NANOPOROUS COMPOSITE SEPARATORS FOR REDOX FLOW BATTERIES

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Nanoporous separator for RFB

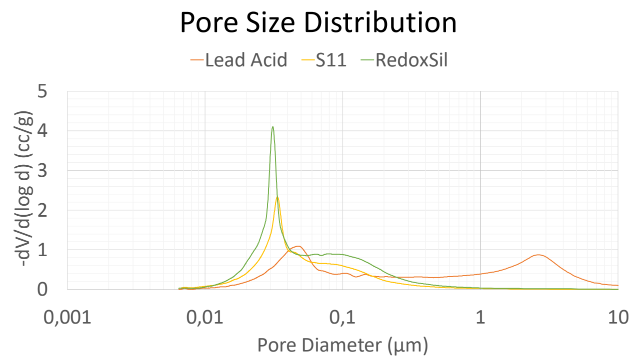
Amer-Sil has developed a next-generation **PVC-Silica membrane** specifically engineered for Redox Flow Battery (RFB) applications. This membrane is manufactured using a controlled **extrusion and calendering** process that ensures mechanical integrity and optimal performance. The membrane is produced with customizable thickness in continuous sheet and rolled. Finally, they are cut to dimension as specified by the final client.

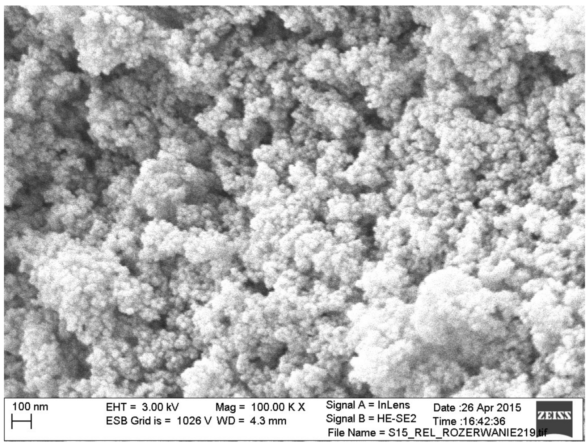
The result is a **fluorine-free, mineral oil-free, and additive-free** membrane, with **no leachable** ensuring chemical purity and long-term stability in electrochemical environments. Designed with sustainability and cost-efficiency in mind, this PVC-Silica membrane is offered at a **highly price-performance ratio** compared to leading reference membranes currently on the market, making it a high-value alternative for large-scale energy storage systems.

From Amer-Sil lead acid separator to Amer-Sil RFB separator

	Lead Acid separator		Amer-Sil separator customized for RFB	
	PVC-SiO_2 (Amer-Sil)	Polyethylene	1st Generation	Redox-Sil
Backweb (mm)	0.40	0.50	0.40	0.40
Porosity (cm^3/g)	1.28	1.07	0.89	1.32
Pore size (nm)	bimodal	265	33	31
ASR (H_2SO_4 37 %) (mOhm cm^2)	100	290	160	155
Elongation at break (%)	10 – 15	519	5	13
Diffusion rate* (72 h) (%)	48	n.d.	32	34

**Diffusion rate: the separator is placed in a diffusion cell with two compartments with respectively $CuSO_4$ and $MgSO_4$ 0.15 M in H_2SO_4 2.5 M. The diffusion rate is monitored via light absorbance at a wavelength of 810 nm.*





VFB Evaluation

	Amer-Sil	N115
ASR (Ohm cm^2)	0.90	1.01
CE (%)	89.2	97.3
VE (%)	87.6	87.0
EE (%)	78.1	84.7
Price (EUR)	$	$$$

*Polyvinyl Chloride/Silica Nanoporous Composite Separator for All-Vanadium Redox Flow Battery Applications; Xiaoliang W., Zimin N., Qingtao L., Bin L., Sprenkle V. ,Wei W., **Journal of The Electrochemical Society**, 2013, 160 (8) A1215-A1218*

Separator feedback compared to a reference membrane: EE loss

Vanadium (example #1)	-12 %
Vanadium (example #2)	-5 %
Pb-Fe	-8 %
Fe-Cr	-7 %

Summary

In RFB, a **separator** could be more suitable than a **membrane** when the focus is on cost-effectiveness, scalability, and acceptable performance in systems where high ionic selectivity is not critical.

Membranes are typically **expensive**, have **limited chemical stability** in some redox chemistries, and can introduce **ionic resistance**, which lowers overall system efficiency. In contrast, a **separator** is a **non-selective porous material** that physically separates the two electrolyte chambers while allowing the passage of ions to maintain charge balance. While it does not prevent crossover of active species as effectively as a membrane, a separator:

- Is **significantly cheaper** to produce and scale,
- Can be made from chemically robust materials suitable for a wide range of electrolytes,
- Is mechanically simple and easy to integrate in large-scale systems.

For many RFB applications (e.g. where active species can be regenerated) this trade-off is acceptable. The reduced cost and simplicity of separators make them attractive for **grid-scale energy storage**, where economic factors often outweigh marginal efficiency gains.