Organics Removal by Ion Exchange

1.0 INTRODUCTION

Many naturally occurring surface waters contain dissolved organics, which are often referred to as Humates and Fulvates. These organics can foul ion exchange resins, particularly anion resins.

To reduce the level of organics going forward on to an ion exchange plant it is common, on highly fouling waters, to employ an organic scavenger resin. This is a strong base anion resin, which has a special porous structure which will capture organic species by a number of different mechanisms.

There is a method of calculating the fouling potential of a raw water. This relates the organics content to the inorganic total dissolved solids in the water. Please contact your Purolite office for assistance if you wish to examine the fouling potential of your water.

2.0 ORGANIC SCAVENGERS

2.1 Organic Scavenger Resins

These resins are normally manufactured from either polystyrenic or polyacrylic polymers. The polystyrenic based Purolite product is Purolite A500P. The polyacrylic based product is Purolite® A860.

In general terms the polyacrylic resin often offers a greater reversible removal of organics on regeneration (more hydrophilic structure) and can therefore cope with higher levels of dissolved organics. The polystyrenic resin often can reduce dissolved organics down to lower levels but is less easy to regenerate (more hydrophobic structure).

Due to their different structures and slightly different performance many modern plants include a combination of both resins. In conventional co-flow regenerated plant the Purolite A500P is loaded into the bottom of the unit with the Purolite A860 on top. Mixing will occur but there an advantage in having the organics passing through the polyacrylic resin first as this portion of the bed sees the higher organic loading.

2.2 Service Operation

Organic scavenger resins, when new, will typically remove between 60-80% of the dissolved organics. However as they age these resins also become irreversibly fouled and the removal can fall off quite quickly if the cycle length is too long or if inadequate cleaning of the resin is undertaken.

© 2006 The Purolite Company
All Rights Reserved
150 Monument Road
Bala Cynwyd, Pa 19004 USA
Tel 1 800 343 1500
1 610 668 9090
FAX 1-610 668 8139
www.purolite.com

The scavenger beds are normally sized on flow rate. They operate best between 8-16 BV/h and hence 12 BV/h is often employed when sizing the plant. They can be operated at much higher flow rates but this has a serious effect on the loss in performance.

Normally, because of this low rating the resin volumes and scavenger units are comparatively large and employ deep bed depths.

It is very difficult to accurately calculate the recommended service cycle. No two waters are the same and the type of organics can vary quite considerably in nature. If there are no other organic scavengers operating in the area to indicate the kind of performance likely from the unit, then we normally recommend starting the plant with regeneration every 24 hours. You can then monitor across the unit the type of performance being achieved. In some cases the cycle has to be shortened and in others it is possible to extend the cycle time. It is unusual to have a cycle time less than 12 hours or greater than 48 hours. 24 hours is the most commonly encountered cycle time on many scavenger plants. Regeneration is therefore normally initiated on a volumetric throughput (water meter) or time basis.

Where multi streamed plants are employed it is often better to operate them like a bank of filters with all the units on line to reduce the BV/h flow rate with an increased flow during through the on-line units when one is taken off line for regeneration.

2.3 Regeneration

Regeneration normally takes between 1 .5 and 2 hours. There are two principal ways to regenerate an organic scavenger resin. The best method is using a caustic brine solution, however in some instances the caustic effluent can cause a problem and then a brine only regeneration can be employed. Brine only regenerations are not as successful in obtaining good reversible removal of organics from the bed. Where brine only regenerations are employed then a occasional caustic brine treatment is also recommended to extend the life of the resin.

Both polystyrenic and polyacrylic based scavenger resins work best with caustic brine regeneration. If you are considering using brine only regenerations, with occasional caustic brine treatment, then the polyacrylic resin is generally the best resin to use.

Following backwashing of the column which is the first stage there is a bed settle period before commencing regeneration of the bed. For caustic brine regeneration we recommend:

> 160 g/l NaCl and 32 g/l caustic injected as a 10% brine solution at between 2-4 BV/h. You must ensure that you get good mixing of the caustic within the brine.

If you are using brine only then the quantity required is much higher and we recommend:

> 250-300 g/l NaCl injected as a 10% brine at a flow rate between 2-4 BV/h.

Following regenerant injection we would then expect a slow rinse at 2-4 BV/h for approximately 1-2 bed volumes followed by a final rinse at service flow rate to drain. This is normally for approximately 4-8 bed volumes depending on the efficiency of the internal design.

© 2006 The Purolite Company
All Rights Reserved
150 Monument Road
Bala Cynwyd, Pa 19004 USA
Tel 1 800 343 1500
1 610 668 9090
FAX 1-610 668 8139
www.purolite.com

At the end of the service run the unit should be ready to return on-line.

