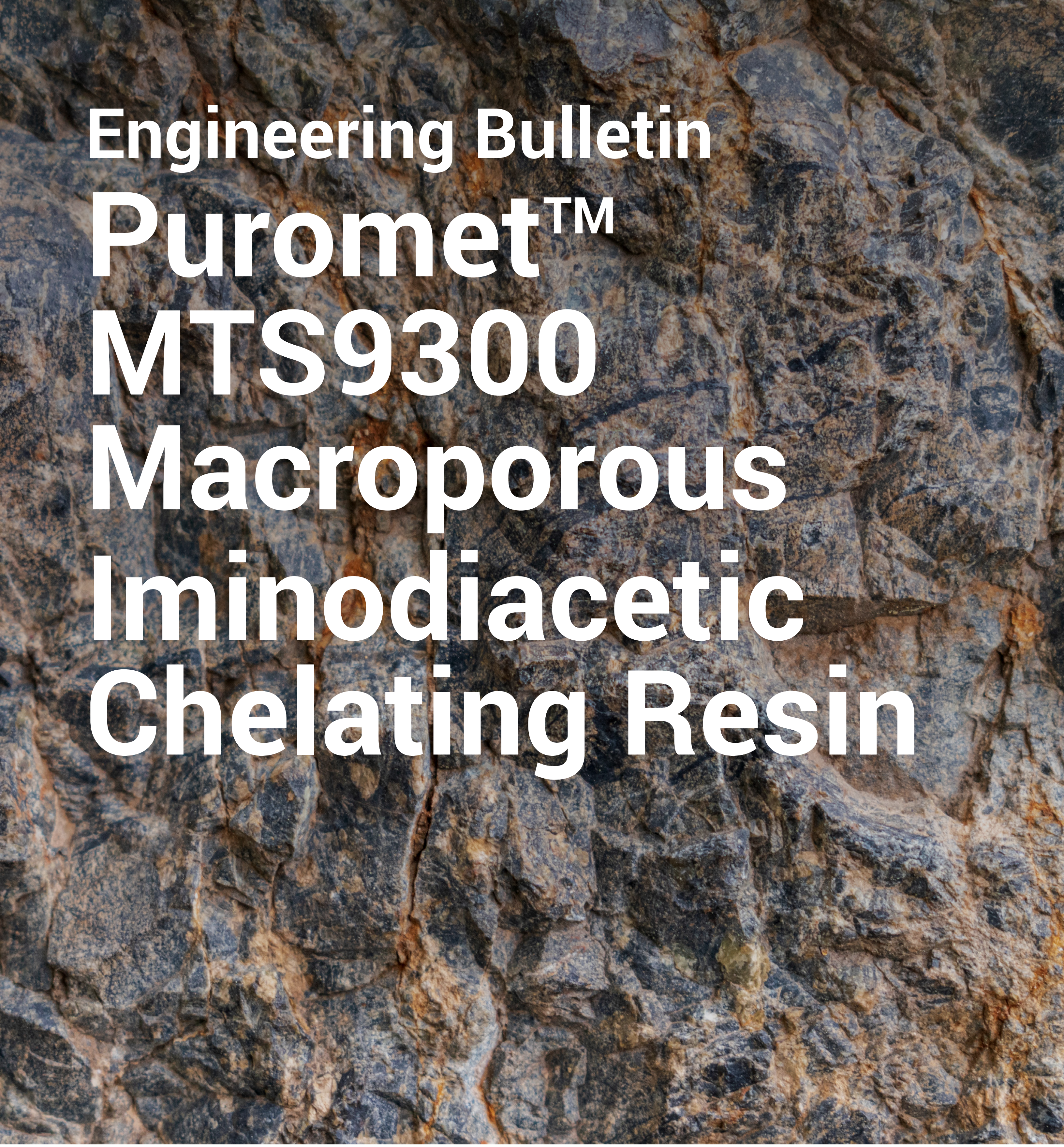


Engineering Bulletin

Puromet™ MTS9300 Macroporous Iminodiacetic Chelating Resin

For the selective removal of heavy metals from aqueous solutions.

Purolite®
An Ecolab Company

About Purolite

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

Responding to our customers' needs, Purolite has a wide variety of products and the industry's largest technical sales force. Globally, we have strategically located research and development centers and application laboratories. Our ISO 9001 certified manufacturing facilities in the USA, United Kingdom, Romania and China combined with more than 40 sales offices in 30 countries ensure complete worldwide coverage.

