GENERAL INFORMATION

Loading and Commissioning of Ion Exchange Resins

This brochure describes how to properly load and commission ion exchange resins for optimal performance.

Purolite®

LOADING AND COMMISSIONING OF ION EXCHANGE RESINS

This Guide presents information on how to properly load, commission and operate ion exchange units for optimal performance. Co-flow and counter-flow systems are reviewed, as well as anion, cation and mixed beds. For more detailed information on our products or to find a product for a specific application, please go to www.purolite.com or contact your closest Purolite regional office as 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.

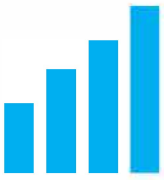
Responding to our customers' needs, Purolite has the widest variety of products and the industry's largest technical sales force. Globally, we have five strategically located research and development centers and eight application laboratories. Our ISO 9001 certified manufacturing facilities in the United States of America, United Kingdom, 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.

Introduction

The correct performance from any ion exchange resin bed unit can only be achieved if the resin is loaded, commissioned and operated correctly. The following information gives guidelines for the loading and commissioning of different types of ion exchange plants.

Supplied resins

Check that the resin type and quantity supplied are those that were ordered according to the resin specification or the manufacturer's recommendations. It is essential that the resins are filled into the correct vessels.

Retainer samples

Take a 1 liter composite retainer sample from each resin—better from each different batch —and keep it in a suitable sealed container for future reference.

Preliminary vessel inspection

If available, check plant documentation and vessel drawings. If not available, record technical data of the vessels including vessel diameter, cylindrical shell height, type of distributor system, type and number of nozzles, density of nozzles, height of collector system, position of sight glasses, etc.

When an old resin bed is being replaced, it is essential that the unit is first inspected to ensure all old resin and any debris has been completely removed before the new resin is installed. Removal of debris, old underbedding and old resin can be completed through siphoning. It is also important to check vessel internals for signs of damage, blockage or excessive movement in the distribution and collection systems.

Checking for blockage on a bottom distribution system can be done by filling the vessel with 20 cm (8 inches) of water and adding enough resin to cover the distribution system. On opening the backwash inlet a regular, even movement of the resin around the strainers indicates that there are no blockages. Strainer/nozzle leaks can be easily detected by carrying out an alternate backwash and draining, as well as sampling and examining drain water for the absence of resin beads.

While vessels are empty, it is also a good idea to spark test the internal rubber lining. The same checks should be done for any new vessels.

It is also recommended—where possible—to check the pressure drop of the empty filter at the service flow rate.

Resin loading

It is important that the resin is not pumped into the column by a centrifugal pump as this can cause damage giving rise to fines and poor performance due to subsequent cross contamination. We recommend using a hydraulic ejector or manual loading through the top manway.

If use of a pump cannot be avoided, then a special pump designed to handle delicate solids, such as a diaphragm pump, should be used with a high water to resin ratio.

All equipment has to be thoroughly cleaned before each filling process to avoid contamination of the resin by either foreign matter or different resin types.

The contamination of the anion vessel with cation beads will cause problems for the plant performance.

Water quality

Use demineralized water for the filling and commissioning processes wherever possible. If this is not available, we recommend filling, regenerating and commissioning the cation vessel first in order to produce decationized water that can support the filling and commissioning of the anion vessel. Use of raw water can result in magnesium hydroxide precipitation when it comes in contact with caustic or OH^- form anion resin.

Co-flow and conventional counter-flow systems (plants with internal backwash)

Loading

Fill the vessel to ½ its height with water to ensure proper settling of the resin and avoid resin damage. Adjust water flow via drain valve to maintain the water level. Load the correct resin volume into the vessel. Backwash the resin bed for 30 minutes at an expansion of 80 – 100% to remove fines and classify the bed. Let bed settle and drain to 10 cm (4 inches) above top of resin bed. Mark resin level in sight glass. This mark can be used to detect resin loss in long term operation. Make sure the resin level conforms to the plant design. Especially for water or air hold-down counter-flow plants, it is important that the resin level is above the central regenerant collector to avoid turning of the bed.

