Electrochemical Activation: Inventions, Systems, Technology

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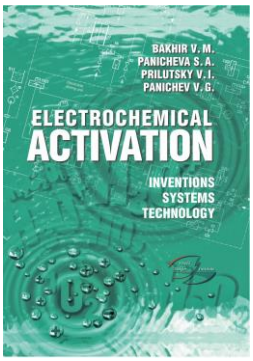

Preface to the second edition

It is more than five years since this book was first published. It has turned out that the book is in demand not only in Russia, but far beyond its borders. Answers to many letters from various countries asking for information contained in the book have required the translation of various fragments of the text into English, Spanish, German, Vietnamese, Chinese and other languages. Also, often, in answering questions, it was necessary to use information that was absent in the first edition for various reasons, including those related to the translation into Russian of studies performed abroad by the authors of the team. Gradually, my colleagues and I formed the idea of the need to prepare a second edition, supplemented by previously unpublished data, as well as information on the latest research and development. This idea was greatly facilitated by the appearance of the book in Vietnamese, which reflected the theoretical aspects of electrochemical processes and technologies, as well as the results of joint practical work of a group of Russian and Vietnamese scientists and specialists on the application of electrochemical activation in various production processes in Vietnam.

Currently, if you type in any search engine the words "Electrochemical activation" in any language and see pictures on the topic or read texts by links, you can see many identical pictures and words once drawn, written and published by me. Moreover, if we analyze the percentage of links to the source, then for Russian-language links (about 300,000) it is less than five percent, and for English-language links (about 20,000,000) - less than 0.001%. Using the rights of the editor of this book, and also as a person to whom God has given the scientific idea of electrochemical activation and whom He helps all the time, including new ideas and new people - colleagues and associates, I have decided in a brief introduction to highlight the main milestones of the development of technology and systems of electrochemical activation, as well as the names of my scientific colleagues, teachers, specialists and scientists I have worked with.

Once upon a time, in the early seventies of the last century, when the idea of replacing imported chemical reagents for drilling wells with electrochemical treatment of drilling mud was just beginning to be embodied in industrial electrochemical equipment, I kept repeating mentally and aloud Vysotsky's words: "move on and up!". The nature of the work contributed to the search for allegories. Let the driven hooks that have helped rise higher drop down with collapsed boulders! We have no other way. We drive in new hooks! Only on and up! Vysotsky's songs sounded from old, shabby, dirty tape recorders at rigs in the deserts of South-West Uzbekistan and East Turkmenistan. We firmly believed that the time would come when, instead of our heavy and rough installations mounted on frames made of casing or tubing, beautiful and perfect electrochemical systems would appear that would be useful and necessary for people not only to process drilling muds, but in hundreds and thousands of other technologies, and that, perhaps, we would be the ones to create such systems. It was a hell of a job - to do what no one else had ever done. To search for the causes of errors at production facilities and find solutions right there.

The main scientific idea of the seventies was formed spontaneously and consisted in using electrochemical influence - by introducing or selecting electrons - to make ordinary water behave in chemical reactions and various technological processes

as if extremely active chemicals were introduced into it, or it was heated to a boil or exposed to huge pressure. It was precisely such conclusions that could be drawn based on the first practical applications of the technology for producing and using electrochemically activated water and drilling muds. Our rigs were saving up to 70% of chemicals (starch, carboxymethyl cellulose, nitro-lignin). A workshop for the production of carbon-alkaline reagent concentrate in the village of Karaulbazar, Bukhara Region, we had built with our hands, allowed us to reduce transport costs by 60% for the delivery of reagents to drilling sites located at a distance of 30 to 150 km from the base. Our plants for the production of electrochemically activated water provided ten-fold cost savings in the operation of drilling diesel drives in the Kyzyl-Kum Desert. And it was there, in the desert, that we noticed a manifestation of the unusual properties of electrochemically activated water. Water after cathodal treatment in the UEV plant was stored at the rig in metal twenty-cubic rectangular open tanks, leaking in different places, and attracted a lot of desert living creatures: hedgehogs, snakes, lizards, spiders, phalanges, beetles, ground squirrels, turtles (in spring, there are many turtles in the desert). In the mornings, we had to use shovels to remove a thick layer of sunken night butterflies from the water surface in the tanks. At the same time, neighboring reservoirs filled with ordinary formation water did not attract the attention of desert inhabitants: on the water surface there were only dry blades of grass, and sparse sunken insects.

