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A remarkable history of the Ir Michel Roegiers family business

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The 18th century marked the beginning of the era of fascination with electricity [1]. It was then that the famous experiments by Francis Hauksbee, Benjamin Franklin, and Luigi Galvani had been conducted. In the 1800, Alexandro Volta built the first galvanic element. In the beginning of the 19th century, the modern understanding of the electric phenomenon started to form due to pioneering works by Michael Faraday, Andre Ampere and George Ohm. It is not surprising that the today's units of capacitance, current and resistance are named after them.

The late 19th century was marked by the War of the Currents between Thomas Edison, Nikola Tesla and George Westinghouse. Edison championed the direct current system, while Tesla and Westinghouse pushed for the alternating current system. In 1881, the first public electricity supply in the UK was generated in Godalming, Surrey, using a waterwheel at a mill, with turbine-driven generators introduced shortly thereafter.

At around the same time, the ability of electricity to alter the properties of materials was discovered leading to the development of new manufacturing methods such as electric discharge machining, electric discharge plasma technology, and plasma chemistry. In particular, the ability of electric discharge to trigger various chemical reactions was discovered, such as the formation of ozone in electric discharge [2], and the polymerisation of ethylene and acetylene [3], [4]. The first ozone generator was manufactured in Berlin by von Siemens. By the end of the century, technical-scale ozone plants were built in Oudshoorn in the Netherlands and Nice in France where ozone was used for disinfection of water. Fascinated with these developments, Count Alexandre de Hemptinne, – (who since 1902 was a Professor of Physics at the Université Catholique de Louvain (UCLouvain)), – started to experiment with other chemical reactions triggered by electric discharge. In particular, he investigated device similar to an ozoniser. He was also obsessed with the idea of producing "Hyzone H_3" – a hypothetical activated hydrogen form – by analogy with ozone (O_3) which he thought could be used to produce synthetic ammonia (NH_3). This idea did not work – and now we know why. The reaction between nitrogen and hydrogen is reversible and exothermic.

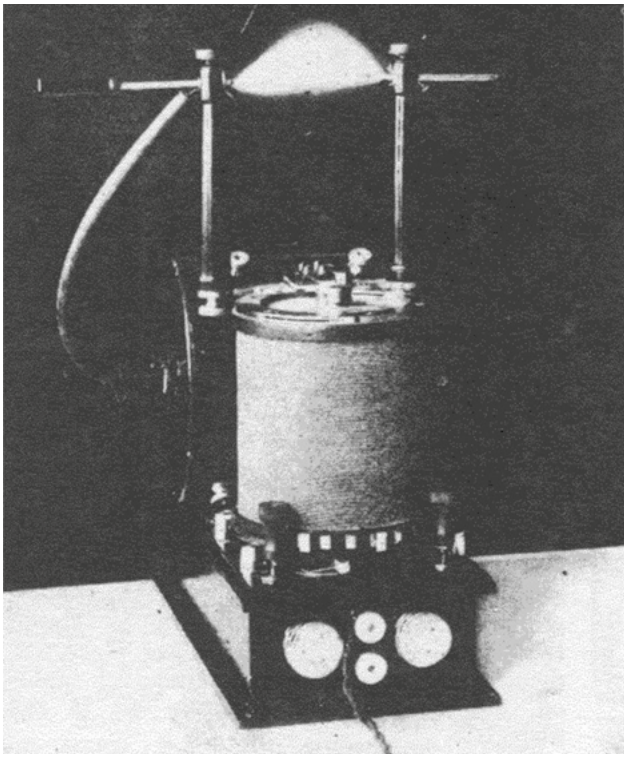


Figure 1: *Tesla coil used in ozone generator for water treatment.*

One would have to use a high pressure (ca 200 bar) to achieve any meaningful yield, while Count de Hemptinne carried out his experiments at atmospheric pressure or in low vacuum. Nonetheless, Count de Hemptinne made one other remarkable discovery: the silent electric discharge could be used to carry out hydrogenation of oleic acid and other unsaturated

compounds. In his groundbreaking experiment, electrodes were wetted by oleic acid and silent electric discharge was ignited in the hydrogen atmosphere. In the course of the experiment, a decrease in hydrogen pressure was observed indicating hydrogen addition to the oleic acid molecule. This discovery was presented in Count de Hemptinne's early patents from 1904-1905.

