Purolite™ Resins S108 Boron Selective Anion Exchange Resin

This Engineering Bulletin discusses the use of Purolite S108 for the selective removal of boron from aqueous solutions.

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Purolite S108 Boron Selective Anion Exchange Resin

This Engineering Bulletin reviews the properties of Purolite S108 macroporous polystyrene based resin for removing boron from aqueous solutions such as drinking water, irrigation water, brine solutions, wastewater, and reverse osmosis (RO) permeate from desalinated brackish and sea water.

Contents

Introduction

Purolite S108 is a macroporous polystyrene-based resin with functional groups designed for the selective removal of boron from aqueous solutions. The resin will operate over a wide pH range and due to excellent kinetics it is effective over a wide range of boron concentrations, under different operating conditions. The presence of boron ions in water for potable and agricultural/horticultural use, even in relatively small (ppm) concentrations can give rise to significant problems. Even where concentrations of other ions are reasonably high, Purolite S108 will reduce boron concentrations by an order of magnitude.

Typical properties of Purolite S108 are shown in Table 1 below.

TABLE 1 Typical Physical and Chemical Characteristics

Polymer Structure	Macroporous polystyrene cross-linked with divinylbenzene
Appearance	Spherical beads
Functional Group	N-methylglucamine
Ionic Form	FB form
Total Capacity (min.)	0.6 eq/L (13.1 Kgr/ft^3) (FB form)
Moisture Retention	60–66% (Cl^- form)
Particle Size Range	425–630 µm
< 425 µm (max.)	5%
Uniformity Coefficient (max.)	1.2
Reversible Swelling, FB → Cl^- (max.)	25%
Specific Gravity	1.1
Shipping Weight (approx.)	670–730 g/L (41.9–45.6 lb/ft^3)
Temperature Limit	60 °C (140 °F)

Purolite S108 Boron Removal Applications

Drinking Water

Boron limits for drinking water are enforced by various national regulations. The World Health Organization (WHO) has set a provisional guideline of 0.5 mg/L maximum. Purolite S108 is approved under WRAS (Water Regulations Advisory Scheme in the UK) and also certified under NSF/ANSI 61 standard in the USA for drinking water treatment.

Irrigation Water

Boron is important as a trace element to promote plant growth. However excess concentrations of boron in irrigation water can have a toxic effect on plants.

RO Permeate from Desalinated Brackish and Sea Water

Sea water typically contains between 4–5.5 mg/L boron. As a weakly dissociated anion at neutral pH boron is not fully rejected by reverse osmosis membranes. Depending on the application of the treated water further post-treatment can be required.

Brine Solutions

Purolite S108 can be used to prepare boron-free magnesium chloride brines. Because these brines can contain up to 100 ppm of boron, they are unsuitable for the production of pure magnesium oxide required by the electric power and electronics industries and for the manufacture of refractory materials. Purolite S108 may also be used for the reduction of boron in brine prior to electrolysis.

Brine application of Purolite S108 will require specific operating and regenerating conditions.

Wastewater

Boron limits for wastewater are enforced by national regulations. Required limits vary from country to country and can be as low as 0.1 mg/L. Purolite S108 is ideal for cleaning wastewater in any chemical processes where the boron concentration exceeds the discharge limits. Regeneration procedures may afford some boric acid recovery.

Semiconductor and High Purity Applications

When selective removal of boron is needed in high-purity applications in the microelectronics industry, it is recommended to use UltraClean™ UCW1080.

