Vitold BAKHIR.
Electrochemical activation: forward and upwards!

This text, written by the author on publisher's advice, makes up a synopsis of a new book about techniques and technologies of electrochemical activation – one of scientific-technical aspects of applied electrochemistry. Nevertheless, the author did not manage to stay within traditional plot summary of a more than 500 hundred pages book. As a result the author is pleased to offer to the reader a kind of an essay.

A long time ago, when the idea of replacing imported chemical reagents for well drilling with electrochemical treatment of drill mud had just begun materializing in industrial electrochemical equipment, I was repeating over and over again, silently and out loud, the words of Vladimir Vysotsky: "Forward and upwards!" The type of work itself encouraged to look up allegories. Let pitons driven into the rock which had helped to climb up wards fall down with collapsed lumps! We have no alternative but to drive in new pitons! Forward and upwards! The songs of Vysotsky were played on old, shabby, muddy cassette players on drilling sites in deserts of south-western Uzbekistan and eastern Turkmenia. We firmly believed that time would come when our heavy and awkward units mounted on frames made of casing pipes and oil-well tubing would be replaced with beautiful and perfect electrochemical systems which would be helpful to people not only for drilling muds processing but for hundreds and thousands of other technologies, and probably we would be creators of such systems. It was a very complicated task to do things that nobody had ever done before, trying to understand causes of errors on site and find solutions right there.

The main scientific idea of 1970s emerged on the spur of the moment and consisted in making ordinary water, under electrochemical reaction by way of injection or removing of electrons, behave during chemical reactions and different processes as if extremely active chemical agents had been introduced into it, or as if it had been brought to boil or put under enormous pressure. Precisely these conclusions may be made on the basis of the first practical applications of electrochemically activated water and drill mud generation and application technologies. Our units at drilling sites were saving up to 70% of chemical reagents (starch, carboxymethyl cellulose, nitrolignin). The plant built with our own hands for production of coal-alkali reagent concentrate at Karaulbazar township of Bukhara region permitted a 60% cut of transport costs for delivery of reagents to drilling sites situated 30-150 km from the main facility. Our units for obtaining electrochemically activated water enabled a ten-fold cost saving during operation of diesel-engine drives at drilling sites in Kyzyl-Kum desert. In the same desert we noted uncommon properties of electrochemically activated water. Water after cathodic treatment in Electrochemical Treatment of Water Device (UEV) was stored on the drilling site in 20 cub. m metallic square-cut open containers leaking at different points and attracted a huge number of desert animals and insects: hedgehogs, snakes, lizards, spiders, beetles, phalanges, ground-squirrels, and turtles (in spring there were many turtles in the desert). In the morning we had to use shovels to remove a thick layer of drowned moths from the surface of water in containers. At the same time, nearby containers filled with ordinary stratal water did not attract desert inhabitants: only dry grass and occasional drowned insects were found there.

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By 1978 the results of our work had spread outside Uzbek Soviet Socialist Republic. Viktor M. Latyshev was the first reporter of the USSR magazine 'Inventor and Innovator' who visited drilling sites where electrochemical units had been introduced. Thanks to his good graces people got to know of 'life-giving' and 'dead' water obtained from electrochemical units.

The idea of creating reagent-free processes was so attractive and fascinating that drew attention of a huge number of scientists and specialists in different fields.

It was during that period when active creative cooperation of a group of scientists of Central Asian Scientific Research Institute of Natural Gas started, among which there was the author of this article, with plenty of specialists of various institutions and enterprises of the Soviet Union. This collaboration, changing its forms according to economic and political realia, has been carried out until now.

Personal knowledge and cooperation of the author with outstanding persons, creative minds, heads of large scientific and scientific-production units, which organized research and managed introduction of new processes in their own industries, have contributed to the accumulation of a large volume of scientific-technical information which has become noticeable just recently thanks to, literally, thousands of Master and Doctor theses dedicated to electrochemical activation. Among the originators of such extended work in the field of electrochemical activation there were Ulmas J. Mamajanov, Vazid V. Vakhidov, Alikhan R. Atajanov, Yury V. Latyshev, Nikolay V. Lemayev, Vladimir Ya. Oplanchuk, Vladimir I. Fisinin, Vladimir I. Filonenko, Kalust A. Kalunyants, Nodar G. Tsikoridze, Petr A. Kirpichnikov, Alexander G. Liakumovich. Enormous assistance was provided in explanation of many unclear results by the great theoretical physicist Ilya L. Guerlovin. Great support in scientific field was given by remarkable electrochemists Yakov M. Kolotyrkin, Andrey P. Tomilov, whose works enabled the creation of a vast number of conceptually new processes of applied electrochemistry and fundamental improvement of existing ones, as well as Alexander L. Rotinyan, Valery N. Flerov, Alexey V. Pomosov.

In 1985, summarizing ten years of theoretical and practical boom which inspired specialists of hundreds of the USSR enterprises with prospects of creation of reagent-free technologies, three top reporters of Pravda newspaper in their large article dedicated to electrochemical activation pointed out that the discovery of a new effect gave birth to 'skeptics' and 'go-getters'. The skeptics insisted that nothing new had been discovered but ordinary and thoroughly studied electrolysis. The go-getters called themselves the authors of new technology, manufactured electrochemical units (electroactivators) of different design, which represented variants of original laboratory units described in popular science magazines and quite successfully treated people with 'life-giving' and 'dead' water obtaining quite tangible profit.

