



Oliver Hildebrandt

Zur Dynamik von Redox-Flow-Batterien

**Einsatz von Energiespeichern
an dezentralen Erzeugeranlagen**

Zur Dynamik Redox Flow Batterien Energiespeichern Erzeugeranlagen

Oliver Hildebrandt



Zur Dynamik Redox Flow Batterien Energiespeichern Erzeugeranlagen:

Zur Dynamik von Redox-Flow-Batterien: Einsatz von Energiespeichern an dezentralen Erzeugeranlagen Oliver Hildebrandt, 2015-05 Die von Wind und Photovoltaikanlagen erzeugte Energie fluktuiert und ist oft nicht bedarfsgerecht Im Zusammenhang regenerativer Kraftwerke mit fluktuierender Leistungsabgabe stellt sich immer auch die Frage einer zeitlichen Entkopplung von Erzeugung und Verbrauch d h der Speicherung der Energie Sie soll vorgehalten werden und im Bedarfsfall Regelleistung liefern können Redox Flow Batterien RFB basieren auf dem Prinzip der chemischen Energiespeicherung und stellen eine Möglichkeit zur Lösung des Problems dar Sie besitzen das Potential für große technische Anwendungen z B in einem Windpark In der vorliegenden Arbeit soll die Frage bearbeitet werden ob eine Redox Flow Batterie bei der notwendigen Dynamik verfügt in einem Gesamtsystem mit einer oder mehreren Windkraftanlagen auf einen schwankenden Leistungsbedarf zu reagieren Je nach Bedarf und Angebot kann es zu schnellen Wechseln zwischen Leistungsaufnahme und abgabe kommen Dabei wird von der Zielvorstellung ausgegangen dass die Anlage bestehend aus Kraftwerk und RFB dezentral am Nieder oder Mittelspannungsnetz angeschlossen ist Energie nach Plan liefern und somit bezüglich der Frequenzhaltung netzstabilisierend wirken kann Für den Betreiber einer solchen Anlage würden sich bei der Vergütung nach dem Erneuerbare Energien Gesetz hinaus zusätzliche Vermarktungsmöglichkeiten der erzeugten Energie ergeben

Die Dynamik von Redox-Flow-Zellen Oliver Spelters, 2011-03-02 Bachelorarbeit aus dem Jahr 2010 im Fachbereich Elektrotechnik Note 1,0 Fachhochschule Nordhausen Ingenieurwissenschaften Veranstaltung Regenerative Energietechnik Sprache Deutsch Abstract Die Betrachtung zur Dynamik einer Redox Flow Zelle steht in der vorliegenden Arbeit im Kontext der Anwendung von Energiespeichern gekoppelt an eine dezentrale Erzeugeranlage mit fluktuierender Leistungsabgabe Vor dem Hintergrund der zunehmenden Dezentralisierung der Energieerzeugung im Niederspannungs und Mittelspannungsnetz wird gezeigt dass solch eine Anlage in der Lage wäre einen Beitrag zur Netzstabilisierung zu liefern Dafür muss der Energiespeicher technische Anforderungen hinsichtlich der Dynamik erfüllen um auf einen schwankenden Leistungsbedarf reagieren zu können Redox Flow Batterien haben das Potenzial für große technische Anwendungen mit hohem Wirkungsgrad und außerdem den Vorteil dass ihre Leistung und Kapazität unabhängig voneinander skalierbar sind In einer Übersicht werden ihre verschiedenen Ausführungen dargestellt und Redox Flow Batterien auch mit Speichersystemen verglichen die für die anvisierte Anwendung in Frage kommen Zentrales Thema dieser Arbeit ist die Erprobung der Dynamik einer Vanadium Redox Flow Zelle die dafür eigens am Institut für chemische Verfahrenstechnik der Technischen Universität Clausthal aufgebaut wurde Vorab erfolgt eine Zusammenstellung von veröffentlichten Verfahrenstechniken zum Aufbau und die Beschreibung der für die Messungen konstruierten Zelle Im Anschluss werden die mit einem Batterietestgerät durchgeführten Messungen und deren Ergebnisse dargestellt *Betrachtung zur Dynamik von Redox-Flow-Zellen* Oliver Spelters, 2011 Bachelorarbeit aus dem Jahr 2010 im Fachbereich Elektrotechnik Note 1,0 Fachhochschule Nordhausen

Ingenieurwissenschaften Veranstaltung Regenerative Energietechnik Sprache Deutsch Abstract Die Betrachtung zur Dynamik einer Redox Flow Zelle steht in der vorliegenden Arbeit im Kontext der Anwendung von Energiespeichern gekoppelt an eine dezentrale Erzeugeranlage mit fluktuierender Leistungsabgabe Vor dem Hintergrund der zunehmenden Dezentralisierung der Energieerzeugung im Niederspannungs und Mittelspannungsnetz wird gezeigt dass solch eine Anlage in der Lage w re einen Beitrag zur Netzstabilisierung zu liefern Daf r muss der Energiespeicher technische Anforderungen hinsichtlich der Dynamik erf llen um auf einen schwankenden Leistungsbedarf reagieren zu k nnen Redox Flow Batterien haben das Potenzial f r gro technische Anwendungen mit hohem Wirkungsgrad und au erdem den Vorteil dass ihre Leistung und Kapazit t unabh ngig voneinander skalierbar sind In einer bersicht werden ihre verschiedenen Ausf hrungen dargestellt und Redox Flow Batterien auch mit Speichersystemen verglichen die f r die anvisierte Anwendung in Frage kommen Zentrales Thema dieser Arbeit ist die Erprobung der Dynamik einer Vanadium Redox Flow Zelle die da f r eigens am Institut f r chemische Verfahrenstechnik der Technischen Universit t Clausthal aufgebaut wurde Vorab erfolgt eine Zusammenstellung von ver ffentlichten Verfahrenstechniken zum Aufbau und die Beschreibung der f r die Messungen konstruierten Zelle Im Anschluss werden die mit einem Batterietestger t durchgef hrten Messungen und deren Ergebnisse dargestellt