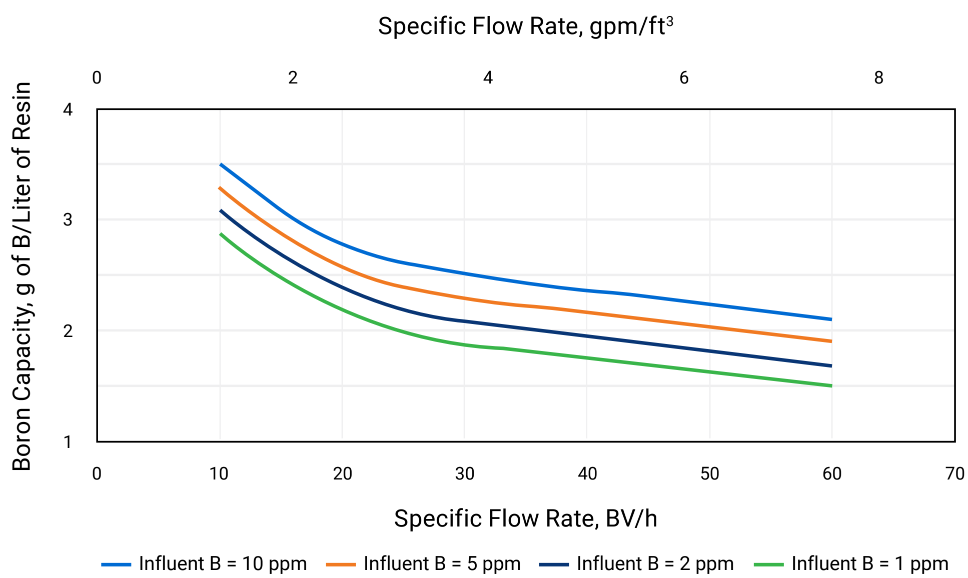
Operating Recommendations

The product is retained within a pressure vessel, and the contaminated solution is pumped through the media. On exhaustion, the resin is regenerated using a two-stage regeneration process. To achieve low boron leakages, a reasonable contact time is important. Higher bed depths, increasing the contact time, can reduce the borate leakage in some applications.

The operating capacity of Purolite S108 is primarily dependent on the specific flow rate and the concentration of boron in the solution to be treated. Typical working capacities from 1–3.5 g/L can be achieved dependent on operating conditions. Purolite S108 can be operated at specific flow rates up to 60 BV/h, but this significantly reduces the resin performance — see Figure 1.

FIGURE 1

Boron Capacity vs. Influent Boron Concentration and Service Flow Rate



To achieve very low boron leakage, counter-flow regeneration is recommended and in some cases lead-lag operation should be considered to maximize resin capacity and achieve very low boron targets. The optimum conditions for operation and regeneration depends on the individual application.

Table 2 provides information on suggested operating conditions for co-flow mode of regeneration.

TABLE 2 Recommended Operating Conditions for Co-flow Regeneration

Operation	Rate	Solution	Minutes	Amount
Service	8–60 BV/h 1–7.5 gpm/ft³	Raw Water		
Backwash	6–8 m/h 2.5–3.5 gpm/ft³	Raw Water	10–20	1.5–2.5 BV 10–20 gal/ft³
Regeneration	2.5–3 BV/h 0.3–0.4 gpm/ft³	4% HCl or 5% H_2SO_4	30–40	50–60 g/L HCl 3–4 lb/ft³ or 65–80 g/L H_2SO_4 4–5 lb/ft³
Slow Rinse	3–4 BV/h 0.4–0.5 gpm/ft³	Raw Water or Softened Water	30–40	2 BV 15 gal/ft³
Conversion to Free Base Form as Required	3–4 BV/h 0.4–0.5 gpm/ft³	2% NaOH	30	30–40 g/L 2–2.5 lb/ft³
Slow Rinse	3–4 BV/h 0.4–0.5 gpm/ft³	Soft Water	30–40	2 BV 15 gal/ft³
Fast Rinse	10 BV/h 1.25 gpm/ft³	Raw Water	30	5 BV 40 gal/ft³

Backwash expansion — minimum 50%; 75% optimum
"Gallons" refers to US. gallons = 3.785 liters

Table 3 provides suggested operating conditions when designing for counter-flow regeneration.

