The Storage, Transportation and Preconditioning of Ion Exchange Resins

Just ask Purolite.

PUROLITE®
ION EXCHANGE RESINS

General Guidelines

Purolite Ion Exchange Resins are generally supplied in fully swollen moist bead form. Provided that transportation and storage guidelines are followed, resins may be stored successfully for extended periods without significant deterioration. Some special products are supplied in a dry or partially-dried condition. In such instances, special care has to be taken as these resins may expand considerably on re-hydration. Therefore, adequate space should be made available in the vessel to accommodate the increase in volume.

Ion exchange resins are supplied in specific ionic forms depending on application and may then be converted into a different ionic form by regeneration or in service duty. Depending on the conversion, resins can swell, remain unchanged or shrink in volume and designs of service units must accommodate such changes. Some resins, such as acrylic strong base resins also undergo irreversible swelling in the first few operating cycles.

Engineers and designers should refer to Purolite specific Product Data Sheet for information on irreversible and reversible volume changes for different ionic forms.

All ion exchange resins should undergo pretreatment prior to service, this is especially important for resins intended for food process or potable water treatment. Recommended pretreatment for specific resin types and applications can be found on www.purolite.com

Shelf Life

Table 1 provides the expected shelf life, in months, for various common ion exchange resins and applications. There are many factors that affect the shelf life of ion exchange resins, including storage conditions, preconditioning applied, and the intended application.

To maximize shelf life of our products, it is essential that resin be protected from extremes of temperature and direct sunlight. Transport should be carried out using covered vehicles / containers and indoor temperature controlled warehousing utilized at site.

Purolite products may be successfully introduced into service in many applications even after extended periods in storage. Table 1 provides engineers and end users a guide to the expected shelf life of Purolite resin families for a few common applications. These guidelines assume that products are transported, stored and introduced in the prescribed manner laid out in this document. Where end users are unsure about the exact transport and or storage conditions, or where over 50% of the expected shelf life has been reached, Purolite recommends that extra precautions be taken when first using the ion exchange resin, particularly for critical or regulated applications. Under these circumstances, we recommend additional pre-treatment before placing the resin in service. Purolite would be happy to provide advice on the use of products stored for extended periods. Further information, including your nearest Purolite office, can be found on www.purolite.com.

Storage & Transportation Requirements

1. Packaging

Various types of primary packaging are employed with Purolite resins. They are designed to ensure that the ion exchange resins are kept sealed to prevent either loss or uptake of moisture, as well prevent contamination.

Contamination

If packaging is damaged or left open and resins are exposed to the atmosphere, a risk exists that resins can deteriorate through a combination of physical, chemical or biological contamination.

Certain resins are supplied in special ionic forms. For example hydroxide form anion resins, when exposed to the atmosphere, can become carbonated from contact with carbon dioxide present in the air. Therefore, once the package is opened, resins should be used as soon as possible, and any unused resin adequately resealed in suitable clean containers.

In the event of damage to bags, drums, kegs etc. every effort should be made to repair the damage to ensure the primary packaging remains sealed and not open to the atmosphere

Dehydration

Over time and especially at elevated temperatures, resins may dry out. Unless re-hydration is carried out carefully, beads will crack or break. To minimize damage use the following recommended procedure for rewetting resins.

A concentrated brine solution is slowly introduced and left for at least 1 hour to equilibrate. Brine displacement is carried out, by reducing brine concentration by 5% on consecutive treatments. A contact time of 30 minutes is used for each successive displacement. The final 5% brine solution is then displaced and rinsed out with water. In cases where resin is very dry it is recommended that the process is optimized in the laboratory by adjusting the starting concentration of brine, temperature, rates of addition and contact times.

It should be noted that cation resins in the hydrogen form will generate hydrochloric acid by passage of brine through the bed. Anion resin in the hydroxide form will likewise produce sodium hydroxide (caustic soda). In each case cation resin will be converted to the sodium form and anion resin to the chloride form and will require multiple regenerations to return to the regenerated form.

2. Warehousing

Exposure to high temperature and sunlight

It is recommended that Purolite resins are stored indoors. This is to maintain the temperature below 40oC, (104oF), and to ensure UV light (which can promote oxidation, and increase growth of algae and bacteria) does not fall upon the sealed packaging. It also follows that resin should not be stored near a radiator, or any other heating appliance, or in a warm boiler house.

Exposure to low temperature and frost

Although it has been shown that Purolite resins can withstand temperatures as low as -40°C, (-40°F), successive thawing and freezing may damage the product, and/or the packaging. Hence it is recommended that the resins are stored above 0°C, (32°F).