Techno-ökonomische Modellierung und Bewertung von stationären Vanadium-Redox-Flow-Batterien im industriellen Maßstab Christine Minke, 2016-07-21 Die Vanadium Redox Flow Batterie stellt eine der aussichtsreichsten Technologien f r die Tagesspeicherung elektrischer Energie im industriellen Ma stab dar Neben dem Scale up auf den zweistelligen Megawattbereich stellt das Erreichen von Kostenzielen einen wesentlichen Meilenstein auf dem Weg zur Realisierung gro technischer Systeme dar In der vorliegenden Arbeit wird die Entwicklung industrieller Speichersysteme mit gro fl chigen Elektroden unter technischen und wirtschaftlichen Gesichtspunkten untersucht Basierend auf einer detaillierten Technologieanalyse mit dem Fokus auf geeigneten Materialien und Fertigungstechnologien f r die Kernkomponenten Membranen Elektroden und Bipolarplatten wird ein synthetisches Kostenmodell erstellt Dieser Ansatz erlaubt transparente Aussagen ber technische Limitierungen und realistische Kostenbereiche f r Speichersysteme und deren Komponenten F r geeignete Batterie Set ups im Megawattbereich werden Kostensenkungspotenziale identifiziert und bewertet

Flow Batteries Christina Roth, Jens Noack, Maria Skyllas-Kazacos, John Wiley & Sons, 2022 From basics to commercial applications Flow Batteries covers the main aspects and recent developments of Redox Flow Batteries FBs or RFBs encompassing the electrochemical fundamentals the used materials and their characterization Flow Batteries The premier reference on flow battery technology for large scale high performance and sustainable energy storage From basics to commercial applications Flow Batteries covers the main aspects and recent developments of Redox Flow Batteries from the electrochemical fundamentals and the materials used to their characterization and technical application Edited by a team of leading experts including the founding mother of vanadium flow battery technology Maria Skyllas Kazacos the full scope of

this revolutionary technology is detailed including chemistries other than vanadium and organic flow batteries Other key topics covered in Flow Batteries include Flow battery computational modeling and simulation including quantum mechanical considerations cell stack and system modeling techno economics and grid behavior A comparison of the standard vanadium flow battery variant with new and emerging flow batteries using different chemistries and how they will change the field Commercially available flow batteries from different manufacturers their technology and application ranges The pivotal role of flow batteries in overcoming the global energy crisis Flow Batteries is an invaluable resource for researchers and engineers in academia and industry who want to understand and work with this exciting new technology and explore the full range of its current and future applications *Redox Flow Batteries* Huamin Zhang,Xianfeng Li,Jiujun Zhang,2017-11-22

Flow batteries have received attention in large scale energy storage due to their flexible design high safety high energy efficiency and environmental friendliness In recent years they have been rapidly developed and tested in a variety of scales that prove their feasibility and advantages of use As energy becomes a global focus it is important to consider flow battery systems This book offers a detailed introduction to the function of different kinds of redox flow batteries including vanadium flow batteries as well as the electrochemical processes for their development materials and components applications and near future prospects Redox Flow Batteries Fundamentals and Applications will give readers a full understanding of flow batteries from fundamentals to commercial applications *Modellierung der Crossover-Prozesse und Entwicklung von Kapazitätsausgleichsstrategien zur Betriebsoptimierung von Vanadium-Redox-Flow-Batterien* Katharina Schafner,2020-01-04

Die Vanadium Redox Flow Batterie ist ein Energiespeichersystem das eine wichtige Komponente im Rahmen der Energiewende sein kann Durch ihren Aufbau weist diese Batterie Vorteile als stationärer Speicher gegenüber anderen Speichertechnologien auf So sind Leistung und Kapazität unabhängig voneinander skalierbar und im Standby-Betrieb findet lediglich eine geringe Selbstentladung statt Im Betrieb kommt es jedoch durch eine Kreuzkontamination von Vanadium-Ionen durch die Membran zu Verlusten Dieser als Crossover bezeichnete Prozess führt zur kontinuierlichen Abnahme der Batteriekapazität Als Transportmechanismen wirken Diffusion Migration und Konvektion Um den Crossover-Prozess zu beschreiben werden im Rahmen dieser Arbeit die Membranparameter elektrischer Widerstand und Vanadium-Diffusionskoeffizienten experimentell bestimmt und zur Entwicklung eines mathematischen Modells verwendet Messungen am Prototyp dienen hierbei der Modellvalidierung Um der Abnahme der Kapazität entgegenzuwirken werden experimentell und mathematisch verschiedene Kapazitätsausgleichsstrategien entwickelt und analysiert Es hat sich hierbei gezeigt dass mit unterschiedlichen Methoden die Kapazitätsabnahme der Batterie verringert und dadurch ein effizienterer Betrieb ermöglicht werden kann

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