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INTRODUCTION

The purpose of this discussion is to describe the various lab tests that can be performed with ion exchange resins and what the results mean in terms of field performance. The intent is to aid users of ion exchange resins to decide which tests they should specify to be performed and how to interpret the results that are reported. This discussion is not intended to describe how ResinTech lab procedures are performed, except in a general way.

The tests into are divided into three categories: **Standard, Regenerated Resins, and Specialty.**

- **Standard** tests are those needed to determine if a resin is suitable for use. Standard tests are performed with resins in their "reference" ionic forms and are used to judge the resin’s physical and chemical condition as well as a qualitative evaluation of any fouling that may be present.
- **Testing** of regenerated resins is used to determine how well the customer’s regeneration procedure is able to convert a resin into a specific ionic form. Regenerated resins may or may not include a health check.
- **Specialty** tests are those used to troubleshoot a resin’s performance, to identify specific foulants, to find out what if any cleaning procedures might be effective to remove contaminants, and to determine how a resin is likely to perform under a specific operating condition by means of bench scale columns exhaustions and regenerations. Specialty tests generally take more time and effort and increase the cost of the analysis, therefore, they are not commonly performed unless there is a specific need to do so.
STANDARD RESIN TESTS

TOTAL CAPACITY
A known volume (or weight) of resin is placed in a column. An excess of chemical solution is passed through the resin to be certain it is in a known ionic form. The known ions are then eluted from the resin using an excess of a (different) regenerant chemical solution. The concentration of the known ion eluted (or exchanged) is determined quantitatively. The capacity is generally reported as milliequivalents capacity per milliliter (or gram) of resin, based on a reference ionic form.

Total capacity is a measure of the total number of exchange sites within the resin, regardless of their type.

SALT SPLITTING CAPACITY (ANION RESINS)
Salt splitting capacity is a measure of an anion resin’s ability to exchange ions in neutral salt solutions. In new strong base anion and strong acid cation resins the salt splitting and total capacities are nearly equal. As resins age, part of their strong acid or strong base capacity converts to weak base or weak acid capacity. The “weak” capacity can only neutralize acids or bases, it cannot split neutral salts.

The difference between salt splitting and total capacity in strong base anion resins helps predict how those resins will perform in various applications. For instance, an hydroxide form strong base anion resin can only utilize the salt splitting capacity to remove silica. If too much salt splitting capacity is lost, the resin will not be able to remove silica effectively and may need to be replaced.

The difference between salt splitting and total capacity is determined by the choice of regenerant used. Total capacity tests are generally performed following pretreatment with acids (HCl) or bases (NaOH) while salt splitting capacity tests are performed following pretreatment with neutral salts such as NaCl.

MOISTURE CONTENT
Also called water retention or percent solids, this test is performed by weighing the moist resin and then drying to constant weight in an oven (usually at 105°C).

Moisture content helps to define how a resin is aging. Oxidation causes moisture to increase while fouling usually causes moisture to decrease. Moisture is normally measured based on the reference form of the resin in order to make comparisons easier.

VISUAL INSPECTION (% WHOLE BEAD)
The general method is to examine the resin under a microscope at 20-40X magnification. The lab reports a somewhat subjective evaluation of the number of cracked or broken beads. This can be reported as a percentage of the total number of beads or as a percentage of the total volume of resin.

MIXED BED PERCENTAGE RATIO (MIXED BED RESINS)
This test is performed for beds of mixed resin, usually cation and anion but sometimes for other mixtures.

The general procedure is to separate the resins hydraulically (or by means of density differences), then measure the volume of each component. The result is generally reported as a volume percentage of each species but may also be reported as a percentage of total ion exchange sites.

