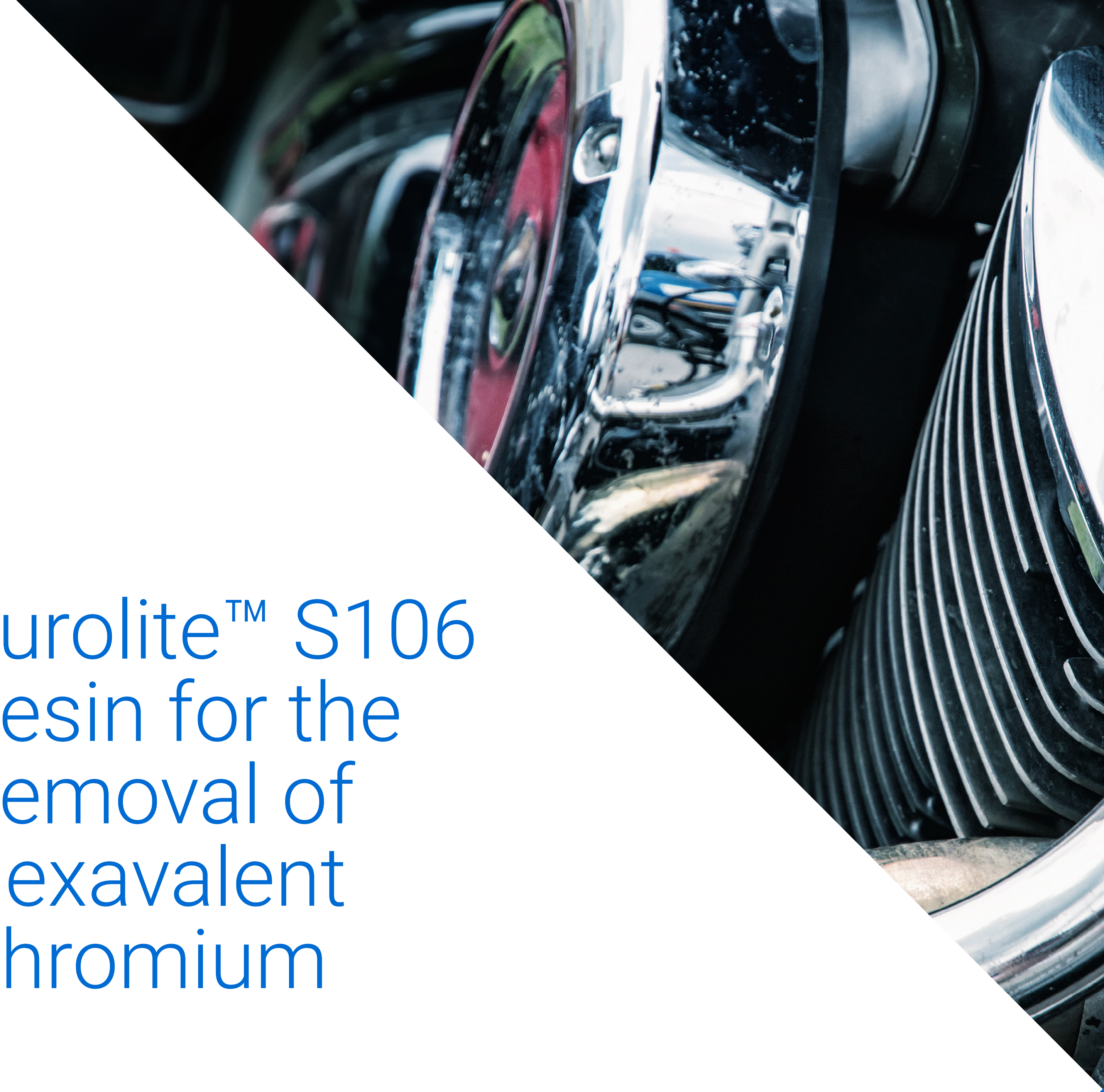

Purolite™ S106 Resin for the Removal of Hexavalent Chromium

Purolite S106 epoxy polyamine chelating weak base anion resin exhibits excellent selectivity and kinetics in the removal of hydrophobic oxyanions from aqueous streams.

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Purolite S106 Resin for the Removal of Hexavalent Chromium

Inside this Engineering Bulletin, you will find an overview of Purolite S106 resin, an epoxy polyamine chelating weak base anion resin that exhibits excellent selectivity and kinetics in the removal of hydrophobic oxyanions from aqueous streams.

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Overview

Purolite S106 is used primarily in potable and groundwater remediation for removing either ppm or ppb levels of hexavalent chromium (Cr^{+6}).