If for any reason a resin becomes frozen it should be left to thaw out naturally.

No attempt should ever be made to free frozen resin mechanically.

If it is anticipated that it will be necessary to handle resin at sub-zero temperatures, the resin may be conditioned with saturated brine.

Double stacking of full pallets in warehouses should be avoided. Where this cannot be avoided due to space requirements then pallet boards should be used between each pallet.

3. Transportation

During transportation of resins, precautions should be taken to avoid the extremes of temperatures as outlined previously.

If product becomes frozen during transportation, thawing should take place gradually, without any physical interference. Moving resin in their primary packaging should be avoided if possible when in a frozen state.

Table 1. Expected Shelf Life of Ion Exchange Resins

Resin Family		*Shelf Life by Application, months from date of manufacture*			
Type	Ionic Form	Potable Water & Food	Industrial Water Treatment	Nuclear Industry	Ultra-pure Water
Strong acid cation	Na^+	24	60	n/a	n/a
Strong acid cation	H^+	n/a	36	24	6
Strong acid cation	NH_4^+	n/a	24	12	n/a
Weak acid cation	H^+	12	60	n/a	n/a
Strong base anion Type 1	Cl^-	24	60	n/a	n/a
Strong base anion Type 1	OH^-	n/a	24	24	6
Strong base anion Type 2	Cl^-	24	48	n/a	n/a
Strong base anion Type 2	OH^-	n/a	12	n/a	n/a
Strong base acrylic anion	Cl^-	24	48	n/a	n/a
Weak base anion	Free Base	24	60	n/a	n/a
Weak base acrylic anion	Free Base	24	48	n/a	n/a
Mixed Beds	H^+/ OH^-	n/a	24	24	6
Chelating	Na^+ or H^+	24	60	n/a	6

Requirements for resin storage during equipment shut-down

It is recommended that some simple precautions are taken where an ion-exchange equipment is to be shut down for an extended period.

These will avoid the problems associated with the following:

- dehydration
- freezing
- growth of bacteria, algae and moulds
- chemical stability
- precipitation and corrosion

Dehydration

For short term storage in the service vessels it is recommended that the unit is filled with water. If draining is necessary, the vessel should be immediately sealed to prevent the resin from dehydrating.

Freezing

The vessel should be filled with dilute brine or ethylene glycol mixtures.

Growth of bacteria, algae and moulds

With long term storage in the service vessels where conditions are favorable, microorganisms such as algae and bacteria can proliferate in ion exchange plants. If such growth is allowed to continue unhindered, irreversible fouling of the resin and blockage of the resin bed can occur.

In order to ensure that the ion exchange plant remains in good working order, the following precautions should be taken prior to shut-down.

All resin beds should first be subjected to an extended backwash, to remove any suspended material which may have collected during service, and regenerated to ensure the resin is in a “clean state” before conditioning for long term storage.

Cation resins should then be exhausted with a 10% NaCl solution until neutral pH. All valves closed and resin beds left immersed in the sodium chloride solution for the period of shut-down.

Anion resins might be advantageously treated with 2 to 3 bed volumes (BV) of alkaline brine (10% NaCl + 2% NaOH), allowing the last bed volume to stand for several hours before displacing with a further 2 BV of neutral brine (10% NaCl). The bed is then left immersed in the sodium chloride solution for the period of shut-down.

At the end of the shut-down, all resins are rinsed free of NaCl and, if necessary, sanitized with peracetic acid (See Sterilisation later).

Where softeners are subject to regular shut-downs, or infrequent use, Purolite C100EAg, which has biostatic properties, should be considered to control biological fouling .

Chemical Stability

Strong and weak acid cation resins are quite stable in terms of ion exchange capacity. However, strong acid resins, after relatively short storage times, can produce some color throw. This is the result of trace leachables which diffuse from the resin matrix. This diffusion is more pronounced in hydrogen form strong acid cation resins. Therefore, in addition to classification backwash (where appropriate) the resin should be regenerated and rinsed prior to use. The sodium form resin is more stable but it is still prudent to carry out the above procedure before use.

Where treated water is intended for human consumption or for use within the food industry, or when the resins are intended for direct food processing, preconditioning as specified by local, national or other regulatory authorities should be used (refer to the appropriate Purolite sales office for guidance).

Strong base anion resins are quite stable in the chloride and sulfate forms. The hydroxide form and to a lesser extent carbonate and bicarbonate forms slowly degrade even at room temperature to produce some weak base functionality at the expense of the strong base groups plus a small (almost insignificant) loss of total capacity. The degradation processes are accelerated at higher temperatures and the loss of total capacity becomes significant close to or above the maximum recommended operating temperatures for the given resin type. It is therefore important to convert the resin to a salt form, generally chloride form, prior to shut-down or storage. This also avoids the generation of an amine odor which develops when hydroxide form anion resins are stored.

