

# bondwell™ sodium carboxymethylcellulose binders

easy-to-use binders ensuring the integrity of your lithium ion batteries

## description

Ashland is the premier supplier of carboxymethylcellulose (CMC) binder technology for lithium ion battery anodes. Typically used in conjunction with styrene butadiene (SB) latex, naturally-derived bondwell™ binders are renowned in the lithium ion battery industry for their usability, integrity and sustainability:

## usability

- fast dissolution for ease of processing
- high viscosity at low shear rates to prevent SB latex migration during slurry coating process
- low viscosity at high shear rates for easy mixing and coating
- compatible with industry standard materials including natural and synthetic graphite

## integrity

- high quality CMC to eliminate electrode defects
- superior capacity retention for cell integrity
- strong rate performance for power applications

## sustainability

Bondwell™ CMC binders contain at least 77% renewable carbon\*. All bondwell™ binders are fluorine-free, enabling use of water-based formulations for solvent-free, zero-VOC formulations.

\*These water-soluble polymers are derived from cellulose. The % renewable carbon has been calculated based on the cellulose and the average substituent level; it reflects the percentage of carbon from cellulose relative to the total amount of carbon in those products.

## cradle to gate CO<sub>2</sub> footprint

location of manufacturing: Alizay, France

packaging: 25kg bags

software used: simapro

bondwell™ grade	material code	CO <sub>2</sub> footprint (kg CO <sub>2</sub> -e/kg product)
bvh7 6290d	966626	3.29
bvh8	955767	3.27
bvh8 2545c	931516	3.43
bvh9	931824	3.79

## Ashland portfolio of bondwell™ sodium carboxymethylcellulose binders:

### bondwell™ bvh8 and bondwell™ bvh7 1525

have lower viscosity for easier processing and lower degree of substitution (DS) - natural and synthetic graphite

### bondwell™ bvh8 2545c

is now available with the same DS but higher viscosity for improved rheology and better slurry stability - synthetic graphite

### bondwell™ bvh9

has higher viscosity for improved slurry stability and higher DS for better dispersion – natural and synthetic graphite

### bondwell™ bvh7 6290d

is the highest viscosity grade for optimum dosage efficacy and higher electrode peel strength - synthetic graphite

## bondwell™ cmc binders

cmc product name	degree of substitution (DS)	viscosity (1% solution, mPa.s) <sup>1</sup>	pH	purity (%) <sup>2</sup>
bondwell™ bvh8	0.80 - 0.95	800 - 1,200	6.5 - 8.5	>99.5
bondwell™ bvh7 1525	0.65 - 0.90	1,500 - 2,500	6.5 - 8.5	>99.5
bondwell™ bvh8 2545c	0.80 - 0.95	2,500 - 4,500	6.5 - 8.5	>99.5
bondwell™ bvh9	0.90 - 1.05	2,000 - 4,000	6.5 - 8.5	>99.5
bondwell™ bvh7 6290d	0.65 - 0.90	5,000 - 9,000	6.5 - 8.5	>99.5

<sup>1</sup> Brookfield viscometer, spindle #4 at 30 rpm at 25°C

<sup>2</sup> purity, % 100-(Na Glycolates + NaCl)

## bondwell™ cmc anode binders for usability

figure 1: bondwell™ binders demonstrate fast dissolution for ease of processing

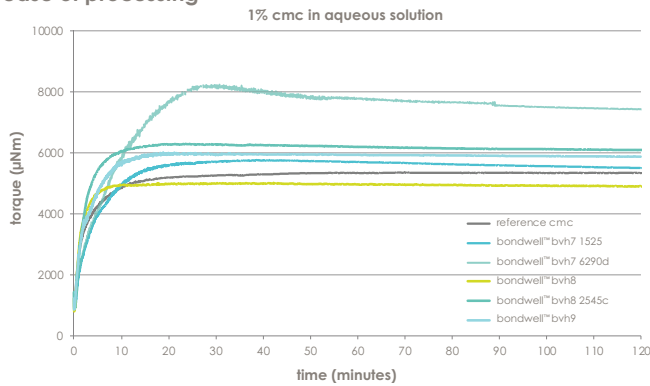


figure 2: bondwell™ binders with (i) high viscosity at low shear rate for stability and (ii) low viscosity at high shear rate for easier mixing and coating

