Zoltek Carbon Felt Electrode Materials - An Overview

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Agenda

I. Zoltek Product Introduction

II. Redox Flow Battery Electrodes Features & Supply Chain

III. Electrode Physical Properties

IV. Activated Cell Performance & Electrode Characterization

V. Summary

Introduction

ZOLTEK PRODUCTS

ZOLTEK PX30	ZOLTEK PX35	ZOLTEK OX
99 % Carbon Content for Extreme Heat & Harsh Environments.	Superior Strength to Weight Performance.	Outperforms All Other Organic Flame Resistant Fibers.

CARBON YARN

CARBON FABRIC

CARBON 50K TOW CHOPPED, PLATE

CARBON FABRIC, FELT

TOW

STAPLE

YARN

FELT,FABRIC

ZOLTEK Toray Group

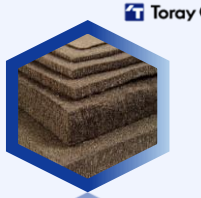
Zoltek Quality Management Systems are certified to the Standards of AS9100D and ISO 9001:2015.

Locations

Hungary
Mexico
United States

Redox Flow Battery Electrodes Features & Supply Chain

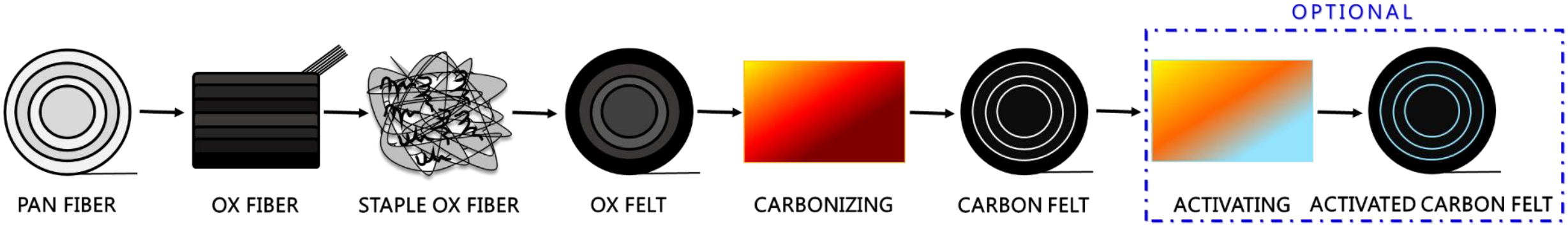
ZOLTEK Toray Group



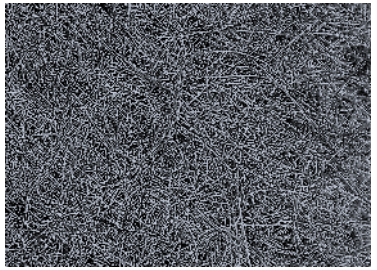
REDOX FLOW BATTERY ELECTRODE FEATURES

- ✓ 95% carbon content
- ✓ Corrosion resistant
- ✓ Optimized for best quality
- ✓ Good permeability
- ✓ Elasticity - compressibility
- ✓ Customizable - activation
- ✓ Electrically conductive
- ✓ Thermally stable
- ✓ High production capacity

