

Purolite™ A860 and A502P for Removing Organic Matter From Water

This Engineering Bulletin provides engineering data for using Purolite A860 and A502P supplied in the chloride form for removing organic matter from surface and waste water supplies.

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Contents

Introduction	3
Regeneration	5
Hydraulic Characteristics	7
Additional Information & Application Notes	10

Introduction

Purolite A860

[Purolite A860](#) is a Type I macroporous strong base anion exchange resin with an acrylic matrix. The matrix ensures excellent removal of organic matter such as humic and fulvic acids from surface and wastewater supplies. Purolite A860 demonstrates excellent reversible elution of organic matter upon regeneration with brine. Reduction of organic matter or total organic carbon (TOC) is an essential method of controlling disinfection byproducts that can form if oxidizing agents such as chlorine or ozone are used to disinfect the water.

Field results show that Purolite A860 can typically reduce influent TOC concentrations by 50–80%, depending on the nature of the organic matter present. For design purposes, it is best to determine TOC removal capacity from properly run field pilots. Typical capacities can vary from 5–20 grams of TOC per liter of resin and higher. Macroporous styrenic strong base anion resins such as [Purolite A502P](#) can sometimes be used to supplement performance, especially when removing particularly low molecular weight TOC compounds is needed. Your Purolite technical representative can evaluate your specific needs and provide more details.

TABLE 1 Purolite A860 - Typical Physical and Chemical Characteristics

Characteristics	Description/Value
Polymer Structure	Macroporous polyacrylic crosslinked with divinylbenzene
Appearance	Spherical Beads
Functional Groups	Quaternary Ammonium
Ionic Form (As Shipped)	Chloride (Cl ⁻)
Total Capacity, (Min.)	0.8 eq/L (17.5 Kgr/ft ³) (Cl ⁻ form)
Moisture Retention, Cl⁻ Form	66–72% (Cl ⁻ form)
Particle Size Range	300–1200 µm
Uniformity Coefficient (Max.)	1.7
Volume Change Cl⁻ → OH⁻ (Max.)	30%
Specific Gravity	1.08
Shipping Weight (approx.)	680–730 g/L (42.5–45.6 lb/ft ³)
Maximum Temperature Limit	80 °C (176.0 °F) (Cl ⁻ form)

Purolite A502P

[Purolite A502P](#) is a Type I polystyrenic macroporous strong base anion exchange resin. Principal applications include organic scavenger and natural organic matter (NOM) removal. Purolite A502P features good thermal stability, excellent resistance to osmotic shock and high reversible sorptive capacity.

TABLE 2 Purolite A502P - Typical Physical and Chemical Characteristics

Characteristics	Description/Value
Polymer Structure	Macroporous polystyrene crosslinked with divinylbenzene
Appearance	Spherical beads
Functional Group	Type I quaternary ammonium
Ionic Form	Cl ⁻ form
Total Capacity (Min.)	0.85 eq/L (17.5 Kgr/ft ³) (Cl ⁻ form)
Moisture Retention	66–72% (Cl ⁻ form)
Particle Size Range	300–1200 μm
< 300 μm (max.)	1%
Uniformity Coefficient (Max.)	1.7
Reversible Swelling, Cl⁻ → OH⁻ (Max.)	25%
Specific Gravity	1.04
Shipping Weight (approx.)	640–690 g/L (40.0 - 43.1 lb/ft ³)
Temperature Limit	100 °C (212.0 °F) (Cl ⁻ form)

Regeneration

Purolite A860 can be regenerated, removing organic matter on a reversible basis using a 10% brine solution. It is important to allow adequate contact between the resin and the brine solution to optimize performance. Combining 10% brine and up to 2% caustic can provide the extra cleaning efficiency needed for hard-to-treat water.

Co-Flow Regeneration

Standard operating and regenerating conditions for sodium chloride co-flow service are provided in Table 3 below.