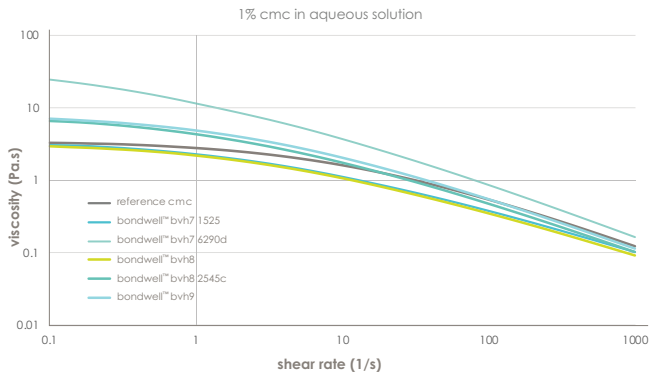
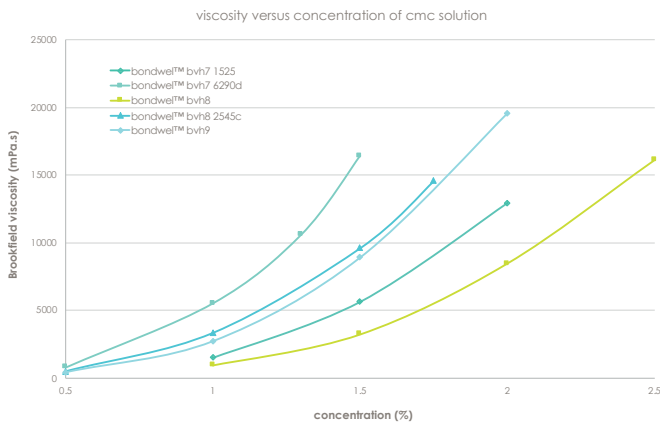
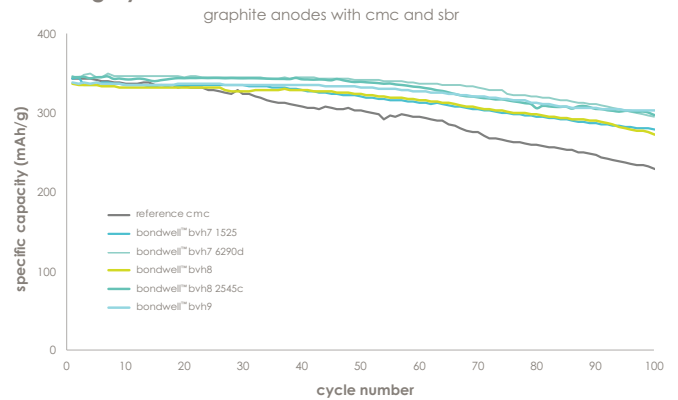


figure 3. typical viscosity versus concentration



Brookfield viscometer, at 30 rpm at 25°C

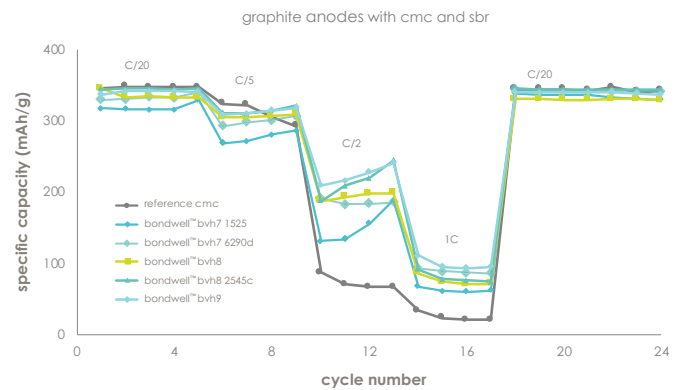
figure 4: superior capacity retention of bondwell™ binders for cell integrity



half coin cell: areal loading: ~ 5 mg/cm<sup>2</sup>; density: 1.5 g/cm<sup>3</sup>;  
electrolyte: 1 M LiPF<sub>6</sub> in EC/DEC/DMC.

test condition: voltage cut-off 0.01V – 1.50V; cycling rate: CC-CV at 0.2C-0.2C

figure 5: strong C-rate performance of bondwell™ binders for fast charging and discharging



half coin cell: areal loading: ~ 5 mg/cm<sup>2</sup>; Density: 1.5 g/cm<sup>3</sup>;  
Electrolyte: 1 M LiPF<sub>6</sub> in EC/DEC/DMC

test condition: voltage cut-off 0.01V – 1.50 V; C-rates: CC-CC at 0.05C, 0.2C, 0.5C and 1C

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