Supply Chain



Electrode Physical Properties



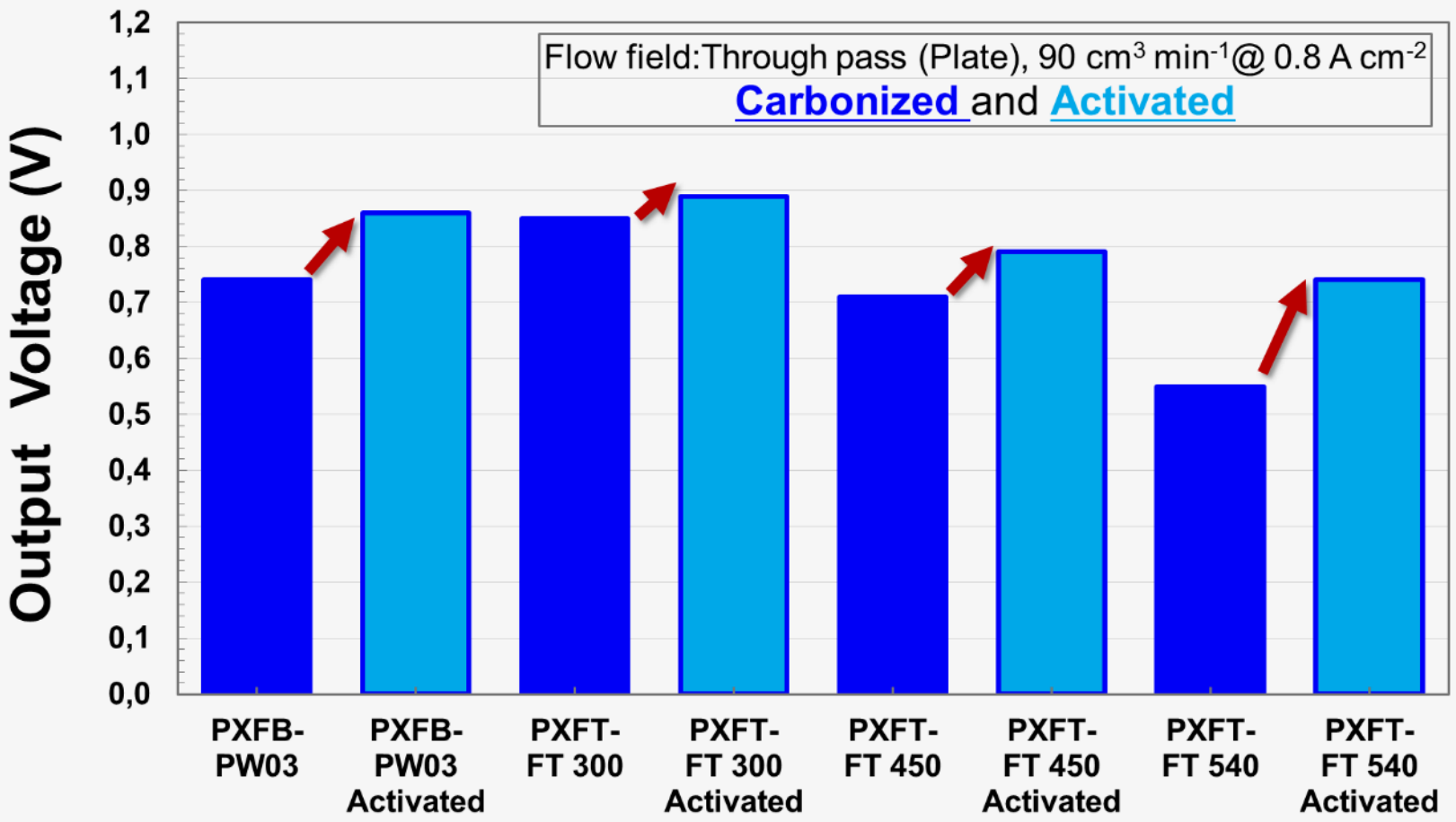
SPUNLACE FELT

NEEDLEPUNCH FELT

WOVEN FABRIC

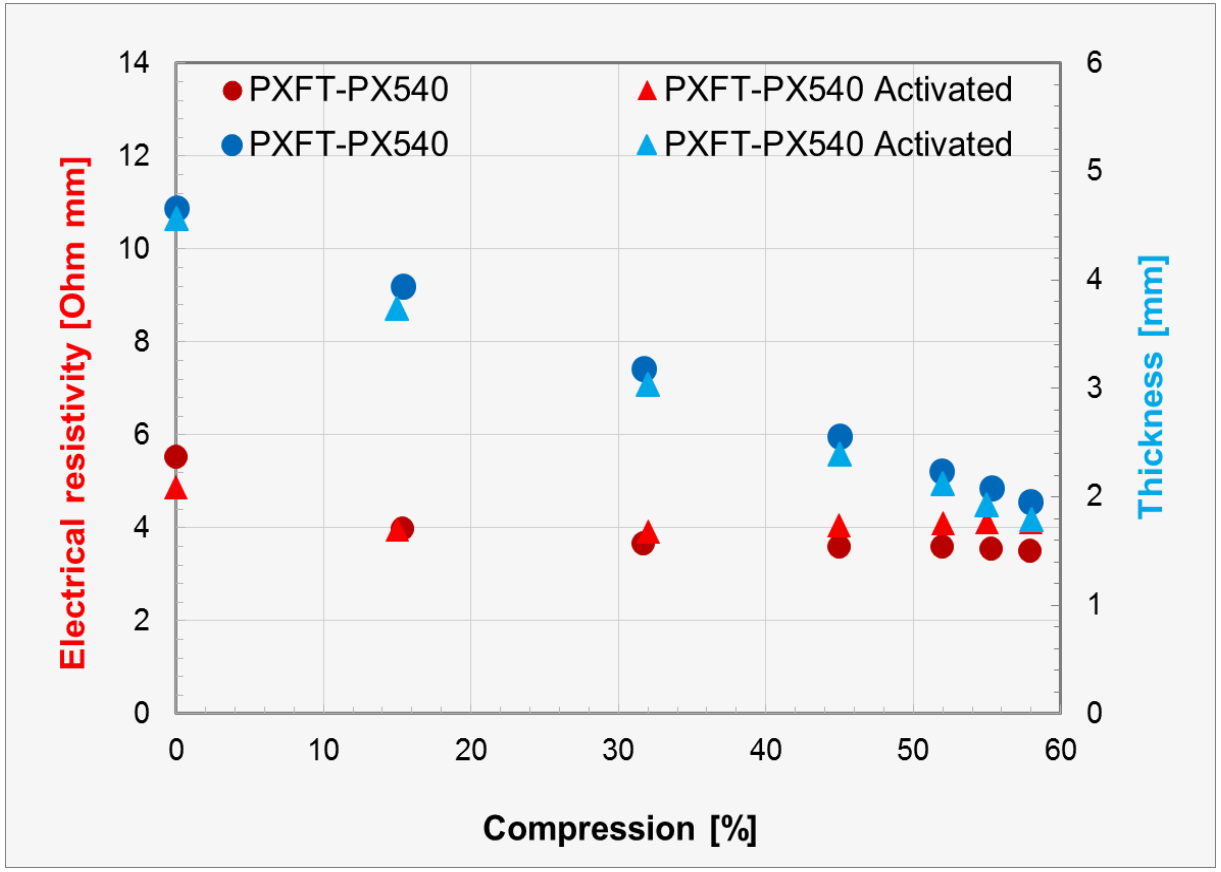
Electrode Property (PAN based CF)	PXFB PW03	PXFB SW08	PXFT FT50	PXFT FT300	PXFT FT450	PXFT FT540
Fabric or Felt Type	Woven		Spunlace	Needled		
Areal Weight, g m^{-2}	122	339	50	301	446	538
Thickness, mm At 0.02 MPa compression	0.39	1.04	0.52	2.7	3.5	4.7
Felt bulk density, g cm^{-3} Areal weight / thickness at 0.02 MPa compression	0.32	0.33	0.096	0.11	0.13	0.12
Electrical resistivity, Ω mm At 1 A current for 30x30 mm sample, 20% compression, thickness direction	8.0	7.3	86	6.3	4.2	4.0
Open Porosity, % Ccalculated as $1 - \frac{w_a}{d * \rho_c}$, w_a felt areal weight, d felt thickness and ρ_c is the fiber density (1.78 g cm^{-3})	82	82	95	94	93	94

