate attention, though it may allow a better knowledge of the liquid and vapour phases constitution and behaviour, whose theory is still today at 1929 year level.

Why the Piccardi's work was devoted to the water alone, and merely a little attention was by him dedicated to other polar liquids, which behaviour has alone investigated? To explain this, we must remember that the water and other polar liquids are characterised by the treatment. Also it is easier to study some reactions, when they are better observed, as in the water, than in other liquids.

Franco Scali, instead, gets to spot a property, because such a phenomenon becomes observable also in no polar liquids, or at last, in a peculiar class of them, as the hydrocarbons.

## *Super-Order Conditions in liquid and vapours*

As before said, the reported phenomena were many times investigated, especially about the water, but the referred studies produced conflicting opinion, except, perhaps, for the Piccardi's works, which was an accurate and very exact experimenter. These can probably due to some different reasons, as:

- a) The phenomenon under investigations is be claimed as pertinent to the class of "fluctuating phenomena", i.e. the ones that, being characterised by a very low energy level involved, can be strongly influenced by external factor, very difficult or totally impossible to be shielded. So that it is very difficult to carry out on such phenomena some measurement exactly reproducible. Indeed Piccardi setted up a suitable laboratory, well shielded by metallic panels, at the Physico-Chemical Institute of Firenze University.
- b) Frequently such a phenomenon is pertinent to the medical-biological field or research therefore, the researchers were certainly fellows of reliable talent, but not, probably enough expert in Physical-Chemistry and related experimental methods.
- c) The phenomenon is enough easily comprehensible by Matter-Physics and Material-Science viewpoint; but these two types of knowledge were, at the time of such research, not enough developed.
- d) Practically speaking, no one of the researches studying the referred phenomena, attempted to explain them by a theoretical viewpoint according with the modern Physics and Physical-Chemistry premises, so that the described phenomena appeared, at the same time, completely out of the existent knowledge and lacking of any reliable theoretical explanation.

Let's here forewarn that our short statements represent only a hypothesis, pertaining to an actually in progress study, but however it seems coherent enough and suitable to present an explanation basis common to the both, Piccardi and Scali effects.

A liquid, in spite of what is frequently told, is not a simple mass of disordered molecules: other wise where is the difference with a gas? Really speaking, in a solid the particles (atoms or molecules) are distributed with a long-range order, e.g. in a crystal, a perfect sold model. The liquids are characterised by a short-range order, and in the gases the particles (mono o polyatomic molecules) are distributed in a completely casual way, and are continuously stirred by the ambient thermal energy. So that at any instant the system configuration is casually and completely altered. The vapour phase is a middle state between the liquid and gas phases, very badly described in the literature, but Andrew's and the Van der Waal isotherms very well clarify his nature. We must also bear in mind the critical temperature definition, i.e. the temperature above that the pressure alone can liquefy no gas. Over his critical temperature, any gas can be compressed till to reach higher density then in his liquid phase (also of his solid phase, as in deeper layers of stellar atmosphere), but without becoming liquid. Below the critical temperature, on the contrary, it is possible, by compression alone, to liquefy a gas: for instance, at ambient temperature we can liquefy carbon dioxide, ammonia and sulphur dioxide. It is evident that below the critical temperature the intermolecular forces are intense enough to overcome the thermal stirring, but they become insufficient above. Below the critical temperature, exist the vapour phase, but only above can exist the real gas phase. So the vapour has a shorter-range order than is completely lost in the gas phase, so follows the concept: the liquid and the vapour have a structure different from the solid phase, also if different between themselves.

What is now the difference between the three phases: solid, liquid and gas, by the structure viewpoint?

The solid one is essentially *a static system*, with only a very small motion of his particles (atoms, ions, molecules), while the liquid and vapour phases have *a dynamic structure*, continuously

self-arranging, but on alike schema. *The solid body rigidly maintains its own structure, while liquid and vapour phases have some energy levels, according with certain order degree.*

The water exhibits the hydrogen bond, i.e. the stronger intermolecular bond known. The same bond is present, at different energy levels, also in the alcohols, and in other organic substances, having hydroxyl group, in their molecules. So that, when a mass of water molecules exhibit a certain amount of order, this means that the system has a higher energy amount, inside. By this reason, some times it was said that the water can have a “memory”, and also can show a certain apparent degree of polymerisation, or the so called “polywater”. In water system can exist a higher and more stable order degree.