TABLE 3 Standard Operating and Regenerating Conditions for Co-Flow Service

Step	Design Basis	Duration
Service	8–16 BV/h 1–2 gpm/ft ³	Dependent on influent organic loading and desired breakpoint.
Backwash	Set for minimum water temperature to give 50% bed expansion. Refer to Figure 2 for details.	1 BV for clean water supplies and 2–3 BVs where suspended solids are higher.
Bed Settle	To allow the bed to reform fully classified.	5 minutes
NaCl Injection	128 g/L (8–10 lbs/ft ³) applied at 8%–10% brine solution at 2–4 BV/h (0.25 to 0.5 gpm/ft ³).	Typically 20–40 minutes, depending on regeneration level and flow rate.
NaCl – NaOH injection	128 g/L (8–10 lbs/ft ³) applied at 8%–10% brine solution at 2–4 BV/h (0.25 to 0.5 gpm/ft ³). 5–20 g/L (0.3–1.2 lbs/ft ³) at 0.5%–2.0% NaOH.	Typically 20–40 minutes, depending on regeneration level and flow rate.
Displacement Rinse	Flow similar to the brine solution at 2–4 BV/h (0.25–0.5 gpm/ft ³); rinse volume 2 BV or 15 gal.	Typically 30–40 minutes, depending on water volume applied and flow rate.
Final Rinse	3–6 BV (22.5 to 45 gal/ft ³) preferably at service flow rate 8–16 BV/h (1–2 gpm/ft ³).	Typically 10–20 minutes. Less displacement rinse will require more final rinse.

(Key: BV = Bed Volumes, BV/h = Bed Volumes per hour)

Note: 1 BV = 1 liter of water running through 1 liter of resin or 7.48 US gallons through 1 ft³ of resin.

While counter-flow operation can be applied to Purolite A860, the upflow service — downflow regeneration service technology is often used with a specialized grade of anion resin, [Purolite™ Puropack™ PPA860S](#), to enhance performance. In counter-flow technology, bed depths < 1,000 mm (3 ft. 3 in.) should be avoided. Beds in excess of 1,200 mm (4 ft.) are recommended. Consult your local Purolite sales office for guidance.

The traditional counter-flow regeneration technique is normally made up of three steps, as opposed to the five steps described earlier for co-flow regeneration, and typically takes between 1 and 2 hours depending on the detailed design. The softened water produced by the same plant is usually adequate to use for brine dilution and rinses, and the required quantity is either set aside during the previous service run or, in case of two-line units, supplied by the other on-line unit.

In a counter-flow regenerated system, the backwash, that always represents the first step of co-flow regeneration, is not normally performed each cycle. Some engineering designs allow for subsurface backwash or periodic full bed backwash, either inside the service unit or in separate external dedicated towers. In the vast majority of designs backwash is not part of the standard regeneration, although it should be included in the design of the unit. After a full bed backwash, the resin should be regenerated with double the normal amount of brine to restore full performance.

The regenerant brine should be introduced at 2–4 BV/h (0.25–0.5 gpm/ft³) and the regeneration level (amount of NaCl per liter of resin) used will typically be lower than for co-flow regenerated units, typically between 50 and 150 g/L (3–9 lb/ft³).

The regenerant displacement rinse (also called slow rinse) is always carried out at flow rates similar to the brine injection step and in the same direction. This is to ensure a uniform contact time between the resin and the regenerant solution. It also ensures that the rinse water follows the same route of the regenerant through the resin bed. As displacement rinses are usually more efficient in removing spent regenerant from the resin, the more displacement employed, the less final rinse is required. Normally 1–2 BV (7.5–15 US gal/ft³) of displacement rinse is adequate.

The final rinse is often carried out at the service flow rate and this also acts as a proving condition prior to returning to service after regeneration. Normally 2–4 BV (15–30 gal/ft³) are required, depending on the design of the distribution/ collection system and the amount of slow rinsing previously performed.