By 1978, the results of our work became known not only in the republic (Uzbek SSR). The first reporter of the All-Union journal “Inventor and Rationalizer”, who visited the places of introduction of electrochemical plants at drilling sites, was Viktor M. Latyshev. It was thanks to his good graces that people learned about “live” and “dead” water obtained in electrochemical plants. At the same time, the chief editor of the journal "Technology and Science" Evgeni E. Novogrudsky described the technology in more detail.

The idea of creating reagent-free technological processes was so tempting and so interesting that it attracted the attention of a huge number of scientists and specialists of various fields of knowledge.

It was during that period that active creative cooperation began with a group of employees of the Central Asian Research Institute of Natural Gas, including the author, with many specialists from various organizations and enterprises of the Soviet Union. This cooperation, changing its forms in accordance with economic and political realities, has not stopped till present days.

Personal acquaintance and joint work of the author with wonderful people, creative personalities, leaders of large scientific and research and production teams who organized research work and implemented new technological processes in their industries, contributed to the accumulation of a huge amount of scientific and technical information, which is only now becoming noticeable, without exaggeration, in thousands of master and doctoral theses on electrochemical activation. The sources of all those advanced works in the field of electrochemical activation were Ulmas J. Mamadzhanov , my first teacher, Vazid V. Vakhidov, Alikhan R. Atadzhanov, Yuri V. Latyshev, Nikolay V. Lemaev, Vladimir Ya. Oplanchuk, Vladimir I. Fisinin, Vladimir I. Filonenko, Kalust A. Kalunyants, Nodar G. Tsikoridze, Peter A. Kirpichnikov, Alexander G. Liakumovich, German A. Dobrenkov, Victor G. Shol, Adolf F. Kozlov, Willy I. Klassen, Revaz G. Dadiani , Alexander A. Podkolzin, Valentina M. Ilyina, Vladimir P. Tabakov, Boris A. Piskunov , Ivan S. Nayashkov, Leonid E. Spector. The above names, as well as the names of several dozens of other remarkable people are indicated in joint patents and scientific articles described in the book. Below there is a short list of organizations that concluded creative cooperation agreements or business agreements for the supply of electrochemical equipment and technology development with the Central Asian

Scientific Research Institute of Natural Gas where I headed a group of scientists and specialists in 1979 to 1984. The names of organizations demonstrate the possibilities and prospects of this field of science and technology, which have interested specialists in various industries and have been confirmed by them on a laboratory, pilot-project or industrial scale.

