ENGINEERING BULLETIN

Purolite® A860 for removing organic matter from water

This Engineering Bulletin provides engineering data for using Purolite A860 supplied in the chloride (salt-exhausted) form for removing organic matter from surface and waste water supplies. Regeneration information is provided for co-flow systems and counter-flow systems, as well as hydraulic characteristics and typical chemical & physical properties.

Purolite®

PUROLITE® A860 FOR REMOVING ORGANIC MATTER FROM WATER

Inside this Engineering Bulletin you will find an overview of Purolite A860, effective for removing organic matter from surface and waste water. For more detailed information on this product, or to find a product for an application not mentioned, please go to www.purolite.com or contact the Purolite office closest to you, listed on the back cover.

INTRODUCTION

Founded in 1981, Purolite is a leading manufacturer of ion-exchange, catalyst, adsorbent and specialty resins. With global headquarters in the United States, Purolite is the only company that focuses 100% of its resources on the development and production of resin technology.

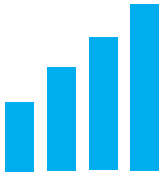
Responding to the needs of our customers, Purolite has built the largest technical sales force in the industry, the widest variety of products and five strategically located Research and Development groups. Our ISO 9001 certified manufacturing facilities in the U.S.A, Romania and China combined with more than 40 sales offices in 30 countries ensure complete worldwide coverage.

PREMIER PRODUCTS

The quality and consistency of our products is fundamental to our performance. Throughout all Purolite plants, production is carefully controlled to ensure that our products meet the most stringent criteria, regardless of where they are produced.

RELIABLE SERVICE

We are technical experts and problem solvers. Reliable and well trained, we understand the urgency required to keep businesses operating smoothly. Purolite employs the largest technical sales organization in the industry.



INNOVATIVE SOLUTIONS

Our continued investment in research & development means we are always perfecting and discovering innovative uses for ion exchange resins and adsorbents. We strive to make the impossible possible.

Purolite A860 is a type I macroporous strong base anion exchange resin with an acrylic matrix. The acrylic matrix ensures excellent removal of organic matter such as humic and fulvic acids from surface and waste water 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 important 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 in cases where removal of particularly low molecular weight TOC compounds is needed. Your Purolite technical representative can evaluate your specific needs and provide more details.

Table 1 – Typical physical and chemical characteristics

Polymer structure	Polyacrylic crosslinked with DVB
Physical form	Opaque, spherical beads
Functional groups	Type I quaternary ammonium
Ionic form, as shipped	Chloride (Cl^-)
Total capacity, Cl^- form	0.8 eq/L (17.5 Kgr/ft^3) min.
Moisture retention, Cl^- form	66 – 72%
Particle size range	300 – 1200 µm 1% max. < 300 µm
Uniformity coefficient	1.7 max.
Reversible swelling, Cl^-→OH^-	20%
Specific gravity, Cl^- form	Approx. 1.08
Shipping weight, Cl^- form	680 – 730 g/L (42.5 – 45.6 lb/ft^3)
Maximum temperature limit OH^- form Maximum temperature limit Cl^- form	40 °C (104 °F) 80 °C (175 °F)

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. For hard to treat water, a combination of 10% brine and up to 2% caustic can provide the extra cleaning efficiency needed. Standard operating and regenerating conditions for sodium chloride co-flow service are provided in Table 2 below.