Purolite has been part of Ecolab since 2021. A trusted partner at nearly three million commercial customer locations, Ecolab (ECL) is the global leader in water, hygiene and infection prevention solutions and services. Ecolab delivers comprehensive solutions, data-driven insights and personalized service to advance food safety, maintain clean and safe environments, optimize water and energy use, and improve operational efficiencies and sustainability for customers in the food, healthcare, hospitality and industrial markets in more than 170 countries around the world.

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 team in the industry.

INNOVATIVE SOLUTIONS

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

Engineering Bulletin: Puromet MTS9300 Macroporous Iminodiacetic Chelating Resin

Contents

Product Description

Puromet MTS9300 is a macroporous polystyrene based chelating resin, with iminodiacetic groups designed for the removal of heavy metal cations from industrial effluents. These cations may be separated from high concentrations of monovalent cations (typically sodium) and also from common divalent cations (such as calcium). Removal can be achieved both from weakly acidic and weakly basic solutions depending on the metals to be removed. Puromet MTS9300 finds use in processes for extraction and recovery of metals from ores, galvanic plating solutions, pickling baths and effluents even in the presence of alkaline earth metals (calcium and magnesium).

Further important uses include refining salt solutions of transition and precious metals and for the cleaning and purification of various organic or inorganic chemical products by removal of heavy metals contamination (usually from aqueous solutions).

TABLE 1 Typical Physical and Chemical Characteristics

Characteristics	Description/Value
Polymer Structure	Macroporous polystyrene crosslinked with divinylbenzene
Appearance	Spherical beads
Functional Group	Iminodiacetic
Ionic Form	Na^+ form
Copper Capacity (min.)	50 g/L
Moisture Retention	52–60% (Na^+ form)
Particle Size Range	425–1000 µm
< 425 µm (max.)	2%
Uniformity Coefficient (max.)	1.5
Reversible Swelling, $H^+ \rightarrow Na^+$ (max.)	35%
Specific Gravity	1.18
Shipping Weight (approx.)	750–800 g/L (46.9–50.0 lb/ft³)
Temperature Limit	80 °C (176.0 °F)

Standard Operating Conditions

These operating conditions are given as a general example. However, regeneration conditions and flow rates should be chosen for the particular application. For further recommendations, please contact your local Purolite sales office.

TABLE 2 Standard Operating Conditions

Operation	Rate	Solution	Minutes	Amount
Service	8–16 BV/h 1–2 gpm/ft^3	For Treatment	–	–
Backwash	5–7 BV/h 2–3 gpm/ft^3	Raw Water	10–20	1.5–6 BV 10–35 gal/ft^3
Regeneration	3–4 BV/h 0.4–0.5 gpm/ft^3	6–10% HCl 6–10% H_2SO_4*	30–60	140–200 g/L HCL or 12.5–20 lb/ft^3 200–320 g/L H_2SO_4
Slow Rinse	3–4 BV/h 0.4–0.5 gpm/ft^3	Raw Water	30–40	2–3 BV 15–25 gal/ft^3
Conversion to sodium form as required	3–4 BV/h 0.4–0.5 gpm/ft^3	2–4% NaOH (Upflow)**	30–60	40–100 g/L 2.5–6.25 lb/ft^3
Rinse	3–4 BV/h 0.4–0.5 gpm/ft^3	Soft or Demin Water	20–40	2–4 BV 15–30 gal/ft^3

Backwash expansion 75% (optimum)
Design rising space 80–100%
Minimum bed depth 1,000 mm
"Gallons" refer to U.S. Gallon = 3.785 liters

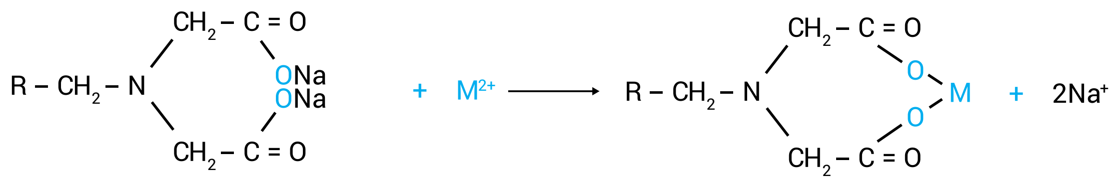
* The use of H_2SO_4 should be avoided, where Puromet MTS9300 is operated on feed solutions, which contain Ca. This is to avoid $CaSO_4$ precipitations.

** The aim is to achieve the same pH as that of the incoming solution.

For better performance, two columns can be operated in series with a third on stand-by to achieve lowest leakage.