Uzbekgazprom All-Union Production Association (Manager A.S. Melsitdinov, Bukhara, 1979), Turkmengazprom All-Union Production Association (Deputy Head S.A. Badalov, Ashkhabad, 1980), Soyuzuzbekgazprom All-Union Production Association (Manager A.R. Atajanov, Tashkent, 1982), Uzbekneft Production Association (Deputy Manager M.A. Khashimov, Tashkent, 1980), Tashkent branch of the All-Union Scientific Center of Surgery of the USSR Academy of Medical Sciences (Director V.V. Vakhidov, 1979), Uzptitseprom State Committee UzSSR (Chairman B.A. Piskunov, Tashkent, 1981), All-Union Scientific Research and Technological Institute of Poultry (V.I. Fisinin, Zagorsk, 1982), Central Asian Scientific Research Institute of Irrigation (Director V.A. Dukhovny, Tashkent, 1981), Leninabad Mining and Chemical Integrated Plant (Director V.Ya. Oplanchuk, Chkalovsk, 1982), Photon Production Association (Chief Engineer V.G. Tateosov, Tashkent, 1981), Soyuztermneft Research and Production Association (General Director A.R. Garushev, Krasnodar, 1981), Irkutsk Institute of Organic Chemistry, Siberian Branch of the USSR Academy of Sciences (Director M.G. Voronkov, Irkutsk, 1985), Dzhezkazgan Mining and Metallurgical Integrated Plant (Director M.T. Urumov, 1983), DzhezkazganNIIIPItsvetmet (Deputy Director M.I. Zharkenov, 1982), Magnitogorsk Iron and Steel Works named after V.I. Lenin (Director Yu.V. Yakovlev, 1983), Central Scientific Research Technological Institute (Director A.Ya. Shifrin, Moscow, 1981), Kazan Chemical-Technological Institute named after S.M. Kirov (Rector P.A. Kirpichnikov, 1979), Kazan Zarya Confectionery Factory (Director Z.I. Khubulava , 1983), Koshchakovsky State Fur Farm (Director N.B. Valeev, Kazan, 1982), Southern Branch of the All-Union Thermotechnical Research Institute named after F. Dzerzhinsky (Director A.A. Madoyan, Gorlovka, 1983), Production Association "Nizhnekamskneftekhim" (director N.V. Lemayev , 1981), Research Institute for the Study of Leprosy, the USSR Ministry of Health (Director A.A. Yushchenko, Astrakhan, 1982), Taganrog Mechanical Plant named after G. Dimitrov (Engineer-in-Chief G.E. Vudyuk, 1981), Central Research Laboratory of the Third Moscow Medical Institute (Manager A.A. Podkolzin, 1982), Scientific Research Institute of Ambulance named after N.V. Sklifosofsky (Director V.D. Komarov, Moscow, 1984), Moscow Technological Institute of Food Industry (Rector V.V. Krasnikov, 1982), Scientific-Physical-Chemical Institute named after L.Ya. Karpov (Director Ya.M. Kolotyrkin, Moscow, 1983), Soyuzburgeothermy Scientific Production Association (General Director M.G. Aliyev , Makhachkala, 1983), North Caucasus Scientific Research and Design Institute of Oil (Director A.S. Mavriysky , Grozny, 1981), Grozny Chemical Plant named after 50th anniversary of the USSR (Engineer-in-Chief P.I. Vetrov, 1982), Vilnius branch of the TEMP Scientific and Research Technological Institute (Director S.R. Stanyavichus, 1982), AVANGARD Leningrad Scientific and Production Association (Manager of NIO-2 Tereshkin V.A., Leningrad, 1982), Research and Production Association for Starch Products (Director N.G. Gulyuk, Korenevo, Moscow Region, 1982), Severovostokzoloto Scientific Research Institute (Director V.I. Yemelyanov, Magadan, 1980), Giproniselprom Institute (Director A.Ya. Mazurov, Orel, 1982), Belarusian Filiation of the All-Union Scientific Research Institute of Halurgy (Director N.I. Vorobyov, Minsk, 1983), State Krasnoyarsk Medical Institute (Director B.S. Grakov, 1984), Syzran Plastic Production Association (Director E.N. Bryukhnov, 1981), Kishinyov Combined Thermal Power Plant (Director M.A. Korchagin, 1980), Institute of Geological Sciences (Director Shnyukov E.F., Kiev, 1982), Kursk Schetmash Factory (Engineer-in-Chief V.I. Shuteyev 1981), All-Union Oil and Gas Research Institute

(Director G.G. Vakhitov, Moscow, 1982), Nizhnevartovskneftegaz Production Association (Engineer-in-Chief V.N. Ivanov, 1983), Vostok Research and Production Association (Engineer-in-Chief Yu.V. Latyshev, Tashkent. 1980), Central Research Institute of Automation and Hydraulics (Director G.N. Posokhin, Moscow, 1981), Giprouglemash Malakhov Experimental Plant (Director I.E. Laktionov, 1981, Malakhovka settlement, Moscow region), Baltic Research Institute of Fisheries (Director M.P. Polyakov, Leningrad, 1982), Yareganeft Oil Mine Department (Head P.G. Voronin, Komi ASSR, Ukhta, Yarega village, 1980), Leningrad Order of Lenin Polytechnic Institute named after M.I. Kalinin (Scientific Adviser on the Problem of SSP Development and Use I.L. Gerlovin, Leningrad, 1985).