KAISERLICHES PATENTAMT.

AUSGEGEBEN DEN 11. JUNI 1907.

PATENTSCHRIFT

— № 185931 —

KLASSE 12 *i*. GRUPPE 4.

ALEXANDRE DE HEMPTINNE IN GAND, BELG.

Apparat zur chemischen Behandlung von Flüssigkeiten mit Gasen, bei welchem die Gase in Gegenwart der zu behandelnden Flüssigkeit elektrischen Glimmentladungen ausgesetzt werden.

Patentiert im Deutschen Reiche vom 24. Juni 1904 ab.

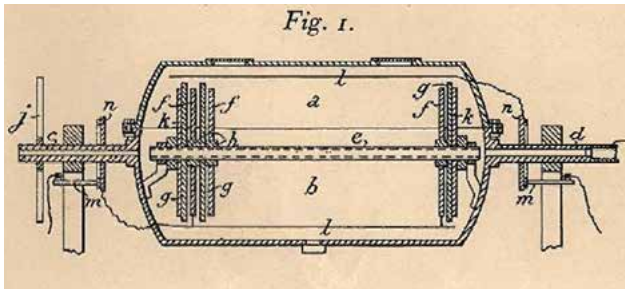
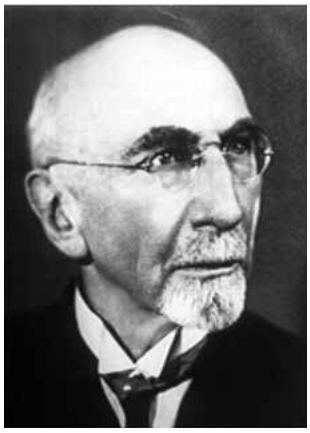


Fig. 1.

In time, the same technique was used for the deodoration of fish oil (which as we know now is rich in omega-3 fatty acids and conjugated double bonds are more reactive than isolated double bonds). In 1907, Count de Hemptinne built his first plant for deodorising fish oil in Gentbrugge-lez-Gand. Soon that fate brought him together with young Michel Roegiers Sr. who lived along the channel beside the plant. While studying bookkeeping, Roegiers Sr. was enchanted with mysterious electrical engines the sound of which was coming from the factory.



Alexander de Hemptinne (1866-1955).

Michel Roegiers Sr. (1896-1965)

Count de Hemptinne needed a bookkeeper, so he hired Roegiers Sr. Very quickly, Count de Hemptinne realised that Roegiers Sr. was a very resourceful and ambitious young man and he decided to let him run his company. Roegiers Sr. started to experiment with the effects of the treatment on vegetable and petroleum oils, noticing an increase in viscosity of the oils as a result of the treatment. Count de Hemptinne and Roegiers Sr. were one of the first scientists who looked into the lubricating power of different oils and built first tribometers decades before the word "tribology" was introduced into our vocabulary by Peter Jost. Due to high demand for high viscosity oils at that time, Count de Hemptinne scaled up his process to a full industrial scale and in 1909 founded a company "Huiles et Graisses Elektrion" in Wondelgem-lez-Gand, the stock capital of which soon exceeded 1 million gold francs (equivalent to ca 20 million USD in today's money) [5].

The legacy Elektrion process, also known as the voltolisation process, for producing lubricants consists of subjecting a vegetable oil or mixture of vegetable and mineral oils to silent electric discharge [18], [6], [9], [5]. By tweaking the process conditions, different degrees of cross-linking and hydrogenation could be targeted opening the door to manufacturing products with a broad spectrum of rheological properties, from nearly Newtonian fluids to semisolid thixotropic oleogels [14], [15], [16].