Principle of Reaction

The iminodiacetic functional groups, in either the sodium or the hydrogen form, will chelate heavy metals by ion attraction to the dicarboxylic functionality and electron donation from the nitrogen:



Applications

FIGURE 1

Selectivity of Puromet MTS9300 in Acidic to Neutral Conditions

Iron (Ferric)
Copper
Hydrogen
Lead
Nickel
Cadmium
Zinc
Cobalt
Iron (Ferrous)/Manganese
Calcium/Magnesium
Strontium
Sodium

Puromet MTS9300 is particularly suitable for the removal of heavy metals (as weakly acidic chelated complexes). Relative selectivity of Puromet MTS9300 in acid to neutral conditions as shown in Figure 1:

Fe^{3+} > Cu > H > Pb > Ni > Cd > Zn > Co > Fe^{2+} > Mn > Mg > Ca > Sr >> Na^{+}

The macroporous resin structure ensures excellent diffusion of ions thus affording efficient exhaustion and regeneration. Recovery of heavy metals from effluents from the plating industry is achieved by concentration and is particularly useful where full demineralization and recycling of the rinse water is not practiced. The simplest case is where only one heavy metal is present, when volumes of rinse water are low, wastewater fees may be low and raw water has a low salt content. Puromet MTS9300 can be used to reduce residual toxic heavy metals to below the maximum admissible concentration levels which are often far below those obtainable after precipitation reactions. It may also be used to remove similar residuals from demineralized rinse water circuits.

Puromet MTS9300 is also used to separate and concentrate heavy metals in hydro-metallurgical processes (ore dressing and scrap recovery). It is particularly suitable where metals are present in low concentrations. Separation techniques may be carried out according to the order of selectivity given above. However, changes in the sequence occur with change in pH and in the presence of certain anions (including higher concentrations of chloride and sulfate). The sequence given above is applicable for neutral and weakly acidic solutions. The optimal pH for this resin is 5–6 for greatest capacity but will work between a pH of 4–8. When the pH is greater than 9, the resin becomes more selective for calcium and magnesium which will use up capacity very quickly.

Operating Performance

The information below may be taken as a general guide. However, before any plant design is contemplated, the user should perform column testing of the feed solution to be treated.

The operating capacity is a function of pH and inlet concentration for each metal. Figures 2 and 3 provide estimated resin capacity for each metal based on pH. Actual loading will best be determined by piloting and testing during the service cycle.

FIGURE 2

Exchange Capacity for Metals as a Function of pH

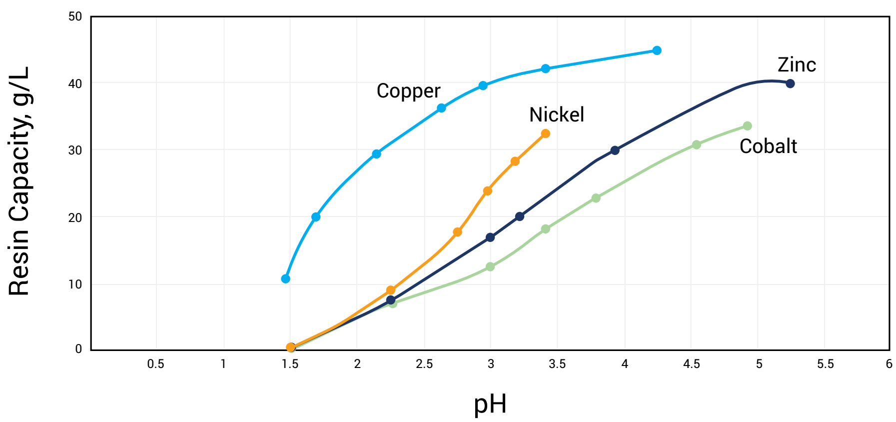
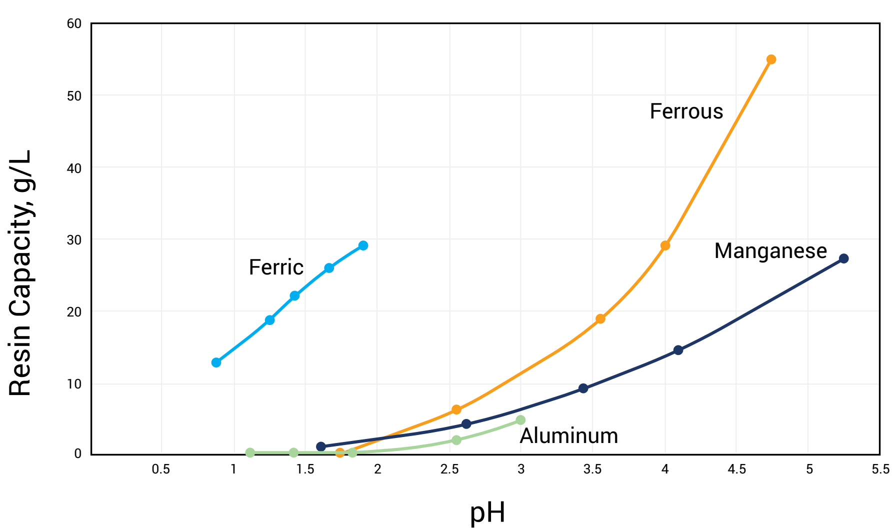


