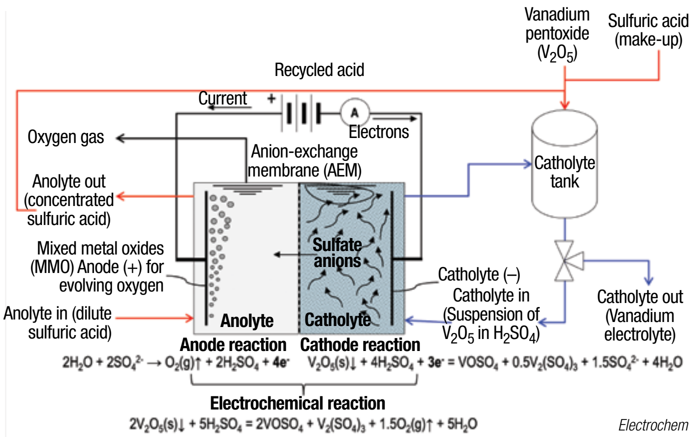
An electrochemical process for producing and recycling VRFB electrolytes

Electrochem Technologies & Materials Inc. (Montreal, Canada; www.electrochem-technologies.com) has recently patented its process for the production and recycling of all vanadium electrolytes (VE) used in vanadium redox flow batteries (VRFBs). This electrochemical technology offers a sound and profitable alternative to the chemical production of electrolyte, says company president, François Cardarelli.

Industrially, all vanadium sulfates electrolyte solutions are prepared chemically by reacting high-purity vanadium pentoxide (V_2O_5) as starting material with high-purity sulfuric acid. However, the chemical process requires the use of a reducing agent that allows the reduction of the barely soluble peroxovanadium (VO_2^+) cation into highly soluble vanadyl (VO^{2+}) cation and, to a lesser extent, V^{3+} cation to reach the targeted molarities. The proper reducing agent used is either an organic compound, such as oxalic acid, or an inorganic reagent, such as vanadium (III) oxide (V_2O_3), sulfur or gaseous SO_2. During the chemical processes, the dissolution reaction kinetics are driven by temperature and the concentrations of both H_2SO_4 and the reducing agent. As a result, the production rate is not easily adjustable, Cardarelli says.

By contrast, the single-step electrochemical process is only driven by the amount of electricity supplied — no additional chemicals are required, because the reduction is only performed by the electrons provided at the cathode, explains Cardarelli. In Electrochem's process (flowsheet), the suspension (slurry) made of solid V_2O_5 with H_2SO_4 is electrolyzed inside the cathode compartment of a divided electrolyzer with a plate-and-frame configuration and separated with an anion-exchange membrane (AEM). The electrolysis is conducted until the catholyte — made of equimolar acidic solution of vanadium (III) and vanadium (IV) sulfates — is finally produced. Meanwhile, in the anode compartment, the anolyte (dilute H_2SO_4) is concentrated until the maximum H_2SO_4 concentration is reached and it can be recycled with make-up H_2SO_4 for producing a new batch of catholyte.

The process is also used to recycle end-of-life spent vanadium electrolytes, because the process removes deleterious impurities. The process is currently performed commercially at Electrochem's facilities in Boucherville to produce tradenamed electrolyte formulations Vanalyte and SuperVanalyte, and to recycle used electrolytes. Ongoing discussions with users and constructors are underway to build skid-mounted or containerized modular units that can be deployed on-site, with nameplate capacities ranging from 5,000 to 25,000 L/d.



Electrochem

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ing sites — Wacker Biotech in Amsterdam, the Netherlands, and CordenPharma in Caponago, Italy. The aim is to offer a broad spectrum of LNP formulations, which the companies plan to produce as contract manufacturers according to good manufacturing practice (GMP) guidelines.

BIOTIN

In January, Wacker also signed a contract with Biosynthia ApS (Copenhagen, Denmark; www.biosynthia.com) to develop a large-scale fermentation-based process for the production of biotin (vitamin B7) — a coenzyme for the metabolism of proteins, fats and carbohydrates. The companies are dedicating "considerable" R&D resources in a multi-year program, which will build on Biosyntia's biotin technology. Only plant-based raw materials will be used in fermentative production.

Biotin has a wide range of appli-

(Continues on p. 8)

Advanced amine-scrubbing solvent offers carbon-capture advantages

Honeywell UOP (Des Plaines, Ill.; www.honeywell.com/uop) recently began offering a post-combustion carbon-capture system based on new advanced solvent technology that allows for improved carbon-capture economics for hard-to-abate industries, such as steelmaking, rotary kiln operations (such as cement-making) and natural-gas power production. The advanced solvent technology has been licensed by Honeywell UOP from the University of Texas at Austin (www.utexas.edu), where the technology was developed at the Texas Carbon Management Program, led by chemical engineering professor Gary Rochelle.

The proprietary amine solvent developed by Rochelle's group has two distinct advantages over conventional amine solvents used to capture CO_2 from fluegas. First, it absorbs CO_2 more quickly than other current-generation solvents, allowing for a shorter absorber for the capture phase, which saves capital costs. Second, the solvent is more thermally stable, so the stripper (for solvent recovery and CO_2 collection) can be operated at higher temperatures and pressures. This lowers the energy requirements for compressing the captured CO_2, explains Rochelle. Beyond the solvent, the advanced carbon-capture system has an enhanced heat-recovery system that allows improved utilization of heat energy. Taken together, the system has improved process economics for carbon capture, making it more viable for CO_2 abatement at industrial facilities.

The commercially available technology works at a wide range of CO_2 concentrations, but 4–20% CO_2 in fluegas is the projected operating range, Rochelle says, and it is available for installation at new facilities or to be retrofitted onto existing ones. Ben Owens, vice president and general manager, Honeywell Sustainable Technology Solutions, says the company has begun dialogues with several potential customers, but has not yet announced the first CO_2-capture project using the advanced solvent technology.