PHOTOGRAHP
A picture can be worth a thousand words because it can in many cases give a visible indication of a resins’ physical condition and degree of fouling. However, a photo cannot help determine a resin’s chemical condition, other lab tests are needed for this.
SPECIALTY RESIN TESTS

Screen Size Distribution
Water Soluble Organics
Bead Crush Strength
(Iniability)
Inorganic Impurity Levels
Rinse Requirement
Column Capacity
Kinetic Tests
Oxidative Stability

SPECIALTY RESIN TESTS

Screen Size Distribution
Water Soluble Organics
Bead Crush Strength
(Friability)
Inorganic Impurity Levels
Rinse Requirement
Column Capacity
Kinetic Tests
Oxidative Stability

SCREEN SIZE DISTRIBUTION

This test can be performed by a particle counter or by mechanical sieves through which the resin is passed. The results can be reported in a variety of formats, either in actual size (usually reported as microns) or in mesh size (usually reported as a plus or minus a particular sieve size). The results are usually reported as volume percentages within a particular size range.

ORGANIC EXTRACTIABLES

This test is generally performed by heating a sample of resin in deionized water for a specific amount of time (16 hours @ 65˚C is common) and then either determining the TOC of the water or removing the resin, evaporating the water and weighing the residue. Results can be reported in a variety of formats, most commonly as weight of the extractable per volume (or weight) of resin.

FRIABILITY (CRUSH STRENGTH)

This test measures how many grams of force are necessary to shatter a resin bead, usually reported as an average from a random sample of whole perfect beads within a particular size range. Friability can vary significantly with the ionic form of a resin, particularly those resins that undergo a significant volume change from one ionic form to another.

INORGANIC IMPURITIES

There are two approaches to measuring the level of inorganic impurities contained in the resin. For volatile impurities (such as sulfates, chlorides, carbonates, ammonia, etc.) the usual method is to elute the contaminants, measure the concentration in the spent regenerant and then quantify the concentration as a percentage of the total exchange sites.

For metallic contaminants, the usual procedure is to ash or digest the resin, dissolve the residue, then measure the concentration of the contaminants, reporting the concentration as parts per million (lbs. impurity/million lbs. of resin).

RINSE REQUIREMENT

This test is usually performed with the resin after regeneration with various chemical solutions.

The purpose is to determine how easily the chemical solution can be removed from the resin and is generally performed with deionized water. The result is reported in bed volumes rinse to a certain end point (or as gallons per cubic foot of resin). The result depends strongly on the test conditions (such as flow rate, temperature, bed height, etc.) and is usually referenced against new resin or against a known resin performance.
PERCENT VOLUME CHANGE
This test is performed by measuring the volume of a sample of resin in a particular ionic form, then converting the resin to some other form and again measuring the volume.

ASH ANALYSIS
The resin is burned, the ashes are redissolved and then analyzed for metallic impurities. This may be performed qualitatively or quantitatively. Another similar method used X-ray diffraction technology to quantitatively measure metal concentrations in a resin sample. X-ray diffraction is not very precise, but is a fast way to determine high levels of metallic impurities.

CLEANING TESTS
Cleaning tests are performed on fouled resin samples to determine if a specific cleaning procedure will be effective to restore the performance of the resin. These tests are usually user defined based on the type of foulant suspected (or identified). The result (usually column capacity or rinse requirement) is compared to a reference sample of fouled resin that was not cleaned, or to the customer’s requirements (expectations) for the system.

IDENTIFICATION OF FOULANTS
These tests can involve many types of analyses depending on the type of foulant suspected. They generally involve some type of extraction to separate the foulant from the resin, followed by various qualitative and/or quantitative analysis. Identification of biofoulants may also involve culture tests in various growth media. Without any clues to a foulant’s origin, these tests can be very arduous.

KINETIC TESTS
These tests are similar to the test for rinse requirement but are performed using a rinse solution of known composition. The flow rate is varied to determine the flow sensitivity of the resin. There are a variety of different procedures in use and the results are generally compared against a typical value for new, good quality resin as a standard.

COLUMN CAPACITY
This test is performed by exhausting a resin column with a solution of specific composition to a specific endpoint. The end user generally defines the solution and the endpoint. In some cases, the column is regenerated and exhausted several times in order to determine the operating capacity. The results are generally reported as bed volumes of throughput (or gallons per cubic foot).

