LOADING AND COMMISSIONING OF ION EXCHANGE RESINS

1. 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.

2. General

2.1 Supplied Resins

Check that the resin types and quantities which were supplied are identical with the resins which were ordered according to the resin specification or the manufacturer's recommendations. It is essential that the resins are filled into the correct vessels.

2.2 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.

2.3 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, before the new resin is installed, the unit is first inspected to ensure all the old resin and any debris has been removed completely. Removal of debris, any old underbedding, and old resin can be done by the siphoning technique. Also important is that the vessel internals have been checked to ensure there are no signs of damage, blockage, or excessive movement in the distribution and collection systems. Checking for blockage on a bottom distribution

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system can be done by filling the vessel with water to a 20 cm (8 inches) level 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. By carrying out an alternate backwash and draining, sampling the drain water and examining it for the absence of resin beads, strainer/nozzle leaks can be easily detected.

It is also prudent, while vessels are empty, to have the internal rubber lining spark tested. The same checks should be done for a new vessel.

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

2.4 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 would recommend using an hydraulic ejector or manual loading through the top manway. If the use of a pump cannot be avoided then a special pump, such as a diaphragm pump, designed to handle delicate solids 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. Especially the contamination of the anion vessel with cation beads will cause problems for the plant performance.

2.5 Water quality

Wherever possible use demineralized water for the filling and commissioning processes. Where this is not available fill, regenerate and commission cation vessel first in order to produce decationized water for the filling and commissioning of the anion vessel. Use of raw water can result in magnesium hydroxide precipitation in contact with caustic or OH^- form anion resin.

3. Plants with Internal Backwash (Coflow and Conventional Counterflow Systems)

3.1 Resin Loading

Fill the vessel to 1/2 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 counterflow plants it is important the resin level is above the central regenerant collector to avoid turning of the bed.

3.2 Resin Commissioning

You can now go through the normal acid and caustic regeneration procedure. 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 but 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 plant to conductivity. New resins should be rinsed to drain separately when regenerated first time. The recycle mode should only be applied in subsequent regenerations. This shall avoid that organic residuals from the manufacturing, which might be present on the new resins, are concentrated in the recycle water and contaminate the resin beds or end up in the treated water.

4. Plants Without Internal Backwash (Packed Bed Systems)

4.1 Resin Loading

For plants without external backwash vessels the resin has to be handled manually or a suitable hydraulic ejector system has to be used.

It is important for packed bed systems that the freeboard level (free space between top of resin bed and inert resin or nozzle plate) is kept to a minimum in order to ensure best possible plant performance, especially important for strong acid and strong base resins. The freeboard needs to be calculated accurately taking the resin bed height in the most swollen form. This is the hydrogen form for strong acid cation resins and the hydroxide form for strong base anion resins. Weak acid and weak base resins have their highest 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 bed settle and drain to 10 cm (4 inches) above top of resin bed. If possible determine the resin volume. Transfer the resin into the service vessel, which has been filled to half with water. Repeat the procedure with the second half of the resin.

4.2 Resin Commissioning

You can now go through the normal acid and caustic regeneration procedure. 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 but 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 plant to conductivity. New resins should be rinsed to drain separately when regenerated first time. The recycle mode should only be applied in subsequent regenerations. This shall avoid that organic residuals from the manufacturing, which might be present on the new resins, are concentrated in the recycle water and contaminate the resin beds or end up in the treated water.

Check the freeboard levels to ensure the filling levels are correct according to the plant design.

An alternative approach is to fill 90-95% of the resin first, carry out a double regeneration and top-up the resin volume accordingly to the wanted freeboard level. A single regeneration is carried out after the top-up. This way very low freeboards can be adjusted very accurately.

Inert resin can be either added manually to the service vessel before adding the resin. Or alternatively the inert resin could be transferred via the backwash vessel – where possible – after completion of the resin transfer.

A more comprehensive filling procedure is given in the Puropack manual for Puropack counterflow plants.

5. Mixed Bed Vessels

5.1 Resin Types / Ionic Form

Please remember, regardless of the resin manufacturer, when ordering replacement mixed bed resins, that resins supplied in the exhausted form (cation in the sodium form and anion in the chloride or sulphate 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 sulphate form anion resins successfully, but OH^- (hydroxide) form anion resins are more prone to clumping when new.

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5.2 Cation Resin Loading

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

It is critical when you load the cation resin that you ensure that the top of the cation resin is positioned correctly in relation to the central system. Once loaded the 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 interspace inert you must ensure, allowing for the volume change between different ionic forms, that the central collection system will be very 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 where intermediate spacer resins are not employed. The effect of getting caustic on to cation resin is much less of an operating problem than contacting anion resin with hydrochloric or sulphuric acid during regeneration.

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

5.3 Spacer Inert Resin

If Purolite IP3 or IP7 spacer inert resin is used this must be loaded into the column next ensuring that it not only covers and surrounds the central collection system but that the depth covering the system is at least 50 mm (2 inches) on all sides. For example a 100 mm (3.9 inches) wide centre system would require a 200 mm (7.9 inches) depth of intermediate spacer inert. The inert resin can be charged manually from the top of the vessel. Loading of the inert resin should be carried out with a layer of water 600 mm (23.6 inches) above the cation resin so that as the inert resin is loaded the disturbance of the bed is kept to a minimum.

5.4 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, or the inert or interface between the cation and inert or anion and inert if included. 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) resin so that as the anion resin is loaded the disturbance of the bed is kept 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 then it is sometimes not prudent to carry out a full bed backwash to grade the anion component before the initial regeneration as this can give rise to clumping.

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Please remember during the commissioning of the bed if you are changing the generic resin type or the grading of the products then you may have to adjust the backwash rate to achieve optimum expansion and separation. Reference to your Purolite office is recommended for guidance.

Following the backwash of the anion component check the top of the bed and remove any debris which may be present on the surface of the bed and check the interface position on the sight glass.

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

5.5 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 in contact with caustic or OH^- form anion resin.

You can now go through the normal acid and caustic regeneration procedure. 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 but ensuring that double or triple the amount of chemical is 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 draindown, followed by air mixing, bed settle, refill and final rinsing

During the draindown stage ensure the water level drains down to just above the resin bed and that during the air mixing stage the mixing is vigorous.

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

During the final rinse stage extend the rinse to drain. Depending on the application, the required treated water quality and time the resin has been in stock following manufacture, this may take some time before water quality is achieved meeting all your requirements. New resins release organic leachables when first used, particularly if they have been held in stock for some time. When monitoring the water quality during this extended rinse you should not only look at the conductivity and silica levels which may be achieved quickly, but also check for any significant TOC release if this is critical to your final use. This is particularly important on very high purity applications.

5.6 Returning to Service

Mixed beds should never be run to exhaustion if you wish to maintain quality at the highest level. They are therefore taken off line early, either on time or 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 problems:

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

In the event of clumping within the bed further addition of regenerant chemicals can 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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