Protonation of the weak base anion exchange sites on the resin is a necessary pretreatment step in its ability to function as an ion exchanger. Reduction of the pH of the influent water to the range of 5.0 to 6.0 is usually adequate to achieve sufficient protonation of the resin for removal of trace levels of oxyanions. The desired range can be accomplished by continuous injection of an acid such as CO_2 upstream of the resin bed. Operation of two ion exchange vessels in a lead-lag configuration can provide greater assurance of meeting the targeted maximum concentration levels in the treated water.

For higher concentrations of oxyanions, it may be necessary to fully protonate the resin by treating with an appropriate quantity of acid. Please contact your local Purolite representative for details.

TABLE 1 Typical Physical and Chemical Characteristics

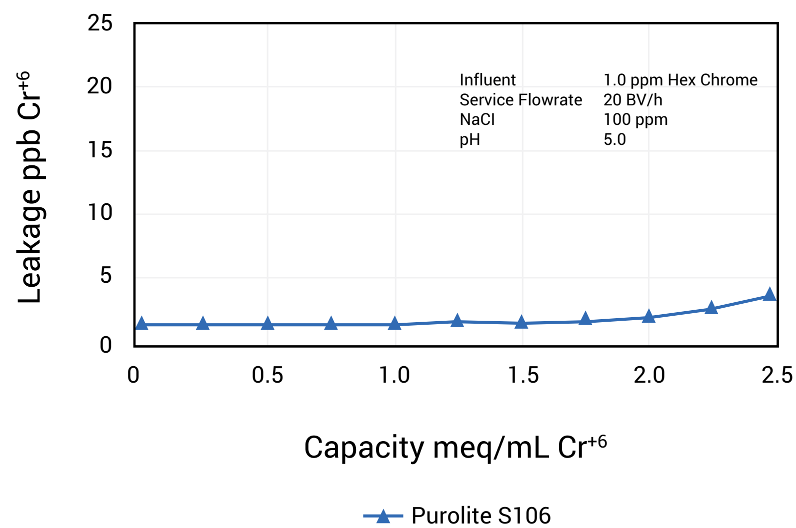
Physical Characteristics	Chemical Characteristics
Polymer Structure	Epoxy
Appearance	Golden yellow, granular beads
Functional Group	Polyamine
Ionic Form	Free amine
Total Capacity, Free Base Form	2.0 eq/L (43.7 Kgr/ft³) min.
Moisture Retention, Free Base Form	60–70%
Particle Size Range	300–2,000 µm 2% max. <300 µm
Reversible Swelling, FB → Cl^- (max.)	30%
Specific Gravity	1.05–1.15
Shipping Weight (approx.)	700–800 g/L (43.8–50.0 lb/ft³)
Temperature Limit	40 °C (104.0 °F)

Performance Data

Pilot plant data using a column of Purolite S106 showed a high capacity for hexavalent chromium when treating an influent concentration of 1 ppm hexavalent chromium at an average pH of 5.0. Greater than 99% reduction was achieved when operating at a service flowrate of 20 bed volumes per hour. See Figure 1.

FIGURE 1

Purolite S106 Hexavalent Chromium Removal (Cr^{+6}), Capacity Curve

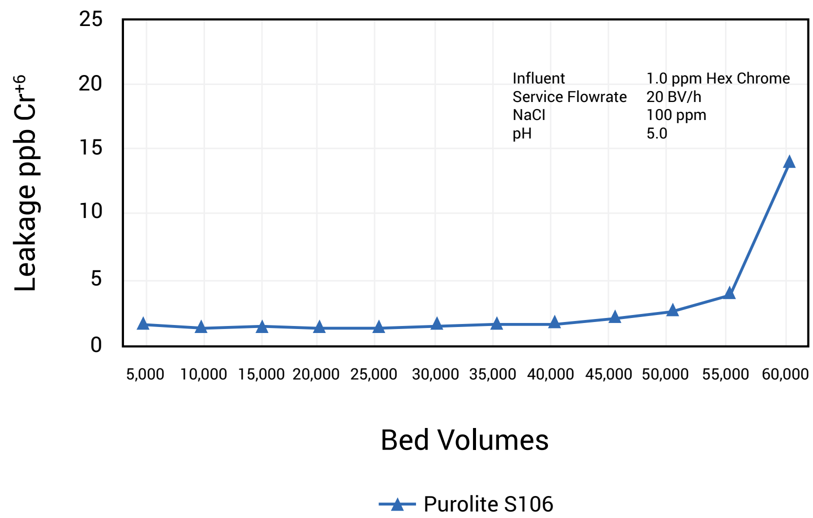


During this time, approximately 58,000 bed volumes of influent water was treated (see Figure 2), amounting to a loading of approximately 58 g/L of resin or a total of 2.2 equivalents of chrome per liter of resin (eq/L). This is a remarkable feature of the resin. It has the unusual ability to load chromium in excess of its published theoretical capacity of 2.0 eq/L. Further investigation of the phenomenon, including subsequent regeneration of the resin, showed that a significant fraction of the hexavalent chromium loaded on the resin had subsequently converted to the trivalent chromium form. This resulted in precipitated trivalent chrome locked in the matrix of the resin. Similar precipitation has been observed with other hydrophobic resins.