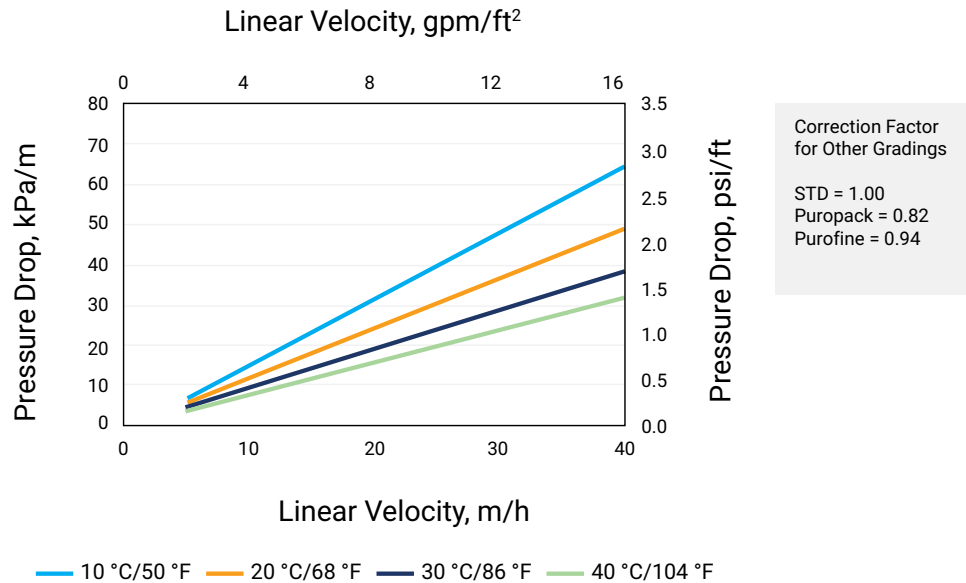
Hydraulic Characteristics

The pressure drop across a properly classified bed of ion exchange resin depends on the particle size distribution, bed depth, flow rate, viscosity and temperature of the influent solution. Factors affecting any of these parameters – for example, the presence of particulate matter filtered out by the bed or abnormal compressibility of the resin – will have an adverse effect and result in an increased pressure drop.

Depending on the quality of the influent water, the application and the plant's design, service flow rates may vary from 8–16 BV/h. Typical pressure drop data is shown in Figure 1.

FIGURE 1

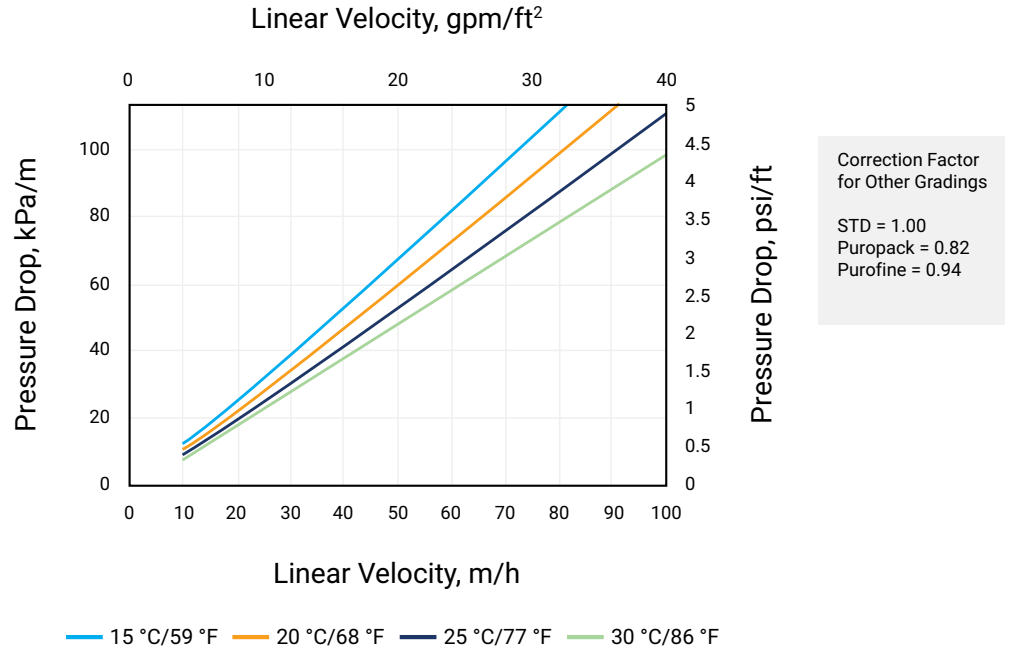
Purolite A860 Pressure Drop vs. Linear Velocity



Note: For other temperatures uses
 $P_t = P_{20} / (0.026T_c + 0.48)$, where P_{20}
 = kPa/m at 20 °C and T_c = desired
 temperature. 22.63 kPa/m = 1 psi/ft

FIGURE 2

**Purolite A502P
Pressure Drop vs.
Linear Velocity**



During upflow backwash, the resin bed should expand between 50% and 70%. This operation will free particulate matter, clear the bed of bubbles and voids, and classify the resin, ensuring minimum resistance to flow. Bed expansion increases with flow rate and decreases with temperature, as shown in Figure 3. Care should always be taken to avoid resin loss by over-expansion of the bed. These backwash curves should be used as a guide. Fine-tuning of backwash rates versus bed expansion is best done in the field at startup.