The combination of high viscosity index, oiliness and dispersancy made the Elektrion oils a preferred choice for the lubrication of marine steam engines which at that time were mostly lubricated by animal and vegetable oils. Seeing a large commercial potential of this new product, the Société d'Armement et de Commerce (SAIC) at Antwerp acquired a stake in Elektrion and helped to disseminate its products all across Europe. The exclusive distribution rights for Germany were granted to the German SAIC partner "Olwerke Stern Sonneborn AG (OSSAG)" selling the Elektrion products under the brand name "Voltöl" [5].

During World War I (1914-1918), the Elektrion technology and some pieces of equipment were forcefully transferred to Germany and, under the leadership of Walter Nernst, used by Deutsche Elektrion Öl Geselschaft at Potschappel, near Freital and Dresden [7], becoming later Deutsche Voltöl Gesellschaft that was finally acquired by Rhenania-Ossag.

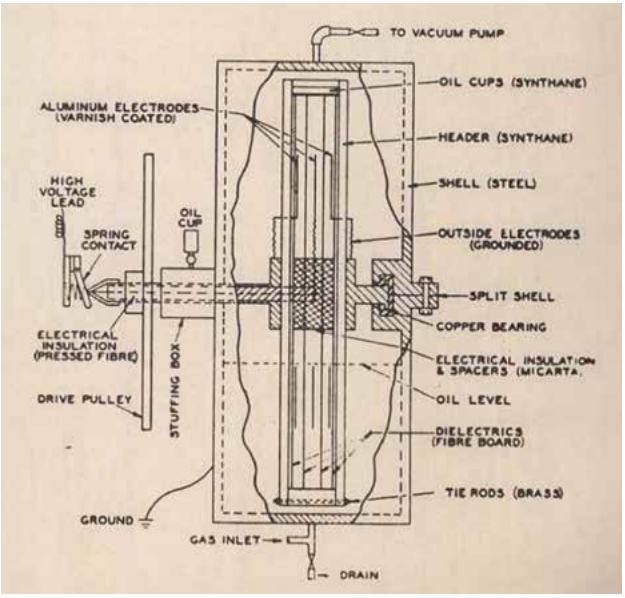


Figure 2: *The construction of glow discharge plasma reactor used to run the Elektrion process [9].*

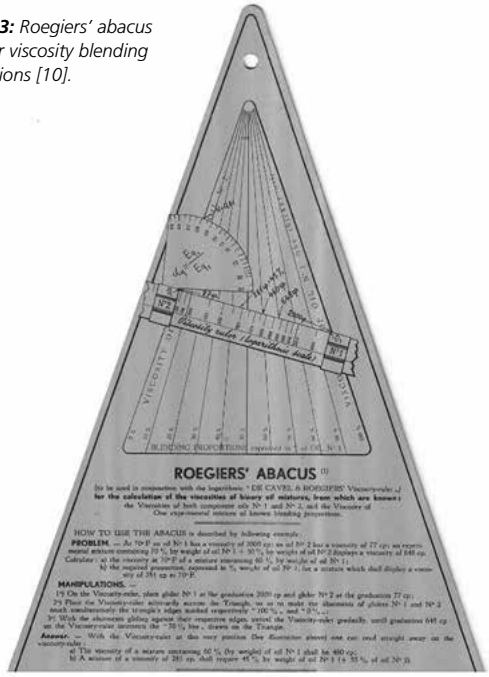


Figure 3: *Roegiers' abacus used for viscosity blending calculations [10].*

After the World War I, Count de Hemptinne liquidated Huiles et Graisses Elektrion, and then, in 1919 Michel Roegiers Sr. and his associate Leopold De Cavel founded their own "De Cavel and Roegiers Company." In 1928, the latter and Count de Hemptinne formed the Association Elektrion, granting them the right to develop and commercially exploit the Elektrion process for 30 years, leading to the development of Elektrion R; the first product that allowed manufacturing lubricants with very high viscosity index (>120) decades before the catalytic hydrotreatment was invented.