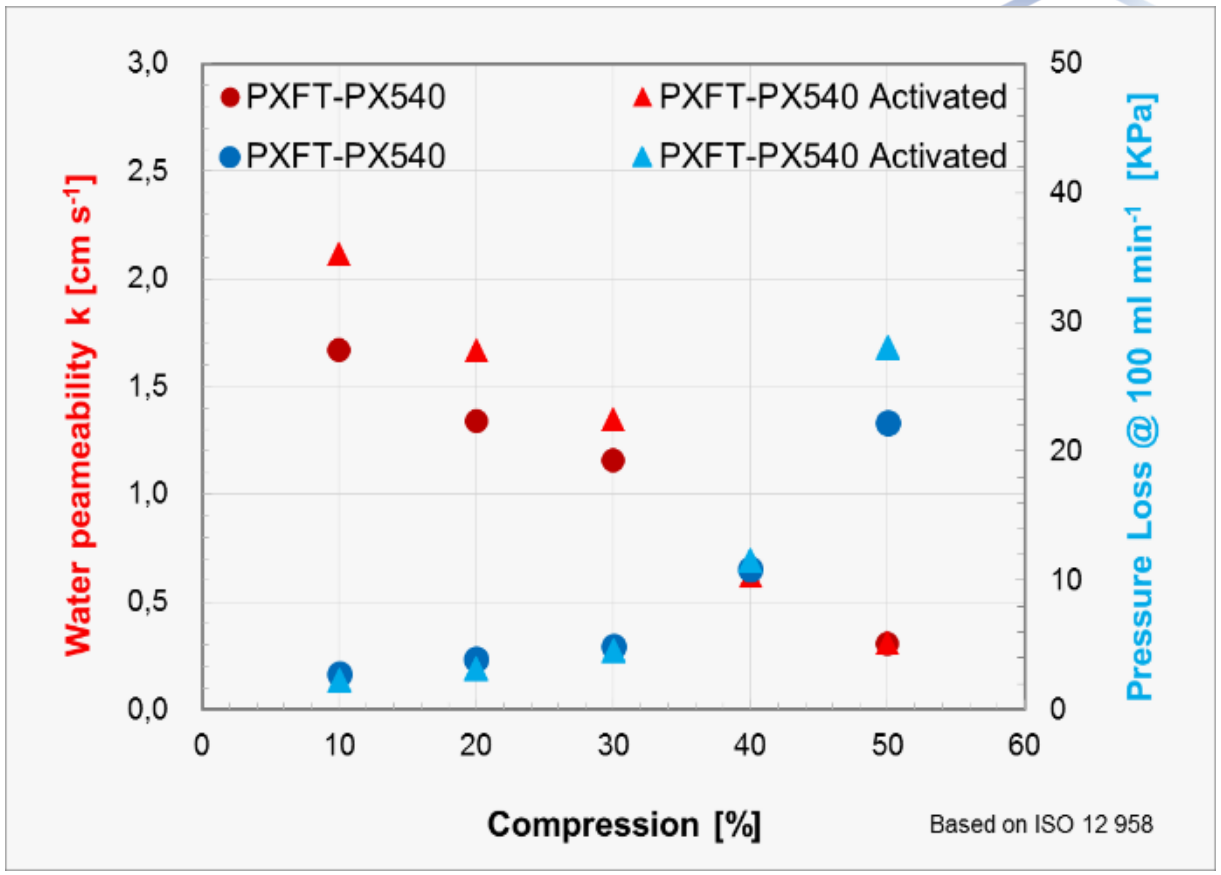
Electrode Cell Performance



VRFB output voltage improved, after activation for all PXFT and PXFB electrode types.

Activated Electrode Characterization





Zoltek's activation process has little impact on electrical resistivity or water permeability of the electrode

Summary

I. Zoltek can supply carbonized felts and fabrics which can be customized for RFB applications requiring electrodes between ~0.4 mm to ~5 mm thick.

II. Zoltek's electrode activation process improves output voltage in VRFB applications.

III. Carbon felt and fabric parameters continued to be optimized to maximize RFB performance.

Thank you for your attention

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