I am deeply convinced that if humanity has a future, then this future cannot be imagined without the widest use of electrochemical activation in all spheres of human activity. Therefore, this book is dedicated to all those specialists and scientists who were the first to set foot on this uncharted continent of new knowledge.

Great help in explaining many incomprehensible results was rendered by the great theoretical physicist Ilya L. Gerlovin (my second teacher). Great scientific support was provided by remarkable electrochemists: Yakov M. Kolotyrkin, Eduard V. Kasatkin, Vladimir A. Shepelin, Vladimir Ye. Kazarinov, Alexander L. Rotinyan, Valeriy N. Flerov, Aleksey V. Pomosov, Nikolay V. Gudin, Andrey P. Tomilov.

In 1985, summing up the results of the ten-year scientific and practical boom, which had captured people's minds by the prospects of creating reagent-free technologies for specialists from hundreds of enterprises of the USSR, three most distinguished journalists of the Pravda newspaper noted in their long article on electrochemical activation that the discovery of the new effect had brought to life “skeptics” and “go-getters". Skeptics said that nothing new was discovered, that all that was ordinary and well-studied electrolysis. Go-getters, on the contrary, called themselves the authors of a new technology, made electrochemical devices (electroactivators) of various designs, which were versions of the original laboratory devices described in popular science magazines, and quite successfully treated people with “live” and “dead” water, gaining quite considerable benefits. By the way, at present (2020) skeptics have disappeared, but the entire visible space is almost entirely filled with go-getters, as N. Gladkov, N. Morozov and V. Reut had aptly defined them in their article "Water Extravaganza".

Meanwhile (since 1975), a group of researchers, together with the author, continued to study and make practical use of phenomena incomprehensible and inexplicable from the standpoint of traditional electrochemistry and continued to find new unusual effects of unipolar electrochemical effects on liquids (fresh and distilled water, aqueous solutions of organic and inorganic compounds, alcohols, oil, gas condensate, gasoline, kerosene, mineral oil, cooking oil, milk, serum, blood plasma) and gases (helium, argon, hydrogen, carbon oxides, hydrogen sulfide, oxygen, nitrogen, chlorine, chlorine dioxide, ozone, methane, propane, butane).

In the period from 1972 to 1974, only the author of the book was engaged in the design of electrochemical systems. In 1975, with the arrival of Yu.G. Zadorozhniy, there appeared a team of authors. In the period from 1977 to 1984, the team included S.A. Alyokhin, due to whose participation the joint work created industrial plants for the electric treatment of drilling mud and formation water such as UOBR and UEV, adopted in 1979 for serial production by the interdepartmental commission of the USSR Gas Industry, the USSR Ministry of Petroleum Industry and the USSR Ministry of Geology. In the mid-eighties, it became clear that the development of the new direction in applied electrochemistry is impossible within the framework of the traditional design of electrochemical systems. New technical solutions were required. They were found

during the work of the authors in the system of the Ministry of Defense Industry of the USSR (1985 - 1987). Ceramic diaphragms, providing electrochemical processing of fluids at a significant pressure drop and not requiring replacement, solved the problem fundamentally. However, there are no limits for improvement, and all new designs expanding the field of application, increasing reliability, durability, and improving the usability appeared (and appear) with the growth of the demand for this technology of reagent-free control of the physicochemical properties of liquids and gases.

