

Essentials of **Lead-Acid Batteries**



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Lead-acid batteries have attained a significant role in meeting the needs of several decentralized energy users. Lead-acid batteries have made heavy inroads into the social fabric of several developing countries. While the interface of the use of lead-acid batteries is wide and spread out, the essentials of research and development leading to favorable outcome remain far from mature. There is thus still scope for new knowledge. The first use of lead-acid batteries may have been made long ago but the new emerging knowledge in the area makes lead-acid batteries an evolving area of technology.

In the emerging global contacts, the new publication by the Society for Advancement of Electrochemical Science and Technology titled *Essentials of Lead-Acid Batteries* brings into focus several new facets of a product which connects intimately the common man. It is an authoritative account and is truly a masterpiece on the subject. The publication is also a result of a healthy collaboration of many scientists from India and Bulgaria.

The Indo-Bulgarian Inter-Governmental Programme on Science & Technology has laid a platform for a vibrant S&T cooperation and alliance between the two nations. Under this programme, academic exchanges are fostered and facilitated. A series of academic lectures from Academician Detchko Pavlov, Head, Lead-Acid Batteries Division of the Institute of Electrochemistry and Energy Systems (IEEES), Sofia was organized. Professor A.K. Shukla, Director, Central Electrochemical Research Institute (CECRI), Karaikudi in coordination with Dr. B. Hariprakash of the Indian Institute of Science, Bangalore and Dr. T. Prem Kumar of CECRI have compiled and edited the lecture material. An edited publication, *Essentials of Lead-Acid Batteries*, has now been brought out through the sponsorship of the Department of Science & Technology, Government of India. As a practising chemist, I value the publication for its academic content, quality and utility.

Let me congratulate Academician Detchko Pavlov, Professor A.K. Shukla, Dr. B. Hariprakash, Dr. T. Prem Kumar and Er. AK. Kalra (from DST, New Delhi) as well as those who have made this valuable publication possible.

In short, I may document that the present publication is a symbol of a successful bilateral scientific collaboration between the two countries and a symbiotic partnership of two groups of outstanding scientists. It is a pleasure to acknowledge the collaborative spirit and academic value among some of the outstanding global Citizens of Science. The Department of Science & Technology has brought out this publication with the hope that it would be of immense value to the battery industry.

T. Ramasami
Secretary
Department of Science & Technology
New Delhi, India

An Agreement on Cooperation in Science & Technology between the governments of the Republic of India and the Republic of Bulgaria was concluded on November 10, 2000 with an aim to carry out joint research activities. The Department of Science & Technology of the Government of India and the Ministry of Education & Science of the Government of Bulgaria are responsible for the supervision, coordination and implementation of the Agreement.

I had a good opportunity of visiting the Central Laboratory of Electrochemical Power Sources (CLEPS) in Sofia in April 2002. CLEPS is a world-class laboratory with up-to-date scientific equipment and computerized test facilities. The fundamental and applied work on the development of different types of batteries are also focused on the development of appropriate charge regimes, investigation of lead alloy corrosion, advancement of new technologies, new materials and additives, etc.

As a follow up of my visit to CLEPS, Sofia, detailed discussions were held with Professor A.K. Shukla, Director, Central Electrochemical Research Institute (CECRI), Karaikudi for framing a joint research project with the Bulgarian side. A project titled *Development of low-cost, high-energy density lead-acid batteries*, with a view to develop low-cost high-energy density lead-acid batteries and to improve the battery performance under high temperature conditions was then duly framed for support from the Department of Science & Technology on the Indian side and the Ministry of Education & Science / Bulgarian Academy of Sciences on the Bulgarian side. It was recommended for implementation in October 2003 and its implementation was started in April 2004. It is heartening to mention that under the Indo-Bulgarian joint project various characterization studies on the compatibility of the grids for lead-acid batteries have progressed. Concomitantly, 6V-135 Ah batteries have been developed and supplied jointly by the Indian Institute of Science, Bangalore and NED Energy Ltd., Hyderabad to Reva Electric Car Company, Bangalore for field trials.

Academician D. Pavlov, Director, Institute of Electrochemistry and Energy Systems (formerly known as CLEPS) is known internationally for his contributions to the development of lead-acid batteries. He has extensive experience in electrochemical power sources and leads research in the area of lead-acid batteries. He is the Principal Investigator of the Indo-Bulgarian

Joint Research Project. We are thankful to Professor Shukla for organizing the lecture series by Academician Pavlov in association with the Society for Advancement of Electrochemical Science & Technology at the Indian Institute of Science, Bangalore during November 19-23, 2005. I personally had the opportunity of participating in the lectures by Academician Pavlov and presentation by Professor Shukla under the Indo-Bulgarian S&T cooperation activities. It is indeed gratifying to acknowledge the efforts put in by Academician D. Pavlov as well as Professor A.K. Shukla and his colleagues in implementing the joint work and in organizing the lecture series. I specially thank Mr. KR. Karupiah and Ms. T. Sri Devi Kumari for their tremendous effort in organizing the lectures in book form. I am particularly indebted to Mr. S.A. Gaffoor of NED Energy Ltd., for all the spadework he did in organizing this lecture series. Based on the positive feedback of other R&D institutions and the Indian Industry on the developments, the Department of Science and Technology took a decision to get the valuable lecture material edited by Professor A.K. Shukla and his colleagues for subsequent printing in the form of a valuable book titled *Essentials of Lead-Acid Batteries*.

It is hoped that this publication would be useful to the Battery Industry, in general, and to the electrochemical community in India, in particular.

A.K. Kalra
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New Delhi, India

The Lead-Acid Batteries Department at the Institute of Electrochemistry and Energy Systems (IEES) under the Bulgarian Academy of Sciences (BAS) and the Central Electrochemical Research Institute (CECRI), Karaikudi, India have been working on a joint research project titled *Development of low-cost, high-energy density lead-acid batteries* implemented within the Indo-Bulgarian Inter-Governmental Programme of Cooperation in Science & Technology. I learn that as a part of this project, Academician Detchko Pavlov, Head of LABD/IEES presented a series of lectures on lead-acid battery science and technology at the Indian Institute of Science, Bangalore during November 2005, which was well received by the audience comprising battery researchers from various R&D institutions and lead-acid battery manufacturers in India. Based on the suggestion made by your good self, Professor A.K. Shukla in association with Drs. B. Hariprakash and T. Prem Kumar have compiled and edited these lectures in the form of a book titled *Essentials of Lead-Acid Batteries*. The book is sponsored by the Department of Science and Technology, New Delhi and published by the Society for Advancement of Electrochemical Science and Technology, Karaikudi. I am sure that the book will be an asset to both lead-acid battery researchers and technologists.

The Bulgarian Academy of Sciences wants to extend its highest appreciation to you and especially to Professor A.K. Shukla for his efforts in organizing the above said lecture series, and in compiling and editing the lectures in the form of a book. We also wish to place on record the seminal strides made under joint R&D project between CECRI and IEES, BAS, as also for successfully establishing industry-academia relationship both in India and in Bulgaria. We not only hope but firmly believe that the Indo-Bulgarian Science and Technology collaboration will become still stronger in the years to follow.

Academician Nikola Sabotinov
Vice President
Bulgarian Academy of Sciences
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