In the mean time, a group of researchers together with the author continued studies and practical application of unclear and inexplicable phenomena from the point of view of conventional electrochemistry and carried on discovering new unusual effects of monopolar electrochemical action on liquids (fresh and distilled water, aqueous solutions, organic and non-organic compounds, alcohols, oil, gas condensate, gasoline, kerosene, mineral oil, cooking fat, milk, serum and blood plasma) and gases (helium, argon, hydrogen, carbon oxides, sulphurated hydrogen, oxygen, nitrogen, chlorine, chlorine dioxide, ozone, methane, propane, butane).

From 1972 to 1974 only the author of this book was engaged in design of electrochemical systems. In 1975, thanks to Yu. G. Zadorozhniy, a team of authors emerged which have been working till now (the year 2014). From 1977 to 1984 the team included S. A. Alekhin, with the participation of which industrial units were jointly created for electrical treatment of drill mud and stratal water, such as UOBR and UEV units, approved for serial production in 1979 by interdepartmental commission of the Ministry of Gas Production, Ministry of Oil Production and Ministry of Geology of the USSR. In mid 1980s it became clear that the development of a new aspect of applied electrochemistry was impossible within the framework of traditional design of electrochemical systems. New technical solutions were needed. They were found during the period of work of the authors in the system of the Ministry of Defense Industry of the USSR (1985 - 1987). Ceramic diaphragms enabling electrochemical treatment of fluids under considerable pressure difference and not requiring replacement provided a principally new solution. However, there is always room for improvement, and more and more new designs extending the sphere of application and serviceability have been emerging as far as the demand is growing for reagent-free management of physical and chemical properties of liquids and gases.

New ideas were turned into practice in 1988 – 2010 in Moscow by several organizations, including All-Union Scientific-Research and Testing Institute of Medical Equipment (USSR VNIIIMT MZ), later called Scientific-Production Facility EKRAN, as well as Scientific-Production Facility 'KHIMAVTOMATIKA', EMERALD Joint Venture, Izhevsk Plant KUPOL. As the result of that work, over forty thousand electrochemical units STEL were produced, having no rivals in the world in production of ecofriendly washing, disinfecting and sterilizing solutions used in hospitals across Russia and abroad; unrivaled AQUACHLOR units enabling drinking and waste water disinfection in several towns the population of which varied from 30 to 200 thousand people (Engels, Volsk, Balakovo, Nevinnomysk, Ust-Ilimsk, Sayansk), as well as many small towns and townships; over three hundred thousand unrivalled IZUMRUD units for purification of drinking water and delivering antioxidant properties to the water, operating at homes of Russian people and abroad.

In 2005 Vitold Bakhir Electrochemical Systems and Technologies Institute was founded coordinating efforts of many specialists and scientists from many countries in the field of development of electrochemical activation. Many unique units and technologies developed by the Institute specialists and scientists within the framework of special projects and as part of separate orders have already been used or prepared for wide practical use in different industries.

The saying 'If it weren't for bad luck, we would have no luck at all' turned out to be true. In 2011 a series of corporate raids, betrayal, thievery and frauds made the authors cut connections both with their own enterprise LABORATORY OF ELECTROTECHNOLOGY LLC, founded in 1991, and many other companies and persons.

In 2011 a new period in the development of technical electrochemical systems started, due to creation of all-purpose electrochemical reactors having great potential for development. Production of brand-new electrochemical systems of all types equipped with those reactors has been performed since 2011 by the sole company – DELFIN AQUA LLC, whose scientific and technological advance is reinforced by personal participation of the authors. On the basis of reactors of new type, powerful modular units have been developed – AQUACHLOR-M and ECOCHLOR – designed to replace intellectually worn-out, huge plants for production of chlorine and caustic soda and offer safe chlorine to consumers in any quantity any time. New compact, powerful, safe for human and nature, modular electrochemical units for the

synthesis of persulphuric acid, hydrogen peroxide, hydrochloric acid have been created. Fundamentally new electrodialysis plants are under development, being mud-proof, capable of desalinating sea water and many other liquids with no need for spare part replacement for years. Research and development of brand-new systems of bioelectrochemical purification of waste water has been carried out (during treatment electric current is generated for supply to auxiliary electrochemical reactors). Experimental work on creation of electrochemical systems at the same time treating industrial waste water and producing electric power by means of galvanic process of decomposition of industrial waste of different chemical composition to safe state in special electrochemical reactors.

All these stages of development of technology and techniques of electrochemical activation, theoretical models and fundamental and applied experimental research are described in the book ELECTROCHEMICAL ACTIVATION: INVENTIONS, TECHNIQUES, TECHNOLOGY, published in spring 2014 by VIVA PRESS.

Our team of Vitold Bakhir Electrochemical Systems and Technologies Institute and DELFIN AQUA production company invite different companies and all interested specialists and scientists for cooperation, including the abovementioned ‘skeptics’ and ‘go-getters’. In the course of cooperation the skeptics will turn into supporters, while go-getters will use their energy for introduction of new technologies into the industry. The only criteria of natural selection for performing interesting and necessary work are personal and corporate ethics. Electrochemical activation, forward and upwards!

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