Practice testing of new ideas took place in 1988 - 2010 in Moscow, where ideas turned into finished products at the All-Union Scientific Research and Testing Institute of Medical Technology of the Ministry of Health of the USSR (VNIIIMT Ministry of Health of the USSR), later EKRAN Scientific and Production Association, at KHIMAVTOMATIKA Scientific Production Association, EMERALD Joint (Soviet-British) Enterprise , Izhevsk Plant KUPOL and some other enterprises. Electrochemical reactors - modular FEM elements and, later, MB elements for all types of electrochemical equipment were produced by Laboratory of Electrotechnology Limited Liability Company (LLC "LET") - a private company founded in 1991 by Yu. G.. Zadorozhny and me. Some of the results of that work were more than forty thousand STEL electrochemical plants, which have no analogues in the world, for producing environmentally friendly washing, disinfecting and sterilizing solutions that work in hospitals in Russia and many countries; about one and a half thousand AQUACHLOR devices that have no analogues in the world, which provide disinfection of drinking water and wastewater in several cities with a population of 30 to 300 thousand people (including Engels, Volsk, Balakovo, Nevinnomyssk, Ust-Ilimsk, Sayansk), and also in many small cities and towns; more than three hundred thousand Emerald devices that have no analogues in the world for purifying drinking water and giving it antioxidant properties that work in the apartments of Russians and residents of many countries. In the same period (from 1988 to 1994), Vladimir I. Prilutsky together with Svetlana A. Panicheva and Vadim G. Panichev developed and submitted to clinical trials several unique medical devices, including the BAZEKS device for regulating the biocompatibility of a dialysis solution by redox potential (ORP) and the INFUSTAT apparatus for regulating the biocompatibility of infusion therapy drugs by non-contact electrochemical exposure. These works served as fertile ground for many "go-getters" (the terminology of Pravda correspondents), which intensively inspired and continue to inspire people with the need to adjust the ORP of drinking water, based on information on the value of the ORP of the internal medium of the body, experimentally obtained by V. Prilutsky, S. Panicheva and V. Panichev and hiding the original primary sources of information.

In 2005, on the ideological and technological basis of four hundred inventions, the Vitold Bakhir Institute of Electrochemical Systems and Technologies was created, which combined the efforts of many specialists and scientists from different countries involved in the development of electrochemical activation. Many unique systems and technologies developed by specialists and scientists of the Institute as part of special projects and for individual orders are already being used or prepared for wide practical application in various industries.

The saying about blessing in disguise is really true to life. In 2011, raider seizures, betrayal, theft and deceit forced the authors to sever all ties both with their own private enterprise Laboratory of Electrotechnology LLC, established in 1991, and with many companies and people.

In 2011, a new period began in the development of technical electrochemical systems, due to the appearance of universal shell-type electrochemical reactors, with higher development potential. The production of electrochemical systems equipped with those reactors was organized in 2011 at the Limited Liability Company “DELFIN AQUA” and continued under the supervision and with the participation of the authors until 2015.

Based on the new type of reactors, the AQUACHLOR-M and ECOCHLOR modular systems were created, and their industrial testing confirmed the effectiveness of the developed system of self-cleaning of electrode chambers using the initial salt solution with hardness salts.

At the beginning of 2016, based on the experience of designing and practical testing of shell-type reactors by the design team of I.V. Kozlov, M.V. Byalko and I.A. Grishkov under my leadership, flow-through modular electrochemical cells of a new type were created, which far surpassed all previously created designs, including 2011-2015 shell-type reactors, in terms of technical and economic parameters. These elements formed the basis of the new compact and high-performance AQUACHLOR and ECOCHLOR systems, designed to ultimately replace bulky and hazardous chlorinated caustic plants and give consumers safe chlorine and caustic soda anywhere, anytime, in any quantity.

Since the beginning of 2016, work in the field of electrochemical activation has been developing within the framework of the specially created innovative industrial cluster ROSELECTROCHIMINDUSTRY. New compact, powerful, safe for people and nature modular electrochemical plants have been created for the synthesis of sulfuric acid, hydrogen peroxide, hydrochloric acid. Electrodialysis plants of a fundamentally new type are being developed, which are not afraid of dirt and are able to desalinate not only sea water, but also many other liquids without replacing any elements for many years. Research is underway and fundamentally new systems are being developed for bioelectrochemical wastewater treatment (during the treatment process an electric current is generated that feeds auxiliary electrochemical reactors). Experimental work is underway on the creation of electrochemical systems in which industrial wastewater is treated with the simultaneous generation of electricity due to galvanic destruction processes to a safe state in special electrochemical reactors for industrial wastes of various chemical composition.