Commissioning

Proceed through a normal acid and caustic regeneration procedure. If supplied in the exhausted form, a double or triple regeneration is recommended. This does not mean going through the whole regeneration cycle two or three times, but instead ensuring that double or triple the amount of chemical is applied. This may involve refilling the chemical measure.

Carry out the displacement rinse according to the normal procedure and rinse to the specified conductivity.

New resins should be rinsed to drain separately when regenerated the first time. Only apply recycle mode in subsequent regenerations to prevent contamination of both the resin bed and the treated water with residual organic matter that may be present on newly manufactured resin.

Packed bed systems (plants with external backwash)

Loading

For plants with external backwash vessels, resin should be handled manually or with a suitable hydraulic ejector system.

In packed bed systems it is important that the freeboard level (free space between top of resin bed and inert resin or nozzle plate) is minimized to ensure optimal plant performance. This is especially important for strong acid and strong base resins. The freeboard needs to be calculated accurately taking the resin bed height with resin in the most swollen form. Strong acid cation resins are most swollen in the hydrogen form, while strong base anion resins have maximum volume in the hydroxide form. Weak acid and weak base resins have peak volume in the exhausted form. Determine the required resin volume accordingly.

Fill ½ of the backwash vessel with water. Load ½ of the resin volume into the vessel. Backwash the resin bed for 15 – 20 minutes at an expansion of 80 – 100% to remove fines and classify the bed. Let the bed settle and drain to 10 cm (4 inches) above top of resin bed. If possible, determine the resin volume. Make sure the service vessel is filled half way with water, and transfer the resin. Repeat the procedure with the second half of the resin.

Commissioning

Proceed through a normal acid and caustic regeneration procedure. If supplied in the exhausted form, a double or triple regeneration is recommended. This does not mean going through the whole regeneration cycle two or three times, but instead ensuring that double or triple the amount of chemical is applied. This may involve refilling the chemical measure.

New resins should be rinsed to drain separately when regenerated the first time. Only apply recycle mode in subsequent regenerations to prevent contamination of both the resin bed and the treated water with residual organic matter that may be present on newly manufactured resin.

After proceeding through the displacement rinse and rinsing to specificity, check the freeboard levels to ensure the fill levels meet plant design specifications.

An alternative approach for commissioning is to fill 90 – 95% of the resin first, carry out a double regeneration and top-up the resin volume to the desired freeboard level. A single regeneration is carried out after the top-up. This procedure enables very low freeboards to be accurately adjusted.

Inert resin can be either added manually to the service vessel before adding the resin or transferred via the backwash vessel—where possible—after completion of the resin transfer.

Filling procedures for PuroPack systems can be found in the PuroPack Engineering Manual, which is available on www.Purolite.com.

Mixed bed vessels

Resin types / Ionic form

Remember that regardless of the resin manufacturer, when ordering replacement mixed bed resins, resins supplied in the exhausted form (cation in the sodium form and anion in the chloride or sulfate forms) are more easily commissioned as they are less prone to clumping. Cation resins in the H^+ (hydrogen) form can be loaded with chloride or sulfate form anion resins successfully, but OH^- (hydroxide) form anion resins are more prone to clumping when new.

Cation resin loading

Before loading the resin, put some demineralized or exit-anion quality water into the bottom of the unit. The cation resin can then be loaded into the column.

When loading the cation resin, it is critical to make sure that the top of the cation resin is positioned correctly in relation to the central system. Once loaded, cation resin should be given an extended backwash so that the bed is graded to its full expanded and settled volume. If there is no inert spacer resin, you must allow for the volume change between different ionic forms. The central collection system should be slightly buried into the surface of the cation resin when it is in its exhausted form.