Table 2 – Standard operating and regenerating conditions for co-flow service

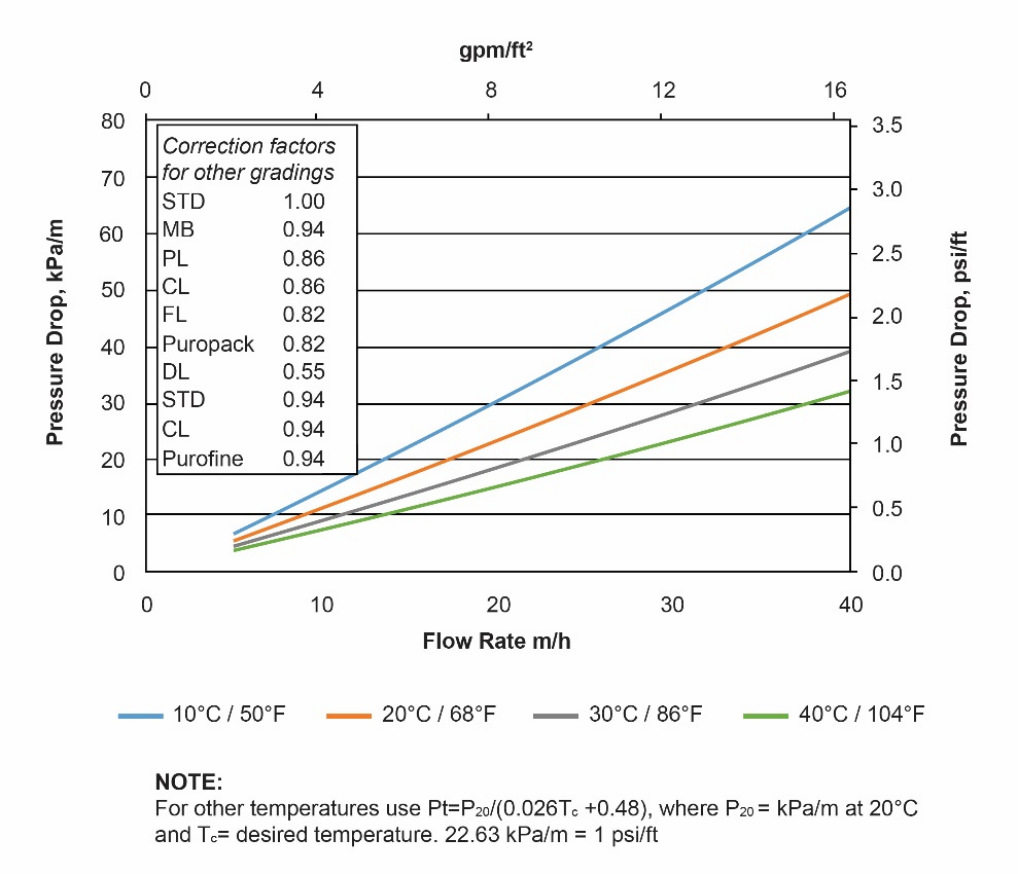
STEP	DESIGN BASIS	DURATION
Service	8– 16 BV/h 1– 2 gpm/ft^3	Dependent on influent organic loading and desired breakpoint
Backwash	Set for minimum water temperature to give 50% bed expansion. Refer to Figure 2 for details.	1 BV for clean water supplies and 2 – 3 BVs where suspended solids are higher
Bed 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 as a 8% – 10% brine solution at 2 – 4 BV/h (0.25 – 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)

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 design of the plant, service flow rates may vary from 8 – 16 BV/h. Typical pressure drop data is given in Figure 1.

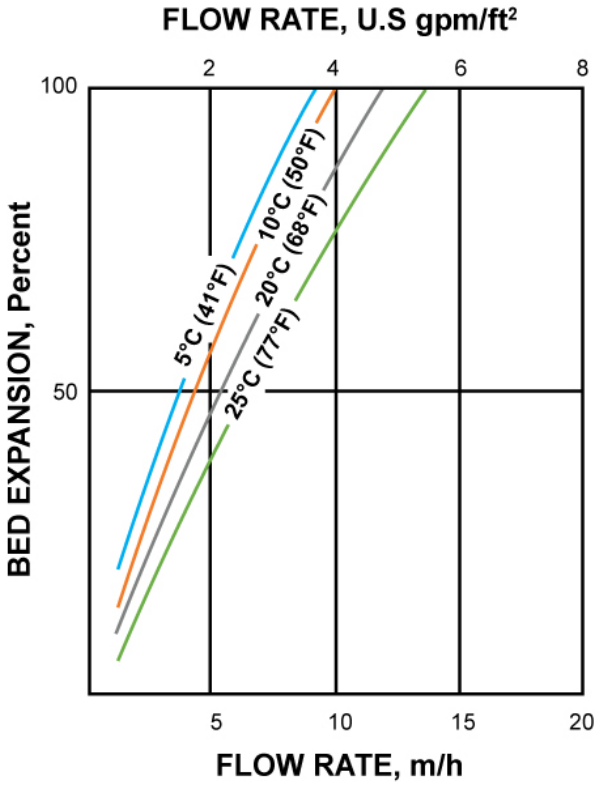
Figure 1 – Pressure drop vs. flow rate (co-flow regeneration)



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

During upflow backwash, the resin bed should be expanded 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 2. 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 2 – Backwash expansion (co-flow regeneration)



Counter-flow regeneration

While counter-flow operation can be applied to Purolite A860, the upflow service – downflow regeneration service technology is often used with specialized grades of Purolite anion resin (PPA860 of PFA860) 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 3 steps, as opposed to the 5 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/ft^3) and the regeneration level (amount of NaCl per liter of resin) used will typically be lower than for co-current regenerated units, typically between 50 and 150 g/L (3 – 9 lb/ft^3).

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/ft^3) 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/ft^3) are required depending on the design of the distribution / collection system and the amount of slow rinsing previously performed.

Table 3 – 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)

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.purolite.com.

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Purolite—the leading manufacturer of quality ion exchange, catalyst, adsorbent and specialty high-performance resins—is the only company that focuses 100% of its resources on the development and production of resin technology.

We're ready to solve your process challenges.
For further information on Purolite® products and services, visit www.purolite.com or contact your nearest Technical Sales Office.

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