Like many prominent scientists at that time, Michel Roegiers Sr. was a real polymath with a keen interest in mathematics, physics and engineering. This combination of skills and natural curiosity allowed him not only to design, build and run the plant, but also endeavour to tackle more fundamental problems. In particular, he was involved, together with some leading SAE experts, in work related to the viscosity index (VI) standard development puzzling them with the fact that there is an oil with VI over 100. He also proposed an equation for viscosity blending [10] that proved to the most accurate of all known equations [12]. Many times, his ideas were far ahead of his time. For instance, trying to rationalise the outstanding ability of Elektrion oil to suppress sludge formation, he hypothesised about the formation of "peculiar nuclei" that helped to solubilise impurities and keep them "in a semi- colloidal or peptised suspension" [5]. This resonated with McBain's ideas about micelles [13], and as we know now, is indeed the way how detergency additives work.

In the early 1930s, aero transport companies, such as Sabena, started to use air-cooled engines instead of water-cooled ones. The increasing engine temperatures in air-cooled engines led to severe sludge formation even with the most refined mineral oils. Searching for a solution to this new problem, the Sabena engineers tested Elektrion oil against the unfavourable report of their consulting chemists who claimed that a vegetable-based product would never stand a chance. However, the results exceeded even the most optimistic expectations – the gumming of the piston rings had disappeared and the engine cleanliness improved enormously, reducing the need for maintenance. This remarkable performance of the Elektrion oil caused a real sensation in American Motor Oil circles after passing the most severe Cyclone Engine endurance test at the Wright Works. Following that success, Standard Oil Development Company studied and exploited the technology (Peter J. Wiezevich, US Pat 2104408; Charles N. Kimberlin, US Pat 2202801; Roger W. Richardson and George L. Matheson, US Pat 2274636). At the outbreak of World War II, Elektrion-Aero oil was licensed for use in aviation engines and was used, among others, by Sabena and Swissair. The operation of Elektrion plant in Ghent ceased in May 1940 due to war.

During the War, the Elektrion process was used by Germany, Japan, USA and USSR (Kelly, 1946; Pritzker, 1947). In Germany, the principal application of Voltöl was in an aero oil known before the war as Aero Shell Medium (ASM). From 1941 to 1942, ASM was replaced by Voltolised oil designated V2 made by the

Rhenania-Ossag and used in Junker diesel aircraft engines. Later the German plant was destroyed by allied bombings of Dresden.

In the end of 1944, the Elektrion plant in Ghent resumed its operations. In 1958, after the licensing agreement between Elektrion and Count de Hemptinne had expired, Michel Roegiers Sr. overtook the full company's ownership. In 1964, his 3 sons – Jacques, Georges and Lucien Roegiers – took over their family business and successfully developed sales of Elektrion R. In 1980, the son of Jacques Roegiers, Ir. Michel Roegiers, joined the company.

Roegiers Jr. started his engineering studies in chemistry and lubricants at Université Catholique de Louvain and Institut Français du Pétrole, and after graduation, left Belgium for Toronto, Canada, where he was recognised as Professional Engineer (APEO) and worked at the World R&D centre of DA Stuart Oil in specialty oils division.

After joining Elektrion in 1980, Ir. Michel Roegiers greatly extended the range of applications of Elektrion products, and in 1989 went for a management buyout to become the sole proprietor of Elektrion.

In the end of 2011, Ir. Michel Roegiers was joined by an associate but, some problematic months later, decided to leave Elektrion. In 2017, Elektrion – the company with over 100 years history – was declared bankrupt.

After four years of inactivity, he and his wife Hongli Zhang started their new company, MicRos (Changshu) Lubrication Technology CO., ltd. in Suzhou, China. Being the proud historic follower of the Elektrion unbreakable traditions and spirit, MicRos manufactures its unique biobased products under the trademark PLASMOIL® using the technology originally invented by Count de Hemptinne more than a century ago.

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