Restricting however our observation to the water alone, it is well known, from the Applied Chemistry, that the clay particles can coordinate, around themselves, the water molecules, so arranged over a distance of many molecular diameters, giving the well known stability of the clay slurries, as, for instance, the bentonite or montmorillonite slurries. Moreover it is well known that some solids, as silica sand, when thin milled, can not only become so consistent to maintain a given shape, but can also support strong mechanical efforts. Such behaviour is due to the bond grown between the water and the total particles surface, the last one becoming enormous. By these statements we can say that the liquid and vapour molecules join in semi stable configuration, continuously resetting, but with an alike schema: as many molecules leave the aggregate, as that one rejoin again (as for the unloosed end body in a saturated solution). The order level of these aggregates matches with a done energy level, and as higher is the level order exhibited by the system, as higher is the stored energy, while the disordered condition matches to the minimal energy level. In the ordered condition, the energy normally matches with the crystal lattice energy, in solids. When we give to a vapour or a liquid, a certain energy amount, in a suitable form, such energy will be first absorbed by the system, conferring it a certain order condition, and then can be released. As stated by Piccardi, the energy can be given as electromagnetic radiation, or by electric or magnetic fields or by ultrasonic. We will also add that the energy can be produced by chemical reactions inside the liquid, or by weak electrical effects (see Piccardi's points 4 and 5), or by means of “animal heat”, corresponding to a weak electrical charges flows, an effect observed jointly by Piccardi and Vittorio Maragliano, colleague of Piccardi, and independently, by William Reich, and also, at an early time, by Mesmer. Again by the action of some molecules or structures having dielectric properties, or being electrically charged at their surface. It is still to be clarified the inherent stability exhibited by such conditions. Probably such stability can be associated to the fact that the energy is absorbed not in a continuous, but in a discontinuous way. So, the macro aggregates, as told before, matches with quantic conditions precisely determinate, which can be defined as super-order quantic conditions. The energy so absorbed by the system, don't produce a temperature increase, because it is used by system itself, to increase his own order level. The same energy can be released also in a discontinuous way, by a slow relaxation, or can be transferred to other systems (i.e. to an other liquid placed beyond a wall, or to reactant chemicals, or to crystals growing, as for the case of waterite, growing from calcium carbonate, instead to calcite or aragonite, or again to biological systems.

When an activated liquid evaporates, the vapour also formed by macro aggregates having the liquid state structure, “remembers” the undergone treatment, even in a different order condition, i.e. with a different energy state; but, when the vapour is allowed to condense, the initial conditions are restored. But when the vapour goes to the gas form, where no order exists, the “activation memory” is lost, so that in the gases, by such a no order condition, it is impossible to record any information, neither the undergone activation.

It is so enough proper to speak of “memory”, referring to the activation states in liquids, being they in a super-order persisting state, corresponding to a certain recorded information quantities (see the equivalence, in modern thermodynamics, between the entropy increase and the information

losses). So an energy signal is reversibly recorded by the liquid structure as in magnetic surfaces or cores, in semiconductors, or in more complex way, in biological systems.

Moreover, from the previous consideration, comes that the phenomenon is well marked in the substances where the hydrogen bond is prevailing (*Piccardi effect*), and less detectable as decreases the liquid polarity, till no polar liquids (*Scali effect*), where the phenomenon results less evident. In the first ones, is ever well clear the dipolar structure, while in the last ones, it appears possible the formation of *transitory dipoles*, where however, we can think in terms of a certain synchrony in such a dipoles forming, behaving, such dipoles, as small oscillators, that aids to preserve the ordered structure in the macro aggregates.

It not possible to exhaust in these short lines such an argument; moreover it would require a very complex physical-mathematical support, here not present, and, also, a lot of accurate experimental data. But what till here we said, seems enough to point out, by a general viewpoint, the real worth of involved phenomena.

### *The “TOEM” Device and his Physico-Chemical Foundation*

From what was till here told, it is easily comprensible the “TOEM” device working principle. As the order condition impressed to molecular aggregates, as energy they can store, facilitates the combustion reactions in the firebox: probably such aggregates have such a features, that they can easier condense the oxygen and the radicals, combustion-sustaining, on theirs surfaces. And the same energy by then transferred, reduces the potential barrier of combustion reactions. It is not difficult to conceive that, for the reactions happening at radicalic level.

Moreover it results coherent with our present knowledge, the fact, found by Franco Scali, that the effect under study, is enhanced by the fuel temperature increase, that also increases the intermolecular distances, and so also the freedom of the mutual molecular motions, that can easily reach the synchrony condition for transitory dipoles formation, essential to allow the phenomena. Coherently also with the previously quoted topics, the device is effective with liquid fuels, as gas, can't from macro aggregates.

The “TOEM” device working and performances are so evident and explainable, at the light of our actual physical and physico-chemical knowledge, though the same represent the actual limit of our present Knowledge.

*Milano, October 12, 2003*

*Gualtiero A.N. Valeri*  
Scientific Chief of Energon Project  
*former teacher of Industrial and Physical*  
*Chemistry to Cassino Institute (Padova)*