Federal Ministry
for Economic Affairs
and Climate Action

ZIM
Zentrales
Innovationsprogramm
Mittelstand

ZIM Success Story

Bipolar Plates for Modern Battery Systems

Vanadium redox flow batteries offer vast potential as energy storage systems to support the transition to renewable energies. The expertise gained in a research and development project at ZIM with partners from Singapore for such a battery can be implemented in both industrial applications and photovoltaic home storage systems. Components for the battery system are marketed, primarily in Asia, by Whitecell Eisenhuth GmbH & Co. KG.

Reliable and affordable storage technologies are essential to make the energy transition succeed. Vanadium redox flow batteries (VRFB) are increasingly establishing themselves as a cost-effective means of storing large amounts of energy.

Electrochemical liquid storage systems offer many advantages when implemented as a stationary solution. Above all, VRFBs are characterized by a high cycle stability. This means that the large number of possible charging and discharging processes enables system operators to use the system for approx. 15 to 20 years. In contrast to solid-state batteries, such as lithium-ion batteries, VRFBs are non-flammable due to their high water content and are therefore safer to operate. Vanadium, which is required for the technology, is an abundant element on earth, so raw material supply bottlenecks are not likely to occur in the foreseeable future.

Similar to fuel cells, redox flow batteries convert chemical energy into electrical energy by means of ion exchange. The battery capacity is determined by the amount of liquid electrolyte. The central component of a VRFB is the battery stack, an electrochemical flow reactor that converts energy as the electrolyte passes through it. Its performance determines the efficiency and costs of the electricity storage system.

The product and its innovation

A battery stack consisting of approx. 30-50 individual cells with an output of up to five kilowatts was researched and constructed in the transnational ZIM project. On the German side, the main focus was on the material development and scaling of the bipolar plates used to a size of 500 square centimeters. Bipolar plates are a crucial component in the stack structure of the flow reactor. They ensure contact between adjacent battery cells as an internal current conductor, while also ensuring the supply and removal of the liquid reaction media. Whitecell Eisenhuth GmbH & Co. KG based in Germany's state of Lower Saxony focused on designing a new carbon composite

that features better electrical conductivity and high corrosion resistance. This was to serve as the base material for the new bipolar plates. The University of Duisburg-Essen (UDE) simulated the fluid mechanical behavior of the reaction media on the bipolar plates and experimentally validated their performance in an individual battery cell. The Singaporean partners were responsible for building the battery cell stack into a full-fledged prototype. To this end, VFlowTech Pte. Ltd. adapted the stack design to the

Unpopulated frame of a battery stack

bipolar plates designed by Eisenhuth and UDE. Nanyang Technological University also supported the UDE in developing the measuring technology.

Market and customers

The bipolar plates produced based on the project results are marketed by Whitecell Eisenhuth. VFlowTech Pte. Ltd. in Singapore installs the bipolar plates in its own redox flow battery systems and sells them primarily in Asia. As a result, Whitecell Eisenhuth was able to establish a sales market in Singapore and other Asian countries. This led to an order from China in July 2022 thanks to the pioneering technology developed in the ZIM project. As Singapore acts as a technology hub for other Asian countries, orders from India for a large number of units were generated as early as 2022. At Whitecell Eisenhuth, the growing demand on the Asian market has already led to the creation of three new jobs.

The partners

Founded in 1945, Whitecell Eisenhuth GmbH & Co. KG specializes in the manufacture of components for fuel cells and electrolyzers. The company's core expertise covers mold construction as well as small and medium series of molded parts made of plastic, rubber and silicone. The company is a supplier to the automotive, medical, food and mechanical engineering industries. It currently employs a staff of 70.

The University of Duisburg-Essen with its Chair of Energy Technology (LET) has been active in fuel cell and battery research since 1995. The LET department boasts an extensive technology center, including production technology for the material development of stack structures and test facilities. Research focuses on the design, construction and optimization of fuel cells, batteries and electrolyzers as well as the development of system control hardware and software.

Project information

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Information about the program

The Central Innovation Programme for SMEs (ZIM) of the Federal Ministry for Economic Affairs and Climate Action provides funding to all technologies and sectors:

- Individual projects
- Cooperation projects
- Innovation networks and feasibility studies prior to R&D projects.

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