Flow battery technology sucre

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A flow battery, or redox flow battery (after reduction-oxidation), is a type of electrochemical cell where chemical energy is provided by two chemical components dissolved in liquids that are pumped through the system on separate sides of a membrane.[2][3] Ion transfer inside the cell (accompanied by current flow through an external circuit) occurs across the membrane while the liquids circulate in their respective spaces.

Various flow batteries have been demonstrated, including inorganic[4] and organic forms.[5] Flow battery design can be further classified into full flow, semi-flow, and membraneless.

The fundamental difference between conventional and flow batteries is that energy is stored in the electrode material in conventional batteries, while in flow batteries it is stored in the electrolyte.

A flow battery may be used like a fuel cell (where new charged negolyte (a.k.a. reducer or fuel) and charged posolyte (a.k.a. oxidant) are added to the system) or like a rechargeable battery (where an electric power source drives regeneration of the reducer and oxidant).

Patent Classifications for flow batteries had not been fully developed as of 2021. Cooperative Patent Classification considers RFBs as a subclass of regenerative fuel cell (H01M8/18), even though it is more appropriate to consider fuel cells as a subclass of flow batteries.[citation needed]

Cell voltage is chemically determined by the Nernst equation and ranges, in practical applications, from 1.0 to 2.43 volts. The energy capacity is a function of the electrolyte volume and the power is a function of the surface area of the electrodes.[8]

Walther Kangro, an Estonian chemist working in Germany in the 1950s, was the first to demonstrate flow batteries based on dissolved transition metal ions: Ti-Fe and Cr-Fe.[10] After initial experimentations with Ti-Fe redox flow battery (RFB) chemistry, NASA and groups in Japan and elsewhere selected Cr-Fe chemistry for further development. Mixed solutions (i.e. comprising both chromium and iron species in the negolyte and in the posolyte) were used in order to reduce the effect of time-varying concentration during cycling.

In the late 1980s, Sum, Rychcik and Skyllas-Kazacos[11] at the University of New South Wales (UNSW) in Australia demonstrated vanadium RFB chemistry UNSW filed several patents related to VRFBs, that were later licensed to Japanese, Thai and Canadian companies, which tried to commercialize this technology with varying success.[12]

In 2022, Dalian, China began operating a 400 MWh, 100 MW vanadium flow battery, then the largest of its type.[14]

Sumitomo Electric has built flow batteries for use in Taiwan, Belgium, Australia, Morocco and California. Hokkaido''s flow battery farm was the biggest in the world when it opened in April 2022 -- until China deployed one eight times larger that can match the output of a natural gas plant.[15]

A flow battery is a rechargeable fuel cell in which an electrolyte containing one or more dissolved electroactive elements flows through an electrochemical cell that reversibly converts chemical energy to electrical energy. Electroactive elements are "elements in solution that can take part in an electrode reaction or that can be adsorbed on the electrode."[16]

Flow batteries typically have a higher energy efficiency than fuel cells, but lower than lithium-ion batteries.[22]

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