FIGURE 3

Exchange Capacity for Metals as a Function of pH



Hydraulic Characteristics (General Applications)

The pressure drop (or head loss) 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. Anything affecting any of these parameters — for example, the presence of particulate matter filtered out by the bed, abnormal compaction of the resin bed, or the incomplete classification of the bed — will have an adverse effect and result in an increased head loss or pressure drop. Service flow rates from 8–16 bed volumes per hour, 1–2 gpm/ft^3, depending on the application, may be regarded as the normal range used with this resin.

Pressure drop values expected for aqueous solutions, are given in Figure 4. This is applicable to the freshly regenerated H^+ form. As the resin is converted to the metal form, the pressure drop will decrease slightly due to swelling during exhaustion from the H^+ form.

During upflow backwash, the resin bed should be expanded by between 50 and 75%, to free any particulate matter, to clear the bed of entrapped air bubbles, and to reclassify the resin particles as much as possible, ensuring minimum resistance to flow. Bed expansion increases with backwash flow rate and decreases with temperature, as shown in Figure 5, for a typical exhausted form of the resin. Care should always be taken to avoid resin loss by over expansion of the bed.

FIGURE 4

Pressure Drop vs Flowrate

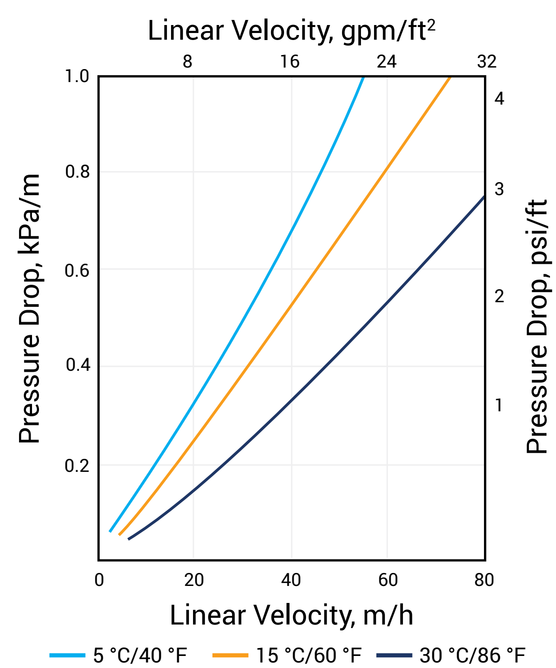


FIGURE 5

Backwash Expansion (Exhausted Form)