TABLE 3 Recommended Operating Conditions for Counter-flow Regeneration

Operation	Rate	Solution	Minutes	Amount
Service	8–60 BV/h 1–7.5 gpm/ft^3	Raw Water		
Regeneration	2.0–2.5 BV/h 0.25–0.3 gpm/ft^3	4% HCl or 4% H_2SO_4	30–40	40–50 g/L HCl 2.5–3 lb/ft^3 or 50–65 g/L H_2SO_4 3–4 lb/ft^3
Slow Rinse	2–2.5 BV/h 0.25–0.3 gpm/ft^3	Raw Water or Soft Water	35–45	1.5 BV 10 gal/ft^3
Conversion to Free Base Form as Required	2–3 BV/h 0.25–0.4 gpm/ft^3	2% NaOH	20–30	20–30 g/L 1.25–2 lbs/ft^3
Slow Rinse	2–3 BV/h 0.25–0.4 gpm/ft^3	Soft Water	30–60	1.5–2 BV 15 gal/ft^3
Fast Rinse	10 BV/h 1.25 gpm/ft^3	Raw Water	20–25	3–4 BV 22–30 gal/ft^3

Figure 2 below provides guidance on appropriate flow rates for backwash while Figure 3 shows expected pressure drop across the resin bed for various linear flow rates.

FIGURE 2

Backwash Expansion

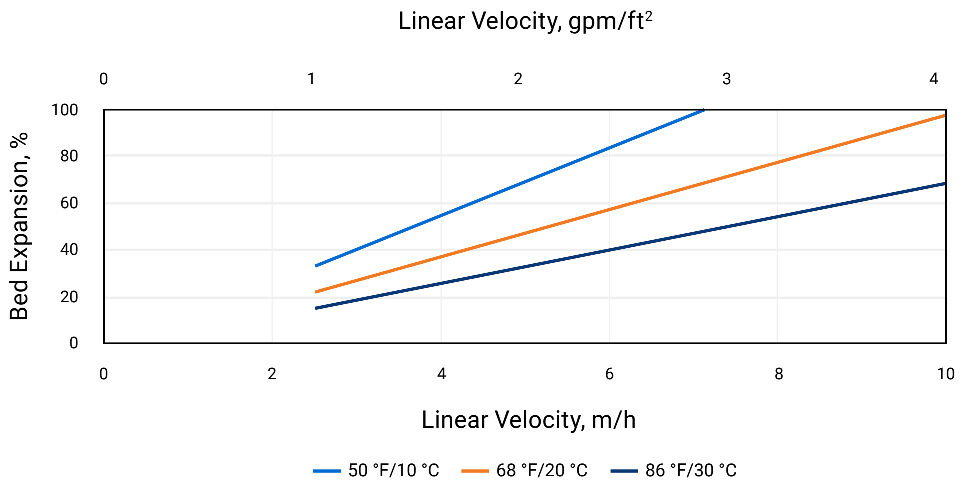
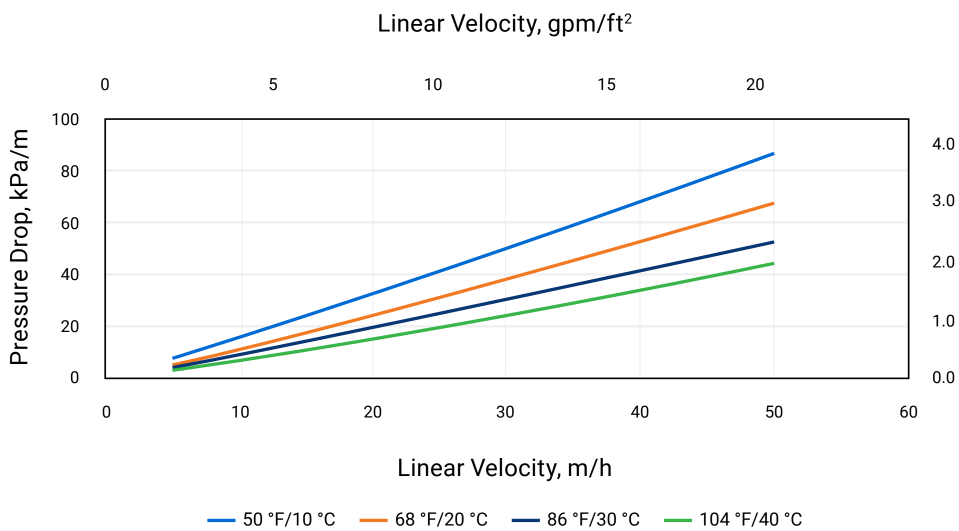


FIGURE 3

Pressure Drop



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