OXIDATIVE STABILITY
This test is performed by soaking the resin in a solution with a known concentration of a user specified oxidizing agent, sometimes at elevated temperatures. The result is reported as capacity remaining (or lost) over a period of time. In many cases, the moisture content of the resin before and after exposure to the oxidant is also reported.

OSMOTIC SHOCK TEST
A sample of the resin is subjected to acidic and then basic conditions over and over (hundreds of times) to determine its physical stability. The test should include rinsing with deionized water in between each cycle as the object is to create an osmotic pressure difference at the surface of the resin beads. The result is reported as the change in the percentage of broken resin beads over a certain number of cycles (often 300).

APPARENT DENSITY
This test is performed by measuring the volume of a known weight of resin. The result is reported as grams per milliliter (or pounds per cubic foot). The volume measurement procedure can be performed by tapping the resin to minimum volume or by backwashing and allowing the resin to gently settle in a column. Tapped volumes are generally used for capacity determinations, whereas backwashed and settled volumes are often used for shipping weights.

SPECIFIC GRAVITY
This test can be performed by placing a sample of resin in water, (or other solvent), gradually increasing the solution concentration until the resin begins to float. Another method is to calculate “true density” from the apparent density and the void volume.

VOID VOLUME
Void volumes are calculated from the volume of water that can be drained from a known volume of resin. Void volumes vary significantly based on backwashed and settled vs. tapped vs. mixed volumes of resin.

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PERCENT VOLUME CHANGE
This test is performed by measuring the volume of a sample of resin in a particular ionic form, then converting the resin to some other form and again measuring the volume.
COLUMN TESTING

Standard testing includes:

- An initial characterization of the water (water analysis) including the targeted contaminant(s) and the bulk ions.
- A column effluent profile of the targeted contaminant(s) over 8 to 10 points of the estimated exhaustion.
- A report interpreting the results.

Typical lab columns are 1 inch diameter, and hold anywhere from 50 to 250 mls of resin. The solution is pumped or siphoned thru the columns at 25 to 125 milliliters per minute. The flow rate thru the columns should be held constant. Typical flow rates used for ion exchange systems are between 15 and 30 bed volumes per hour. Flow rates greater than 30 bed volumes per hour often cause problems with premature breakthrough, high pressure loss and resin fouling.

Columns should be operated long enough to obtain meaningful long term information about the leakage of various ions including the contaminant of interest. It often requires 10s or 100s of bed volumes for an ion exchange column to stabilize. Very short column runs (less than 10 bed volumes of product collected) often give misleading results. However, short column runs can often give a quick yes or no answer if ion exchange is worth pursuing or is inappropriate technology for a particular application.

Longer column tests should be performed to verify operating capacity and column thru-put. Here, the column is operated until it exhausts and the contaminant of interest has increased to a high concentration (this should be at least twice the steady state leakage and preferably around 50% of the inlet concentration). Unfortunately, the exhaustion of lab columns does not occur any more rapidly than full sized exchangers and it can take many days to obtain capacity data.

A minimum of 10 points along the expected exhaustion curve should be taken, in order to obtain a realistic profile of the effluent. If the expected run length will be several days (or longer) take 3 or 4 samples during the first 24 hours, then one or two per day afterward. As a minimum, take data on conductivity and pH long enough to know that the outlet is stable with respect to the inlet. Record every bit of data possible, no matter how obvious or stupid it may seem at the time (later, when you review your notes, even something as stupid as recording the time of day or ambient temperature could be helpful).

If the initial effluent concentrations for the contaminant of interest are higher than the treatment objective, it may be worth adding a second polisher column to the set-up in series with the first column. This will depend on how close to the limit the concentrations are. If the process will involve pretreatment of the solution prior to the ion exchange columns (pH adjustment, filtration, etc.), this should also be done to the solution used in the lab test.