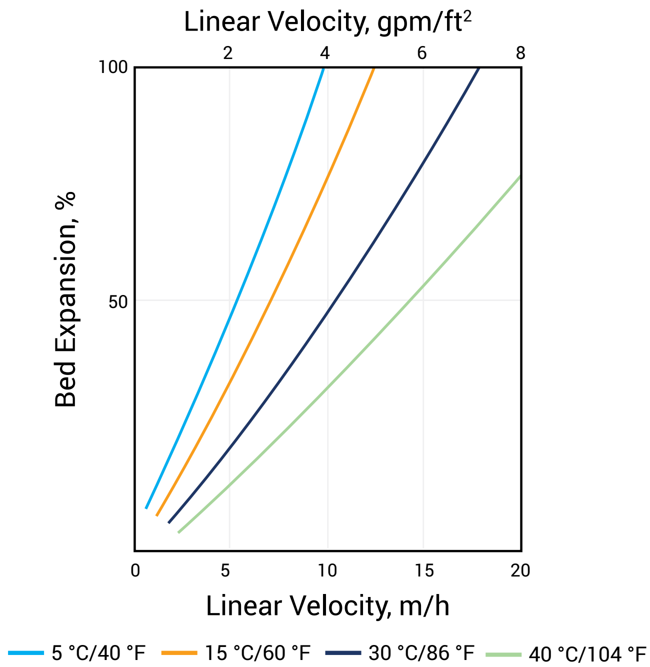


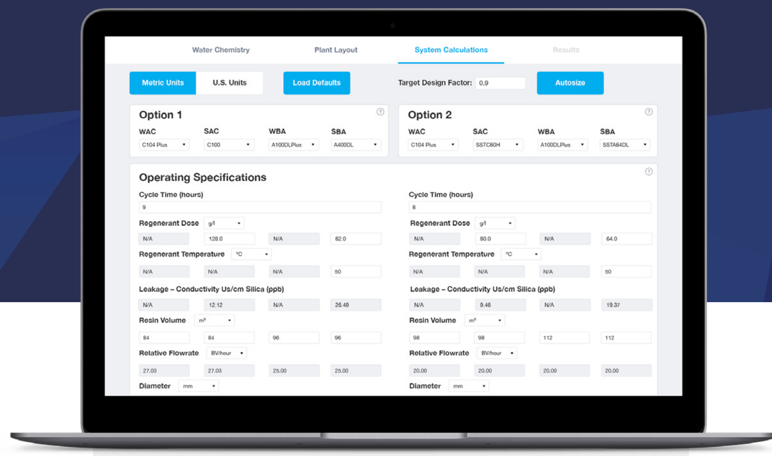
TABLE 5 Conversion of Units

1 m/h **(Cubic Meters Per Square Meter Per Hour)**	= 0.341 gpm/ft^2 = 0.409 U.S. gpm/ft^2
1 kg/cm^2/m **(Kilograms Per Square Cm Per Meter of Bed)**	= 4.33 psi/ft = 1.03 atmos/m = 10 ft H_2O/ft

Customized Resin Simulation at Your Fingertips

PRSM™
Purolite Resin System Modeling

PRSM is a free program that models all aspects of plant design associated with ion exchange resin performance and operation.



Plan your next ion exchange resin project with better accuracy and less effort through Purolite's Resin System Modeling platform (PRSM™). This powerful web application for resin plant simulation contains seven specific system modules that instantly consider hundreds of variables. Whether you are designing a new plant or modeling an existing plant, Purolite's expert engineers are giving you the access you need to get the results you can trust.

Key Insight Every Step of the Way

Predict

Calculate the effect of your site's unique variables

Compare

Side-by-side product and plant configuration performance evaluation

Optimize

Add operation and product cost analysis to better understand the value of product options

PRSM includes modules for water softening, demineralization, WAC softening, brine purification, mixed beds and modules for removal of nitrate, arsenic and boron. Features include:

Technical Help – Reach out directly to Purolite engineers for advice

Cloud Backup – Easy and secure retrieval of projects

Reporting – Print/save a pdf of the entire design including all engineering details

ROI Payback Calculations – Contrast performance vs. standard resins

Efficiency Evaluation – Compare operating costs of existing ion exchange plant vs. new design

Schedules – Obtain detailed regenerant schedules for cation and anion resins

Page, Topic and Calculation Help – View detailed notes and suggestions for the optimal design

Register today and get started at **www.purolite.com/PRSM**

Purolite®
An Ecolab Company

Algeria
Australia
Bahrain
Brazil
Canada
China
Czech Republic
France
Germany
India
Indonesia
Israel
Italy
Japan
Jordan
Kazakhstan
Korea
Malaysia
Mexico
Morocco
New Zealand
Poland
Romania
Russia
Singapore
Slovak Republic
South Africa
Spain
Taiwan
Tunisia
Türkiye
UK
Ukraine
USA
Uzbekistan

Americas
Purolite
2201 Renaissance Blvd.
King of Prussia, PA 19406
T +1 800 343 1500
T +1 610 668 9090
F +1 800 260 1065
americas@purolite.com

EMEA
Purolite Ltd.
Unit D
Llantrisant Business Park
Llantrisant, Wales, UK
CF72 8LF
T +44 1443 229334
F +44 1443 227073
emea@purolite.com

FSU
Purolite Ltd.
Office 6-1
36 Lyusinovskaya Str.
Moscow, Russia
115093
T +7 495 363 5056
F +7 495 564 8121
fsu@purolite.com

Asia Pacific
Purolite China Co. Ltd.
Room 707, C Section
Huanglong Century Plaza
No.3 Hangda Road
Hangzhou, Zhejiang, China 310007
T +86 571 876 31382
F +86 571 876 31385
asiapacific@purolite.com

Purolite, a leading manufacturer of quality ion exchange, catalyst, adsorbent and specialty high-performance resins, 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.

www.purolite.com

P-000265-NPOLD-1222-ENG-PCO