Weak base anion resins are more stable and can be stored in both freebase or chloride form. To avoid possible bacteriological growth, the chloride form resin should be immersed in brine, as outlined above. This may be preferred for storage of used resin.

Cautionary Note

If cation or anion resins are left standing in the presence of strong oxidizing agents such as nitric acid there is a risk of explosion. This risk is greater at elevated temperatures. Before storage of resins in the nitrate form, it is recommended that expert advice is sort. For full details on safe handling of ion exchange resins or copolymers, please consult the relevant

Purolite material safety data sheet (See web site www.purolite.com).

Precipitation and Corrosion

Care should always be taken to choose an ionic form of resin and water source for making up storage solutions which avoids the possibility of precipitation within the bed. For example a high hardness in the presence of high bicarbonate or hydroxide can cause precipitation which can block collector systems, foul the resin, and cause deposits which can set up corrosion. Such problems may occur when contaminant ions are oxidized or become insoluble as a result of any changes in temperature that may occur during shutdown.

Care should also be taken to ensure that the storage solutions are compatible with materials of construction, not only the vessel / lining but also materials of construction for vessel internals. For example certain grades of stainless steel cannot accommodate high chloride levels.

Preconditioning recommendations

In this document we have advised on classification backwash (where appropriate) to ensure the bed is fully classified and that the lowest pressure drop across the bed is then encountered. We have also mentioned regeneration and additional rinsing to move trace leachables from new resin.

We would also advise that when resins are first used, the ionic form required for the duty is often different to that the resin is supplied in. To convert the resin to the correct form a double/triple dosage of regenerant is employed. In most cases this will require an initial double / triple regeneration to substantially convert the resin to a high state of regeneration.

Food Industry

Special food grade resins are supplied to potable water and food and beverage industries.

Food grade resins undergo special production steps in their manufacture and additional post treatment to reduce any leachables that may be present and to meet specific regulatory and customer requirements.

However, on initial installation Purolite recommends additional regenerations / rinsing, or in some cases special treatments to ensure the resin meets the required specifications and provides the best performance from day one. The end user should then test the water to ensure it satisfies his specific requirements for the application before placing the plant in service.

In the unlikely event of any continued concerns about taste etc. further cycling between exhausted and regenerated forms will normally address the problem.

Consult your local Purolite office if guidance is required.

Sterilization

In some industries there is an increasing demand by the end users for regular and routine sterilisation of the water treatment system including the ion exchange plant. Sterilization is also required if biological contamination of a bed is suspected.

Historically chemicals such as formaldehyde, sodium hypochlorite, hydrogen peroxide etc. have been used. The use of formaldehyde is no longer recommended, as there are major concerns handling this material, and strong oxidizing agents can damage ion exchange resins. While hypochlorite and hydrogen peroxide solutions are still used, it is important to be very careful over the concentration and contact time employed as these chemicals can also damage the resin causing de-crosslinking of the resin matrix and in the case of anion resins they will also chemically attack the resins' active groups.

The sterilization chemical of choice favored by many companies is peracetic acid. A low hydrogen peroxide grade is widely available and this has been shown to work very effectively on cation and anion resins without seriously affecting the subsequent performance of the bed. A procedure for its use can be obtained from your local Purolite sales office.

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Purolite Corporation was founded in 1981 and is a leading manufacturer and developer of ion exchange, catalyst, absorbent and specialty resins and is the only company to focus exclusively on this market. Headquartered in Bala Cynwyd, PA, the company has ISO 9000:2001 certified manufacturing and R&D facilities sites in North America, Europe and Asia, and sales offices in more than 30 countries. Purolites' dedicated "Centre of Excellence" research and development facility is located in the United Kingdom and coordinates research in China, Romania, Russia, United Kingdom, and the United States of America.

Americas

The Purolite Company
150 Monument Road
Bala Cynwyd, PA 19004
USA
Tel +1 610 668 9090
Tel +1 800 343 1500
Fax +1 610 668 8139

Europe

Purolite International Ltd
Llantrisant Business Park
Llantrisant
Wales
CF72 8LF
UK
Tel +44 1443 229334
Fax +44 1443 227073

Asia Pacific

Purolite (China) Co. Ltd
World Trade Center Grand D-705
122 Shuguany Road
Hangzhou
Zhejiang Province 310007
P.R.China

Tel +86 571 8763 1382
Fax +86 571 8763 1385

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