FIGURE 3

**Purolite A860
Bed Expansion vs.
Linear Velocity**

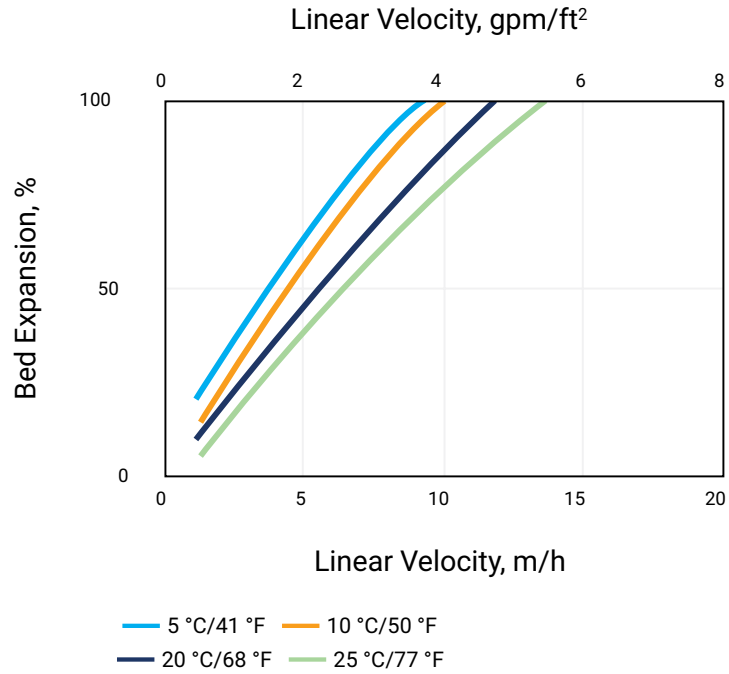


FIGURE 4

**Purolite A502P
Bed Expansion vs.
Linear Velocity**

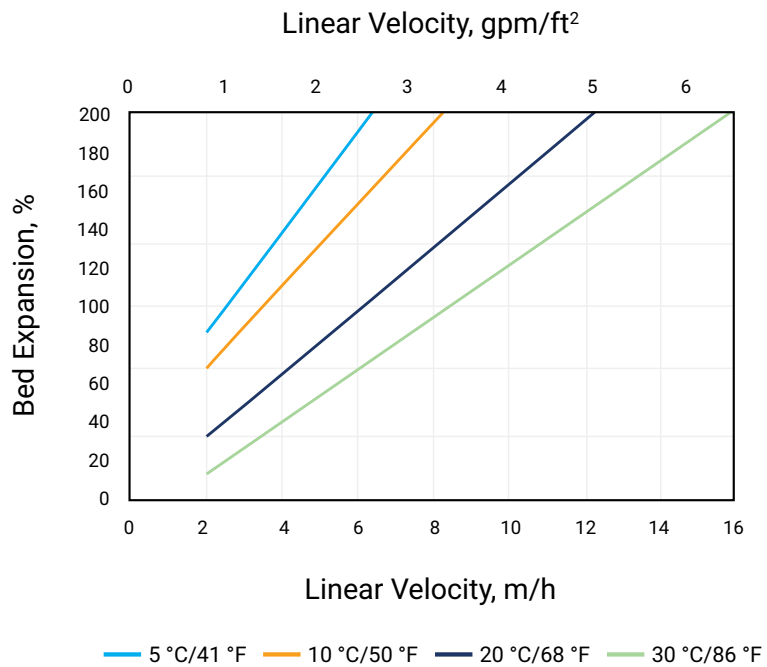


TABLE 4 Typical Operating Conditions for Counter-Flow Regeneration

Step	Design Basis	Duration
NaCl Injection	50–150 g/L (3–9 lb/ft ³) applied as a 10% brine solution at 2–4 BV/h (0.25–0.5 gpm/ft ³).	Typically 20–45 minutes, depending on regeneration level and flow rate.
Displacement Rinse	2 BV (15 gal/ft ³) at approximate regenerant flow rate.	Typically 20–45 minutes, depending on volume of water applied and flow rate.
Final Rinse	2–4 BV (15–30 gal/ft ³) preferably at service flow rate or alternatively > 15 BV/h (2 gpm/ft ³).	Typically 10–20 minutes.