APARATUS REQUIRED

Resin columns may be purchased from ResinTech. We offer a sturdy 1 inch ID clear acrylic column with fitted screen and outlet valve designed specifically for column testing of ion exchange resins.

Alternatively, a burette, chromatography column or section of pipe can be used as a column. Glass or cotton wool can be used in a burette to retain the resin. For larger columns a stainless steel screen approximately 50 mesh can be fitted into the bottom. Our experience is that column sizes smaller than 1/2 inch ID produce somewhat distorted results due to wall effects.

Columns can be supported by a ring stand and clamp. If the feed solution will be siphoned through the resin it will be necessary to locate the column below a suitable shelf where a large container of the feedwater can be stored. Solutions can be siphoned or pumped using standard lab pumps. A selection of tubing, tube fittings, stoppers and other common lab supplies will also be needed.

In addition to the columns, a suitable (large) number of sample containers will be needed plus labels, marking pens and notebooks.

In most cases the resins used in a column will need to be preconditioned and possibly regenerated prior to use.
BACKWASHING & RINSING

Once the resin is loaded in the column the resin should be backwashed so that the resin bed is fully classified. This is carried out with demineralized water in an up flow manner. 10-15 minutes should be sufficient to classify the bed. The resin bed will expand and the larger particles will fall towards the bottom of the bed and the smaller beads will be nearer the surface when they are allowed to settle. The backwashed bed height is the basis for most capacity calculations so be sure to mark the resin height and calculated the resin volume from the height and column diameter.

Rinse the resin with demineralized water to reduce any leachables that may have formed in the resin during storage before starting the column test. 5-10 bed volumes should be sufficient in many applications.

For high purity or other unusual applications consult ResinTech Technical support for advice.

For water applications, drain the column to just above the resin bed prior to adding the feed solution.

APPLICATIONS INVOLVING HIGH (TDS) SOLUTIONS

Ion exchange resins are roughly 50% water by weight. When the feed solution is salty, or contains sugars, alcohol or other solvents, the resin will give up some of the water in front of the initial portion of the feed solution.

The first 1/3 bed volume (or more) will likely be watery and will not be representative of the remaining effluent. Often, the technique of “sweetening on” or displacing the initial solution to waste can be used to avoid diluting the remaining effluent. At the end of the test the column can be “sweetened off” or displaced with approx. 1/3 bed volume of DI water to recover remaining product trapped in the resin.

PROCESS SET UP AND CALCULATIONS

Depending on the application process conditions for the resin will vary widely. This is a case where one size definitely does not fit all and a bit of precalculation is advisable.

COLUMN SIZE AND BED HEIGHT

A 1 inch ID column has approx 12.8 mls volume per inch of bed depth Resin volume should be 25 to 250 ml (150 mls is a typical starting point)

Resin bed depth should be 2 inch to 24 inch (150 mls is 12 inches in a 1” ID column and a good place to start)

“Weak” resins, both weak base anion resin and weak acid cation resin, undergo very significant swelling as the exhaust. For these resins it is generally better to keep the bed depth closer to the minimum than the maximum.

SERVICE FLOW RATE

Service flow rates less than about 10 mls/minute are extremely difficult to control, particularly when siphoning. Flow rates greater than about 100 mls per minute require pumping. Flow rates greater than about 250 mls per minute require pressurizing the column beyond the typical range that plastic tubing and rubber stoppers can accommodate. Keep all this in mind when designing the bench test.

Typical resin flow rates for the “strong” resins are between 0.25 and 0.5 bed volumes* per minute. Lower flow rates are typically used for salty or other high TDS solutions, higher flow rates for watery solutions. 50 ml/min flow is a typical flow rate for 1 inch column with 150 ml of resin. The “weak” resins, including weak acid cation, weak base anion resin and all chelating resins, are flow sensitive and generally require a lower flow rate than their “strong” resin counterparts (strong acid cation and strong base anion). Use 0.25 bed volumes per minute maximum for these resins or expect the contaminant breakthrough to occur early in the exhaustion.