Piloting is recommended, if practical, for all new jobs. More reliable capacity estimates can be obtained and variables such as influent pH control, resin bed depth and specific flowrates (US gal/ ft^3 of resin or BV/h) can be optimized. In general, a lower influent pH will yield a higher capacity. Weak base resins are sensitive to the specific flow rate chosen, with higher flowrates yielding higher leakages. This limitation must be balanced against the need to minimize capital investment and to meet targeted maximum levels of the contaminant in the treated water. Please consult Purolite for recommendations relevant to your specific jobs.

FIGURE 2

Purolite S106 Hexavalent Chromium Removal (Cr^{+6}), Throughput



Single-use "load and dispose" systems do not utilize an on-site regeneration process and are ideal in locations with significant footprint constraints or where accessibility to brine disposal options is limited. After the resin is spent, it can be sent to a landfill for disposal or transferred to a chrome recovery facility. Resin will then be replaced for on-going treatments.

As with all water treatment applications, a detailed raw water analysis is needed for proper resin selection and system design. Water parameters needed include:

- pH
- Total Dissolved Solids (TDS)
- Total Suspended Solids (TSS)
- Alkalinity
- Nitrate
- Sulfate
- Chloride
- Uranium

With WBA resin, it is necessary to reduce the influent water pH using an acid.

Operation of two ion exchange vessels in a lead-lag configuration within a pH range of 5.0 to 6.0 is recommended. Reducing the pH converts most of the chrome-6 from its divalent to its monovalent state — this essentially doubles the loading capacity of the resin for chromium-6 and facilitates single-use operation of the resin to meet targeted MCLs in the treated water.

A reduction of over 99% can be achieved when operating at a service flowrate of 20 bed volumes per hour. Resin can treat between 100,000 and 300,000 bed volumes between replacements.

Consideration should be given to the following design and operating factors:

- The pH of the influent water must be reduced to between 5.5 and 6 before the Purolite S106.
- The bicarbonate alkalinity of the raw water will determine the acid dosage needed.
- The pH of the treated water must be re-adjusted upward to the influent levels before the water is sent to the distribution system.
- Most drinking water well quality is amenable to WBA treatment with Purolite S106
- Any uranium present in the influent water will also be removed by the resin; this can sometimes limit loading capacity and can determine disposal cost for the spent resin.
- Purolite S106 resin can generally treat hundreds of thousands of bed volumes of water before it is spent, making it economically feasible in many cases. Please contact a Purolite technical sales representative to help determine throughput estimates.
- Purolite S106 contains no formaldehyde and does NOT require preconditioning that other phenol-formaldehyde type WBA resin do for chrome VI.

Residuals Handling

- Adjust pH to less than 6 before ion exchange (IX) vessels using mineral acid or CO_2 gas.
- Readjust pH to feed levels after IX vessels using caustic or by degasification.
- Test for uranium accumulation in spent resin.

TABLE 2 Weak Base Anion Design Parameters

Design Parameter	Value
Resin Depth	3 ft minimum (0.91 m)
Linear Velocity	8 to 12 gpm/ft^2 (20 to 30 m/h)
Specific Flow Rate	1 to 5 gpm/ft^3 (8 to 40 BV/h)
Empty Bed Contact Time	2–3 minutes minimum
Influent pH	5.5–5.9

Vessels are generally designed in a lead/lag configuration
1 bed volume = 1 unit of water/1 unit of resin