Cross contamination must be minimized in all polishing mixed beds, however it is not completely avoidable when intermediate spacer resins are not used. The effect of getting caustic on to cation resin is much less of an operating problem than contacting anion resin with hydrochloric or sulfuric acid during regeneration.

Rinse the cation bed to drain before loading the next resin in order to remove leachables left from the manufacturing process.

Inert spacer resin

If using Purolite® IP3 or Purolite® IP7 inert spacer resin, it must be loaded into the column next. One should ensure that the inert resin covers and surrounds the central collection system by at least 50 mm (2 inches) on all sides. For example, a 100 mm (3.9 inches) wide center system would require a 200 mm (7.9 inches) depth of intermediate inert spacer. The inert resin can be changed manually from the top of the vessel. Loading inert resin should be carried out with a layer of water 600 mm (23.6 inches) above the cation resin so that disturbance of the bed is kept to a minimum.

Anion resin loading

Before loading the anion component, check that the central collection system sight glass will clearly show the position of the interface between the two resins. Mark the interface position on the site glass for future reference.

Loading of the anion resin should be carried out with a layer of water 600 mm (23.6 inches) above the cation (inert) to keep disturbance of the bed to a minimum. The anion should be loaded in the same manner as described for the cation resin. The anion bed can then be backwashed and expanded to its graded form through the central collection system. If this is not practical, it may not be prudent to carry out a full bed backwash to grade the anion component before the initial regeneration as this can give rise to clumping.

If you are changing the generic resin type or the grading of the products, you may have to adjust the backwash rate to achieve optimum expansion and separation. Your Purolite technical sales team is available for guidance.

After the backwash of the anion, check the top of the bed and remove any debris that may be on the surface of the bed. Also check the interface position on the sight glass.

Remember the cation resin, if supplied in the exhausted sodium form will swell when regenerated.

Commissioning

As with the resin loading, all water used during the commissioning of the beds must be either treated water or water of a quality from the preceding cation-anion units. Use of raw water can result in magnesium hydroxide precipitation when it comes in contact with caustic or OH^- form anion resin.

The normal acid and caustic regeneration procedure can now be performed. If supplied in the exhausted form, then a double or triple regeneration is recommended. This does not mean going through the whole regeneration cycle two or three times. Instead, double or triple the amount of chemical applied. This may involve refilling the chemical measure.

Once regeneration and individual rinses are complete, the unit can move forward to the next stage of the regeneration cycle. This is normally a drain-down, followed by air mixing, bed settle, refill and final rinse.

During drain-down, make sure the water level drains to just above the resin bed, and that during air mixing, that the mixing is vigorous.

There is always a risk of clumping with new mixed bed resins, and the air mix stage can be extended to ensure good mixing.

During the final rinse stage, extend the rinse to drain. New resins release organic leachables when first used, particularly if they have been held in stock for some time. Depending on the application, treated water quality specifications, storage time, it may take a while to achieve desired water quality. When monitoring water quality during this extended rinse, look at the conductivity and silica levels that may be achieved quickly. TOC release should be monitored as well if it is important to your final use, as for high-purity applications.

Returning to Service

In order to maintain high quality water and performance, mixed beds should never be run to exhaustion. They are normally taken off line early, either based on the amount of time the resin has been in operation, or based on the volume of water treated. The water quality to service should not be allowed to be less than a resistivity of 200,000 ohms specific resistance (Conductivity 5 micromhos/cm).

Problems experienced on new resins in mixed bed units are often due to the following:

1. Poor separation due to incorrect backwash rate
2. Incorrect positioning of interface at central collection system
3. Incorrect drain-down position
4. Inadequate air mixing
5. Clumping

In the event of clumping within the bed, additional regenerant chemicals can be used to overcome the problem during subsequent regenerations. Alternatively, if the clumping is very bad, declumping chemicals and a procedure for its application can be obtained from Purolite.

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