VOLUME OF SOURCE WATER NEEDED

It is useful to have some idea of how much source water will be needed for each test. As a rough guide, divide the resin capacity by the concentration of the target contaminant plus any main competing ions. By competing ions we mean other ions besides the target contaminant that will also load onto the resin. For instance, when considering SAC and SBA type resin, divalent ions generally load along with target contaminants. For chelating resins the total concentration of all the transition metals present should be considered in the initial calculation.

*Bed Volumes (BV’s) can be a confusing concept because they are dimensionless. A bed volume is quite simply the same volume as the resin volume. For instance if the resin volume was 150 ml, then 1 BV would also be 150 ml
Whenever possible, the sample analysis should be done immediately, while the test is still running so that information can be used to adjust column flow, sampling interval or other parameters. Sometimes this is not possible and all the samples must be collected and analyzed later. In many cases the samples can be spot checked to see where the leakage begins. For instance, one way to start is to analyze every 3rd sample and only go back and do the ones in between if there is a significant change in the analysis between samples. Keep the samples at least until the data has been analyzed and reviewed. All too often there is an analysis anomaly or sample contamination that skews the result. Rechecking the sample and/or checking the samples before and after can help determine if the event is real or an artifact. There have been more than few “Ah Ha!” moments when it becomes clear the analysis should have included some additional parameter. On the other hand it is not necessary to keep samples until after retirement. Once the samples are analyzed, the data reviewed, and the project ended, the samples should be discarded.

For example above it would be appropriate to take samples every 15 minutes for the first 2 to 3 hours, then samples every 30 to 60 minutes thereafter. Keep track of the sample number, the time the sample was taken and the cumulative volume thru the column at that time. Number the samples immediately, otherwise there is a high risk they will get mixed up.

Once a trial run has begun it is best to operate continuously until the resin is exhausted. Most ion exchange reactions are reversible and once the flow is stopped some of the ions come back off the resin into solution. This can cause premature exhaustion and lead to false results being obtained.

If the test cannot be run continuously to breakthrough it is best to revert to the more frequent sampling schedule for the first hour of longer after the column is started back up. It’s pretty easy to pour an unneeded sample down the drain at the end of the test but impossible to go back and collect one you later wish you had. Keep plenty of sample bottles and take a sample any time anything unusual happens (column start, stop, flow change, water change, etc). Write down everything that happens in a log book.

Under normal conditions tests the resin should remain covered with solution. Draining the column introduces air into the bed which is difficult to remove and which can cause unequal distribution through the resin bed and distorted results. Systems that are gravity fed can be equipped with a u-tube from the bottom of the column up past the resin bed before the discharge point so that the column cannot siphon down below the resin.

*The term “meq/L” or milliequivalents per liter is an expression of concentration based on the number of equivalent charge of an ion. This puts all ions on an equal basis with respect to the resin. 1 milligram per liter (mg/L) divided by the equivalent weight of an ion is equal to its concentration in meq/L.

**ANALYZING SAMPLES**

Whenever possible, the sample analysis should be done immediately, while the test is still running so that information can be used to adjust column flow, sampling interval or other parameters. Sometimes this is not possible and all the samples must be collected and analyzed later. In many cases the samples can be spot checked to see where the leakage begins. For instance, one way to start is to analyze every 3rd sample and only go back and do the ones in between if there is a significant change in the analysis between samples. Keep the samples at least until the data has been analyzed and reviewed. All too often there is an analysis anomaly or sample contamination that skews the result. Rechecking the sample and/or checking the samples before and after can help determine if the event is real or an artifact. There have been more than few “Ah Ha!” moments when it becomes clear the analysis should have included some additional parameter. On the other hand it is not necessary to keep samples until after retirement. Once the samples are analyzed, the data reviewed, and the project ended, the samples should be discarded.