Please remember that the resin is predominantly in the chloride form and during the initial part of its service run the resin will exchange chloride ions for other anions present in the water such as bicarbonate, nitrate, sulphate etc. This may change the nature of the raw water.

Often companies do not get adequate mixing of the brine and caustic and this can give rise to some of the resin being in the hydroxide (OH-) form resulting in a high pH in the treated water. If treated water pH and/or high pH effluent is a problem then operating on a salt only regeneration is the best solution.

2.4 Fouling

With salt only regeneration the loss in performance can occur more quickly as the resin becomes more irreversibly fouled and organics removal efficiency reduces or the cycle length has to be shortened. To try to overcome this problem a periodic caustic brine soak can help provided it is carried out regularly. This is detailed in the procedure in section 2.5

2.5 Alkaline Brine Treatment for Fouled Scavenger Resin

This treatment is recommended on a regular basis from when the resin is installed. If only used when the bed is very badly fouled it is less effective.

Following a standard backwash make up three bed volumes of 10% w/v brine with 2% w/v caustic soda. Start injecting the solution into the bed at 2 BV/h and allow this to pass to drain. When the second bed volume is passing through the bed, stop the injection and retain the second bed volume on the resin.

This should be held on the bed for a minimum of 4 hours. If the plant operation allows retaining the solution on the bed for a longer period, possibly overnight, will increase the amount of organics removed.

The second bed volume is then displaced by the third bed volume which is injected in at the same 2BV/h rate. The resin is then finally rinsed slowly to drain.

In some circumstances a further standard regeneration following treatment is employed to ensure the maximum amount of organics removal has been obtained.

Please note elevating the temperature of the caustic brine solution to 35^{o}C or employing an air rouse during the brine soak can help in the removal of organics from the resin

© 2006 The Purolite Company
All Rights Reserved
150 Monument Road
Bala Cynwyd, Pa 19004 USA
Tel 1 800 343 1500
1 610 668 9090
FAX 1-610 668 8139
www.purolite.com

Range of Organic Scavenger Resins

Purolite A500P / PS

This resin is a macroporous strong base type 1 anion exchange resin with increased porosity to enhance its ability to capture organic species within the matrix structure.

Used on its own or in conjunction with its acrylic counterpart this resin is best regenerated with a mixture of caustic and brine. Brine only regenerations are less effective and can result in premature irreversible fouling. Typical regeneration conditions are 160 g/l NaCl and 32 g/l NaOH.

Optimum performance at service flow rates of 10-16 BV/h. Organics removal can be as high as 80-90% when the resin is new but more normal performance is between 50 – 70%.

Performance will vary from application to application due to the nature of the organics, but in general terms the Purolite A500P can often achieve lower levels of TOC than the acrylic counterpart when new.

In the sugar industry it is sold as Purolite A500PS and receives additional post treatment to clean the resin.

Purolite A860S

This is a macroporous strong base acrylic scavenger resin. It has a greater resistance to irreversible fouling and will normally cope with higher levels of organics than the Purolite A500P. It can cope with brine only regenerations but occasional caustic addition is recommended to maximise resin life.

For salt only regenerations we recommend a salt regeneration level of 250-300 g/l.

Resin Life

Resin life is hard to predict as the TOC levels in water vary and depending on the TOC level, cycle length, regen conditions etc. all have an effect on resin life. During the life of the resin the performance will fall off and normally resins are changed when the TOC reduction falls to below 40%. It is rare not to get 2 years life out of a bed operated correctly under design conditions. While some scavengers have lasted over 6 years between resin changes we would recommend customers without experience of operating these units base initially on changing the resins every 3-4 years. Purolite offers resin testing of scavenger resins for which a 200 ml core sample is required.

© 2006 The Purolite Company
All Rights Reserved
150 Monument Road
Bala Cynwyd, Pa 19004 USA
Tel 1 800 343 1500
1 610 668 9090
FAX 1-610 668 8139
www.purolite.com

REGIONAL OFFICES

(www.purolite.com)

Purolite® has more than 40 offices worldwide! For more information, contact the closest regional office near you or visit our website at http://www.purolite.com/

Americas

The Purolite Company
150 Monument Road
Bala Cynwyd, PA 19004
Telephone: 800-668-8139
+1 610-668-9090
Fax: +1 610-668-8139

Europe

Purolite International Limited
Cowbridge Road
Pontyclun,
South Wales, UK CF72 8YL
Telephone: +44-1443-229334
Fax : +44-1443 227073

Asia Pacific

The Purolite Company
Dongmenwai,
Chenguag Towen,
Deqing Co.,
County, Zhejiang 313216
China
Telephone: + 86-571 87631385
Fax: + 86-57187632229