ALTA PROCESS SOLUTIONS

AFFILIATED TO ALTA ENERGY SOLUTIONS CORPORATION

ALTIUS CENTRE – SUITE 2500 – 500 4th AVE SW CALGARY, AB, T2P 2V6 CANADA

INFO@ALTAENERGY.CA | WWW.ALTAENERGY.CA | WWW.ALTAPROCESS.CA

SCIENTIFIC & RESEARCH PROJECTS

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Project Title:

Numerical Investigation and Thermodynamic Analysis of The Effect of Electrolyte Flow Rate on Performance of All Vanadium Redox Flow Batteries

Abstract:

In flow batteries, electrolyte flow rate plays a crucial role on the minimizing mass transfer polarization which is at the compensation of higher pressure drop. In this work, a two-dimensional numerical method is applied to investigate the effect of electrolyte flow rate on cell voltage, maximum depth of discharge and pressure drop a six-cell stack of VRFB. The results show that during the discharge process, increasing electrolyte flow rate can raise the voltage of each cell up to 50 mV on average. Moreover, the maximum depth of discharge dramatically increases with electrolyte flow rate. On the other hand, the pressure drop also positively correlates with electrolyte flow rate. In order to investigate all these effects simultaneously, average energy and exergy efficiencies are introduced in this study for the transient process of VRFB. These efficiencies give insight into choosing an appropriate strategy for the electrolyte flow rate. Finally, the energy efficiency of electricity storage using VRFB is investigated and compared with other energy storage systems. The results illustrate that this kind of battery has at least 61% storage efficiency based on the second law of thermodynamics, which is considerably higher than that of their counterparts.