Looking back one can see that everything in the world obeys a certain logic. If people were not attracted by the unusual nature of the technology, then there would not be a need and desire for us, its creators, to improve the designs of electrochemical systems to meet the most diverse needs of technologists. It might be interesting to dwell on one device for producing "live" and "dead" water, which, in fact, remains a constant topic for "go-getters" according to the figurative expression of Pravda journalists. But this is a boring (albeit lucrative) activity: selling the same product in different versions. After all, life is meant just for comprehending new things and sharing the knowledge. It is very tempting to find and explore as much as possible interesting and mysterious new knowledge on the new knowledge mainland that rises from the depths of space and time. My current young, not very young and very middle-aged colleagues scattered all over the world, in general, share my views. However, in order to follow the philosophy of life, material support is needed.

With the advent of private ownership of the means of production in the countries of the former Soviet Union, the need for new electrochemical equipment and technology has increased, since each owner objectively seeks to increase profits at lower costs. But the mechanism of the relationship between those who produce new knowledge invested in a new technical and technological product and those who buy this product has fundamentally changed. The vast majority of business buyers are reluctant to pay the cost of finding new knowledge, because they were initially accustomed to consuming finished products, mainly those manufactured in the West. They have no idea of the serious scientific work which usually precedes the appearance of a technical or technological novelty.

While earlier (before the beginning of the nineties) the state was concerned about the development of fundamental and applied science, now, under new conditions,

you need to go on your own all the way from an idea and its development to a finished product, with rare exceptions. And in order to live and develop in accordance with the chosen philosophy, it is necessary to accurately determine, guess, feel and represent at the early stages of development the degree of usefulness of the created product and to evaluate, take into account, adjust its impact on the Nature around, including all its fragile and interconnected components. This art is not taught in higher education. The desire for knowledge of this kind can be initially inherent in man and capable of improvement under the conditions, as well as depending on the type of activity.

Together with my colleagues in Russia and abroad we have gradually developed the ability to anticipate the final result, analyzing all the nuances of developing an emerging idea. To a large extent, the acquisition of such knowledge and experience was facilitated by the joint work of the author and his colleagues on agreements on the transfer of licenses for the commercial use of patents, on agreements on joint research and development, as well as on contracts with foreign and Russian companies for the development of technical documentation, production and supply of various types of original, unique electrochemical equipment having no analogues in the world. Such companies include Monsanto Enviro Chem (St. Louis, Missouri, 1995-1998), Battelle Memorial Institute (Columbus Ohio, 1998-2002), Samsung, Chongway, Puricore, Institute & National Center of Natural Sciences and Technology of Vietnam (Vietnam, Hanoi, 1996 - 2016), Blue Safety (Germany, 2000 - present), NPO EKRAN (Moscow, 1987 - 2010) NPO Khimavtomatika (Moscow, 1988 - present), Izhevsk Kupol factory (1997 - 2007), Delfin-Aqua (Moscow, 2011 - 2015). These companies in the mentioned periods of time produced technical electrochemical systems with the direct participation of the authors of original patents, know-hows, techniques and technologies for electrochemical activation.

Thanks to scientific and technical cooperation with Monsanto, we have succeeded in significant advance in improving the design of unique AQUACHLOR installations and conduct their brilliant industrial tests in the cooling circulating water supply system of the Salt Lake City power plant. We appreciate the motto of the company: Satisfy the client, make money and have fun! Since then, to this day, we have been using it in our work.

Together with the BATTELLE Memorial Institute, a compact unit for the synthesis of ANK anolyte in the field was developed and successful field exercises were conducted with the on-site production and use of Anolyte ANK for treating personnel of marines on leaving a chemical, bacteriological or radiation exposure zone. Another result of joint work with the BATTELLE Institute was the confirmation by the generally accepted methods of more than a hundredfold superiority of the biocidal activity of Anolyte ANK (ECASOL trademark) over a solution of sodium hypochlorite with a concentration of hypochlorite ions fifteen times higher than the concentration of active substances (AS) in Anolyte ANK.

Cooperation with PURICORE allowed us to create a number of technological processes and commercially effective systems in the form of plants for the production of Anolyte ANK varieties with the trade names VASHE, STERILOX, FLORAFRESH, PRODUCEMAXX. Electrochemically activated solutions are used in various fields, including the supermarket system Albertson, Safeway, Lion King, Whole Foods, Amazone, Walmart for aerosol processing of greens, preserving the freshness of flowers, etc.

