

# GRAVEX®

## High Performance Water Treatment for Power Generation

### Gravex® Macroporous Nuclear Grade Resins

GR-1-5 NG, GR-2-17 NG, GR-3-17 NG, GR-7-17 NG, GR-4-17 NG

These Gravex Nuclear Grade Ion exchange resins are polystyrene, macroporous type resins. They have been regenerated and processed to provide the highest possible performance in nuclear applications. GR-1-5 NG and GR-2-17 NG are fully tested and certified. Our unique blending process creates the less separable GR-3-17 NG mixed bed in a 2 cation:1 anion volume ratio. Gravex mixed beds are the most uniformly blended products available and have the same consistent cation to anion ratio in every package. A stoichiometric mixed bed version with  ${}^7\text{Li}^+$  form cation is GR-4-17 NG.

#### Applications – Reactor Coolant Treatment (CVCS, chemical and volume control system)

This series of macroporous Gravex resins is designed to remove fine particulate radionuclides including isotopes of Co, Ni, Fe, and Ag. The cation GR-2-17 NG by itself and as a component of the mixed beds, is also selective for the soluble species of the radionuclide metals. These Gravex products are used for cleanup after outages to help maintain



plant restart schedules. The anion and cation products may be layered over either of the mixed beds. The GR-3-17 NG may be used in place of the GR-3-9 NG during full power operation to provide ongoing removal of fine particulates. Similarly the GR-4-17 NG replaces the GR-4-9 NG during full power operation. Each product continues to perform the normal functions of reactor water treatment and pH control. The GR-7-17 NG,  ${}^7\text{Li}$  form cation component may be used to extend the bed life.

**Radwaste Treatment** — The GR-1-5 NG, GR-2-17 NG, and GR-3-17 NG products are also useful for removing soluble and fine particulate radionuclides from liquid radwaste.

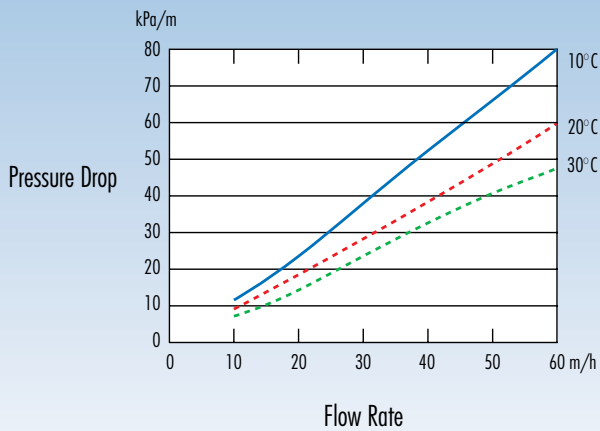
**Spent Fuel Pools** — GR-3-17 NG is chemically and physically resistant to the aggressive environment in spent fuel pools.

PRODUCTS	Typical Properties			
	GR-1-5 NG	GR-2-17 NG, GR-7-17 NG ( ${}^7\text{Li}$ form)	GR-3-17 NG	GR-4-17 NG
Type	SBA Type 1	SAC	SAC/SBA	SAC/SBA
Matrix	Styrene DVB Macro	Styrene DVB Macro	Styrene DVB Macro	Styrene DVB Macro
Functional Group	Quaternary Ammonium	Sulfonic Acid	Sulfonic Acid, Quaternary Ammonium	Sulfonic Acid, Quaternary Ammonium
Ionic Form	$\text{OH}^-$	$\text{H}^+$	$\text{H}^+/\text{OH}^-$	${}^7\text{Li}^+/\text{OH}^-$
Total Exchange Capacity (meq/mL)	0.9 (min)	2.1 (min)	2.1 / 0.9	2.1 / 0.9
Ionic Conversion	97% $\text{OH}^-$ (min) 3% $\text{CO}_3$ (max) 0.1% $\text{Cl}^-$ (max) 0.1% $\text{SO}_4$ (max)	99% $\text{H}^+ / {}^7\text{Li}^+$	99% / 97% (min) 3% $\text{CO}_3$ (max) 0.1% $\text{Cl}^-$ (max) 0.1% $\text{SO}_4$ (max)	99% / 97% (min) 3% $\text{CO}_3$ (max) 0.1% $\text{Cl}^-$ (max) 0.1% $\text{SO}_4$ (max)
Water Retention Capacity	55 – 68%	43 – 49%	43 – 49% / 58 – 68%	43 – 49% / 58 – 68%
Particle Size	>1,190 $\mu\text{m}$ <300 $\mu\text{m}$	2% (max) 0.2% (max)	2% (max) 0.2% (max)	2% (max) 0.2% (max)
Friability	Average g/bead >200 g/bead 350 (min) 95% (min)	350 (min) 95% (min)	350 (min) 95% (min)	350 (min) 95% (min)
Whole Bead	95% (min)	95% (min)	95% (min)	95% (min)
Harmonic Mean Size	670 $\pm$ 120 $\mu\text{m}$	600 $\pm$ 75 $\mu\text{m}$	600 / 670 $\pm$ 75 / 120 $\mu\text{m}$	600 / 670 $\pm$ 75 / 120 $\mu\text{m}$