**COLUMN REGENERATION (ADDITIONAL FEES APPLY)**

Column regeneration can be a very complicated task, and requires a much higher degree of skill than simply running exhaustion tests. Flow rates and solution concentrations are significantly different for regeneration experiments than for service exhaustions. Even when analysis and other measurements are carefully made, mass balances frequently do not come anywhere close to balancing (a mass balance generally consists of a calculation of the mass of contaminant loaded on to the resin during the exhaustion cycle, compared to the mass removed from the resin during regeneration).

It takes between 3 and 5 exhaustion and regeneration cycles before a resin column performance stabilizes. Single exhaustions with virgin resins can provide misleading results, depending on the nature of the contaminant and how difficult it is to remove from the resin. It is beyond the scope of this guide to completely cover all the possible regeneration strategies and scenarios.

**Here are a few basic guidelines:**

- **Regenerant dose** = approx. 160 grams per liter (range is from less than 40 to more than 500)
- **Regenerant concentration** = 5% (range is from less than 1% to more than 10%)
- **Regenerant flow rate** = approx. 6 bed volumes per hour (range is less than 2 to more than 15)
- **Regenerant contact time** = 30 minutes (range is less than 15 to more than 60)
- **Displacement rinse** = 1 bed volume (range is 0.5 to 2) flow same as regenerant
- **Final fast rinse** = 6 bed volumes (range is less than 2 to more than 10)

For regeneration chemicals, concentrations and quantities of regeneration including “sweetening on” and “off”, intermediate regenerants, and all other questions we strongly recommend you contact ResinTech Technical Support for guidance.
It is important to periodically sample resin from ion exchange units and to send them out for laboratory analysis. This will enable the plant operator to track the normal degradation of the resins and to observe fouling problems before they become serious. Resin analysis results are used as a guideline for the optimization of ion exchange systems.

**ANALYSIS PERFORMED**

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<tr>
<th>Volumetric Capacity</th>
<th>Separation &amp; Percent of Components (Mixed Bed &amp; Layered Bed)</th>
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<tbody>
<tr>
<td>Moisture Content</td>
<td>Site Composition (Regenerated Resins)</td>
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<tr>
<td>Visual Examination</td>
<td>Microscopic Photo (Provided upon request)</td>
</tr>
</tbody>
</table>

**NOTE:** Other/Custom testing available upon request

**STANDARD ANALYSIS PRICING**

- Strong acid cation: $185.00
- Weak acid cation: $235.00
- Strong or weak base anion: $315.00
- Mixed bed: $625.00
- TOC Testing: $190.00
- Iron: $55.00
- Regenerated strong acid cation: $325.00
- Regenerated weak acid cation: $410.00
- Regenerated strong or weak base anion: $450.00
- Regenerated mixed bed SAC/SBA components: $935.00
- Cation Layered Bed: $555.00
- Anion Layered Bed: $800.00
- Column Testing*: $1,500.00 min.

*Per column for a single contaminant. For specific details on multiple contaminants or multiple column runs, please call for detailed pricing.

Typical turn around time for a standard analysis is one week, however “rush” analysis can be provided in most cases within three business days.

**NOTE:** A 50% markup to standard pricing will apply for all rush testing.

**INSTRUCTIONS**

For routine testing of salt form resins (cation or anion resins regenerated with sodium chloride), a minimum of 250 mL of resin is required. It is better to send >500 mL in case an analysis needs to be repeated. For resins regenerated with acid or caustic larger samples are needed; 500 mL is the minimum required and 1 liter is recommended. For mixed bed or layered bed samples even larger samples are needed; 1 liter minimum and 2 liters recommended.

