Research underway to cut cost, boost energy density of Vanadium Redox Flow Battery, inventor says

[WEDNESDAY, 26 APRIL 2023]- To increase the adoption of renewable energy and achieve net-zero carbon emissions globally by 2050, the world will require safe, cost-effective, and reliable energy storage systems. The Vanadium Redox Flow Battery (VRFB) is a proven energy storage technology that can unlock the full potential of the clean energy transition through the effective storage and use of renewable energy.

The VRFB was first pioneered in the 1980's by Dr. Maria Skyllas-Kazacos, an Australian chemical engineer, Emeritus Professor at the University of New South Wales (UNSW). It is currently the most widely adopted energy storage technology for long-duration, utility-scale energy storage applications because it is durable, recyclable and has a high safety rating. Hundreds of these long-life batteries have been installed worldwide – with many more under construction and being planned.

To further promote VRFB technology and expand its share in the energy storage market, Vanitec, the not-for-profit international global member organisation whose objective it is to promote the use of vanadium-bearing materials, together with Vanitec-CISRI Vanadium Technology Center hosted the 12th Vanitec Energy Storage Committee Meeting in conjunction with the 2023 International Conference on Vanadium Redox Flow Batteries (VRFB2023) on 15-16 March 2023 in Chengdu, China and online.

Speaking at the event, Dr. Skyllas-Kazacos said that since the development of the first VRFB, several companies have started to successfully commercialise VRFB systems around the world.

The professor said that electrochemical and thermal modelling and control of VRFBs are the research areas currently receiving the most attention at the university. Research has found that improved electrolyte chemistry is enhancing energy density and operating temperature ranges of VRFBs.

The current focus for VRFB technology is to further reduce the cost of a VRFB while also increasing its energy density, the professor said.

"We are now seeing new membrane and electrode materials helping to reduce the cost, while improved cell architectures are enhancing power density, which also results in cost reductions," she said.

Electrocatalysis studies are under way to enhance the activity of the electrodes and improve power density while researchers are also looking at ways to enhance the energy density using organic and inorganic electrolyte additives, such as the commonly used phosphoric acid.

Dr. Skyllas-Kazacos said that apart from investigating ways to increase the energy density of VRFBs, more research is being conducted on reducing component costs in the VRFB stack, such as developing lower cost membranes and reducing the vanadium requirement or electrolyte purity, which is one of the most expensive components of a VRFB.

Dr. Skyllas-Kazacos suggests that one of the ways to reduce the amount of vanadium needed is by moving away from the conventional VRFB technology to a Vanadium-Oxygen Redox Fuel Cell (VOFC). In a VOFC, the positive half-cell electrolyte is replaced with an oxygen gas diffusion electrode – which in turn halves the electrolyte volume and vanadium requirement.

While considerable research and development is required before commercialisation, the VOFC offers potential energy densities of up to 100Wh/litre with half the vanadium requirements.

If you were unable to attend the 12th Vanitec Energy Storage Committee Meeting in conjunction with the 2023 International Conference on Vanadium Redox Flow (VRFB2023) in-person or virtually, you can access links to both the English and Chinese presentations on the Vanitec website: https://www.vanitec.org/vanadium/ESC-Meetings

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