FIGURE 3

Backwash Expansion

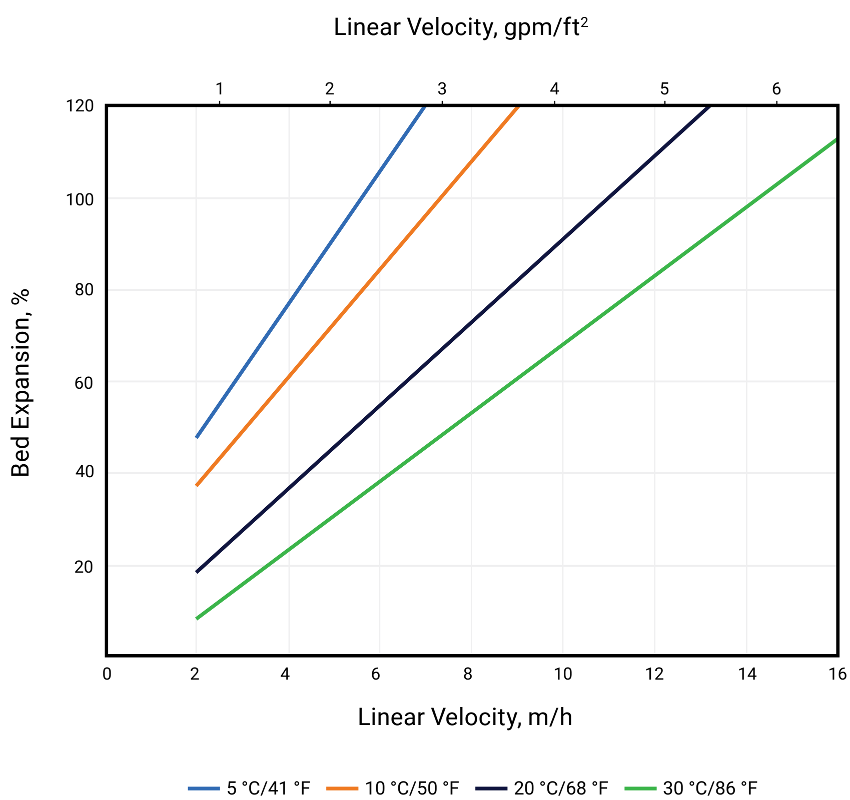
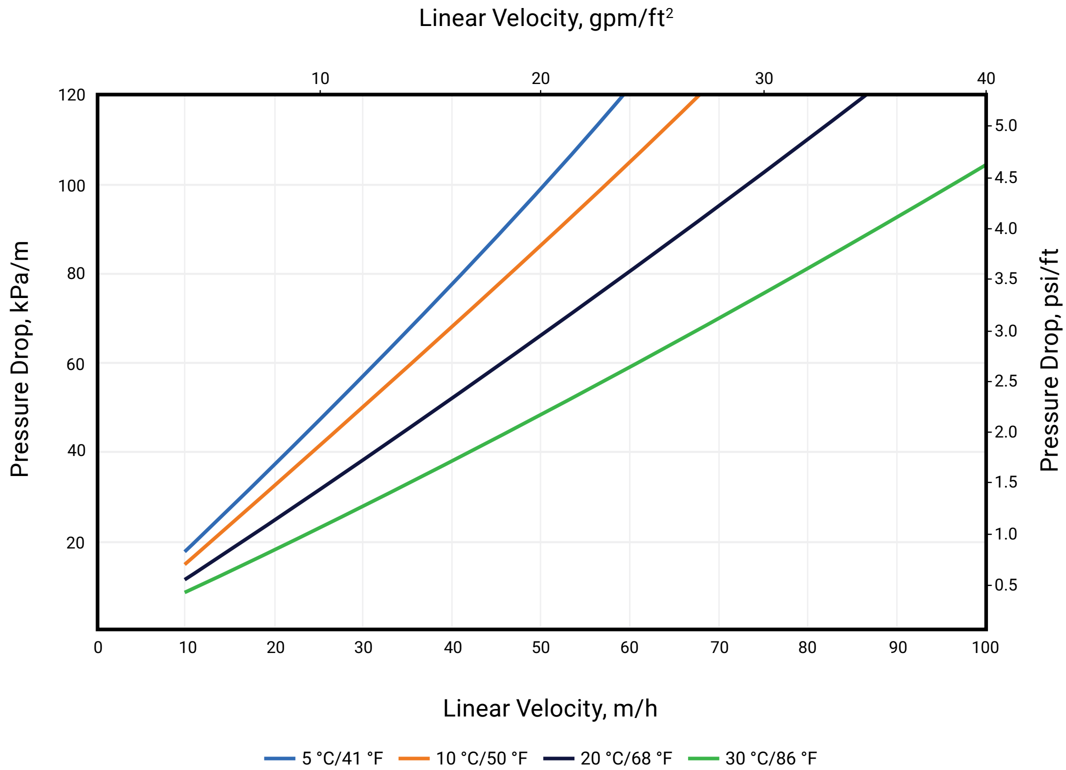


FIGURE 4

Pressure Drop



Safety Information

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.

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