Fill out the Resin Sample for Analysis Form completely, with detailed information regarding each sample, and send to the address below:

ResinTech, Inc,
Attn: Resin Analysis
160 Cooper Road • West Berlin, NJ 08091

For pricing on partial or other types of testing please contact:
Thomas Smith, Jr.
Laboratory Manager
p: 856-626-1510 • f: 856-768-9602 • e: tsmith@resintech.com
**RESIN SAMPLE FOR ANALYSIS**

**CONTACT INFORMATION**

Company Name: ___________________________ Phone: ___________________________
Contact Name: ___________________________ Fax: ___________________________
Address: ___________________________ Email: ___________________________
City: ___________________________ End User: ___________________________
State: ___________________________ Zip Code: ___________________________ Industry: ___________________________

**SAMPLE INFORMATION**

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<td>Age of Sample</td>
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<td>Regenerated or Exhausted</td>
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**NOTES** (IF A SERVICE PROBLEM EXISTS, LIST THE SPECIFIC PROBLEM IN THE SPACE BELOW)

__________________________________________

...continued...

**STANDARD ANALYSIS INCLUDES**

- [ ] Capacity
- [ ] Moisture
- [ ] Bead Integrity
- [ ] Microscopic Photo
- [ ] Visual Evidence of Foulants

**EXPANDED TESTING OPTIONS** (ADDITIONAL FEES APPLY)

- [ ] Metals Assay
- [ ] Iron Fouling
- [ ] Site Composition (% Regeneration)
- [ ] Total Organic Carbon (TOC)
- [ ] Exhaustion or Kinetics Profile
- [ ] Particle Size Distribution
- [ ] Other: ___________________________

**REASON FOR ANALYSIS** (CHECK ALL THAT APPLY)

- [ ] General / PM
- [ ] Age Concern
- [ ] Service Problem
- [ ] Annual Inspection
- [ ] Unusual Appearance
- [ ] Unusual Odor

Resin testing is usually completed within 5 business days from the date that the resin sample is received. Please indicate if results are needed before then (additional charges will apply). All results will be sent via e-mail unless specified otherwise.
WHY TAKE SAMPLES?

It is important to take resin samples and have them analyzed at regular intervals in order to avoid issues with system reliability, poor water quality, excessive chemical use, and other possible problems. Regular analysis not only helps identify potential fouling and need for cleaning but can also be used to track the normal aging of resin as an aid to scheduling resin replacement and preventing catastrophic failures.

HOW OFTEN SHOULD SAMPLES BE TAKEN?

Softeners and other salt form ion exchangers (systems regenerated with sodium chloride) should be analyzed when new and again after each two to three years of service. Demineralizer resins and other resins regenerated with acid and/or caustic should be analyzed when new and again every one to two years of service. Resins that are stored for more than a year before use should be reanalyzed before use to verify they have remained in good condition. Sample frequency should be increased for resins that are used in critical service, resins used in waste treatment, for systems that have known fouling potential, and for resins that are nearing the end of their useful lives.

Whenever possible, retain a small (500 mL) sample of all new resins for possible future comparison or analysis.

HOW MUCH SAMPLE IS REQUIRED?

For routine testing of salt form resins (cation or anion resins regenerated with sodium chloride), a minimum of 250 mL of resin is required. It is better to send >500 mL in case an analysis needs to be repeated. For resins regenerated with acid or caustic larger samples are needed; 500 mL is the minimum required and 1 liter is recommended. For mixed bed or layered bed samples even larger samples are needed; 1 liter minimum and 2 liters recommended. If special analysis and/or cleaning trials are requested, please discuss volume requirements with ResinTech Laboratory ahead of time.

HOW ARE RESIN SAMPLES SHIPPED?

Most resin samples should be shipped moist with the free liquid poured out. However, regenerated resin samples, especially hydroxide form anion resin and H/OH mixed beds are best shipped covered with water to minimize potential exhaustion of the anion component with atmospheric carbon dioxide. For samples shipped in water, fill the sample container completely with water to minimize head space.

Each sample container should be clearly marked with a waterproof label and tightly sealed. Plastic containers are highly recommended over glass. Metal containers are generally not suitable.

Ship samples and completed request form to:

ResinTech, Inc.
Attn: Resin Testing Laboratory
160 Cooper Road
West Berlin, New Jersey 08091

Include a copy of the Resin Sample For Analysis form with shipment.