(Key: BV = Bed Volumes, BV/h = Bed Volumes per hour)

Note: 1 BV = 1 liter of water running through 1 liter of resin or 7.48 US gallons through 1 ft³ of resin.

Additional Information & Application Notes

Safety

Strong oxidants, such as nitric acid, may cause violent reactions with ion exchange resins under certain conditions. Use of strong oxidants must be done under the care and supervision of persons knowledgeable in handling these types of materials.

SDS

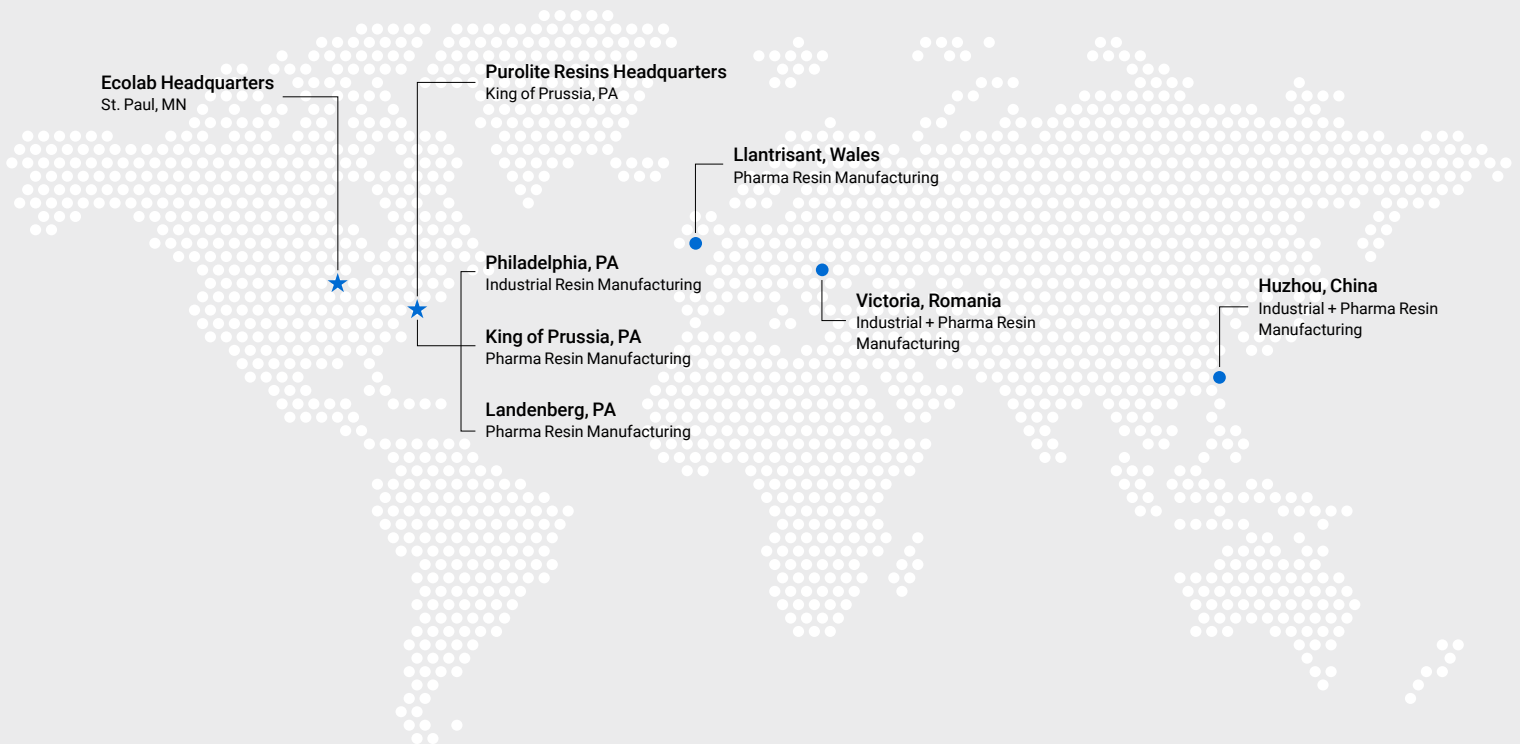
Safety Data Sheets are available on Purolite's website, www.purolite.com. These documents should be consulted for additional information on product safety, handling and disposal.

Storage and Transportation: Information on the proper storage and transportation can be found on Purolite's website, www.puroliteresins.com.

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