Also, at PURICORE, its employees and the author's colleagues Svetlana Panicheva and Vadim Panichev developed fundamentally new stabilized products in the form of liquid and gel drugs for human and veterinary medicine. The main and previously unattainable feature of these drugs consists in a special technology of stabilization of highly active charged antagonist components, such as hypochlorous

acid and hydrogen peroxide allowing them to maintain physicochemical and functional properties for more than 2 years with the AS concentration exceeding 500 mg/l.

NPO EKRAN, the former All-Union Scientific Research and Testing Institute of Medical Technology, where the author headed the department of electrochemical medical equipment for many years, produced all kinds of STEL, AQUACHLOR, EMERALD, and many other devices.

Thanks to the licensed technology for the production of electrochemical systems, NPO KHIMAVTOMATIKA produced more than 20,000 STEL devices from 1995 to 2008 and about four hundred ENDOSTERIL devices for sterilizing endoscopes, winning the international tender of the European Bank for Reconstruction and Development for several million Euros. Currently, it is modernizing the equipment for production of modern electrochemical systems.

The company "Delfin Aqua", with which the author and his colleagues cooperated under business and licensing agreements for four years (from the end of 2011 to a part of 2015), created the first models of STEL-ANK-SUPER installations, the use of which made it possible to obtain RF Registration certificates for Anolytes ANK SUPER with various concentrations of oxidants. Also during that period, solutions were found to create self-cleaning electrochemical cells in AQUACHLOR systems.

Blue Safety Company produces unique automated small-sized electrochemical systems ensuring high standards of microbiological protection for dental offices with complete safety of patients, staff and the environment.

New companies keep appearing - scientific partners of the Institute of Electrochemical Systems and Technologies, which at the modern scientific and technological level create new electrochemical equipment, thereby laying the foundation for the work of new researchers and for those who need an environmentally friendly and faultless product. These companies include EMERALD ECOTECHNOLOGIES LLC, which produces new modern options for household equipment for the purification and conditioning of drinking water.

The universality of electrochemical activation technology has been and is attracting smart and educated people by versatility of applications and the unusual nature of the technology. New chemistry, new knowledge, new horizons. And my colleagues, with whom I have been working for many years, feel and understand this. A new wave of researchers, inventors, designers, technologists, organizers of the production of new electrochemical systems is coming. Their names may be a beacon for those seeking the best possible:

Svetlana A. Panicheva , Vadim G. Panichev , Evgeni P. Buchikhin , Nikolai A. Prinzin, Konstantin N .Nesterov, Igor V. Kozlov, Igor A. Grishkov, Vladimir N. Dmitriev, Natalia Yu. Shomovskaya , Pyotr V., Gnatyuk, Ivan V. Gnatyuk, Alexander G. Pogorelov, Maria A. Pogorelova, Jan Papenbrock, Chris Moeningoff, Roger Bagnal.

It’s a pity that many talented researchers in the technologies for using electrochemically activated water and solutions implement their excellently designed experimental and practical work using primitive laboratory, semi-industrial and industrial devices, without information that the physicochemical properties and reactivity of electrochemically activated liquids in the most dramatic way depends on the ability to control electrochemical processes on the electrodes, in the diaphragm and the volume of the electrolyte, by controlling the intensity and direction of the energy and mass transfer of ions through the diaphragm by changing the pressure drop across the diaphragm, variations in the flow rates of liquids, temperature and gas filling of liquids in the electrode chambers, special design features of the reactor and the operating mode of its hydraulic infrastructure - separators, flotation reactors, speed and pressure stabilizers, mixers, absorbers, strippers and other special devices. However, in any

case, the work of researchers, regardless of the tools at their disposal, is necessary and useful, since it indicates guidelines that the joint work of specialists will turn into fruitful scientific and technical areas. Let's hope that this book will speed up this process. The second edition of the book is supplemented by new information received by the authors and their colleagues - successors of the cause of electrochemical activation.

We, the authors of this book and the entire team of the Vitold Bakhir Institute of Electrochemical Systems and Technologies, invite various companies and all interested specialists and scientists to cooperate.

Electrochemical activation, move on and up!

Vitold Bakhir