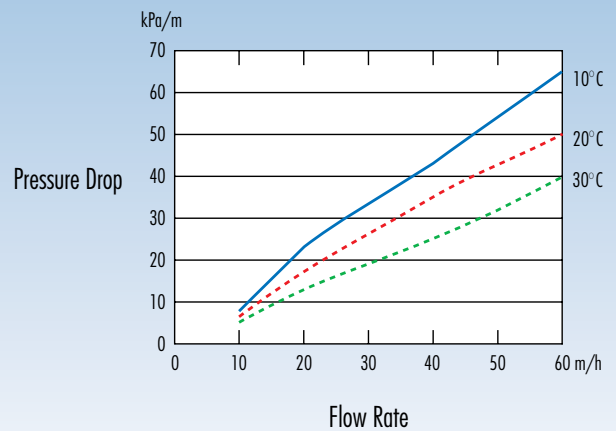
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GR-1-5 NG, GR-2-17 NG, GR-3-17 NG, GR-7-17 NG, GR-4-17 NG

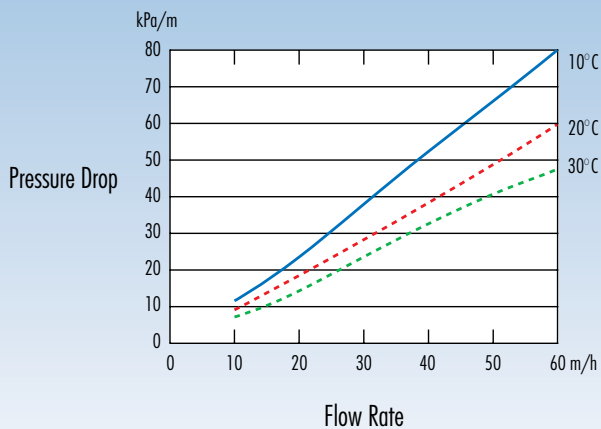
GR-1-5 NG – Pressure Drop



GR-3-17 NG, GR-4-17 NG – Pressure Drop



GR-2-17 NG, GR-7-17 NG – Pressure Drop



## Recommended Operating Conditions

<b>Maximum Operating Temperature</b>	120°C (250°F) Cation 60°C (140°F) Anion
<b>Minimum Bed Depth</b>	800 mm (2.6 ft)
<b>Linear Flow Rate</b>	5 – 125 m / hr (2 – 50 gpm/ft <sup>2</sup> )
<b>Volume Flow Rate</b>	8 – 50 BV / hr (1 – 6 gpm/ft <sup>2</sup> )

## Impurity - Mg/Dry Kg (max)

Impurity mg/dry kg (max)	GR-1-5 NG	GR-2-17 NG GR-7-17 NG
Na	20	50
Fe	50	50
Cu	10	10
Pb	10	10
Al	50	50
Ca	50	50
Mg	50	50
K	50	50
Zn	50	50
Co	30	30
Hg	20	20
SiO <sub>2</sub>	100	
Total Cl	500	
Total SO	600	

GR-3-17 NG and GR-4-17 NG same as components for each impurity.



**Graver Technologies**

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Nuclear Quality Assurance Program  
10CFR50, Appendix B



A Marmon Water/Berkshire Hathaway Company

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