When filling out the analysis request form, please write as much of the following important bits of information as possible:
- Name and address of the plant
- Name and telephone number of the contact person
- Number of the unit sampled and the date the sample was taken
- Condition of resin: Exhausted or Regenerated
- Type of service
  (softening, two-bed deionization, mixed-bed polishing)
- Resin type and the manufacturer’s designation, if known
- Date the resin was installed or rebedded
- Whether or not resin has been added as makeup for losses
- Nature of the plant problem

Any questions, please contact:
Greg Knoettner - Customer Support Analyst
Direct - 856-336-6860
Email - gknoettner@resintech.com

HOW ARE SAMPLES TAKEN?

It is important to take a representative sample of the resin that reasonably reflects the average condition of the entire bed. Samples scooped from the top of a resin bed often result in a misleadingly poor analysis while samples taken from the bottom of a resin bed provide an overly optimistic analysis.

A simple way to retrieve a core sample of resin is with a thin-walled plastic tube or PVC pipe, about 1 in. in diameter. A recommended sampling procedure is as follows:

Before taking the sample, drain the bed (preferably a freshly regenerated bed) until the water level drops just beneath the resin level.

Slowly force the tube through the resin bed, taking care not to damage the distributor or gravel subfill. When the bottom of the vessel is reached, stopper or cap the tube and withdraw it slowly. A device known as a grain thief can also be used to take “core” samples at various depths within a resin bed.

For mixed beds, a representative sample can be taken from the resin slurry during the mixing step.

Sometimes, when it is difficult or impossible to take a sample from the vessel itself, the resin can be removed to a sack, bin, or other container and sampled externally, then the resin can be returned to the vessel.

For difficult or unique systems, consult ResinTech Technical Support for help in devising a sample procedure.
ResinTech Inc.
INNOVATIONS IN ION EXCHANGE

WATER SAMPLE FOR ANALYSIS

CONTACT INFORMATION

Company Name: ___________________________ Date: ___________________________
Contact Name: ___________________________ Phone: ___________________________
Address: _________________________________ Fax: ___________________________
City: _________________________________ Email: ___________________________
State: __________________ Zip Code: __________ Sample Description: __________

SAMPLE INFORMATION (MINIMUM 500 ml)

<table>
<thead>
<tr>
<th>Sample</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample ID</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water Type</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
(Drinking, Surface, Waste)
| Sampler |     |   |   |   |   |   |
| Filtered (Y/N) |     |   |   |   |   |   |

NOTES (EXPLANATION FOR ANALYSIS)
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

STANDARD ANALYSIS INCLUDES

☑ pH, Conductivity, Alkalinity, Turbidity, Hardness  ☑ Cations (IC)  ☑ Anions (IC)

EXPANDED TESTING OPTIONS (ADDITIONAL FEES APPLY, SEE BACK FOR PRICING)

☐ Trace Metals (ICP/MS)  ☐ Volatiles (GC/MS)  ☐ Other: _________________
☐ Total Organic Carbon (TOC)  ☐ Wet Chemistry

INTERNAL USE ONLY

LAB TECHNICIAN: ______________________ DATE RECEIVED: ______________________
RTC #: ______________________ DATE SAMPLED: ______________________

ResinTech makes every effort to ensure that the water analysis provided is accurate, comprehensive and methodology is up to date. As we are not a certified water laboratory, we cannot accept any liability for any omissions, inaccuracies or any decision that may be made based on the information contained within this report. The data is offered for ion exchange calculations only. If NELAC certification or any other certification is required please contact your ResinTech/ACM/Aries sales representative for further guidance. For additional information, visit our websites. ResinTech is a registered ® trademark of ResinTech, Inc.

160 Cooper Road • West Berlin, NJ 08091 USA • p: 856.768.9600 • f: 856.768.9601 • e: ixresin@resintech.com • w: resintech.com
INSTRUCTIONS FOR SAMPLING WATER

1. Collect a minimum of 500 ml of water in a clean plastic container.
2. Each sample container should be clearly labelled and tightly sealed.
3. Fill out the Water Sample Analysis form completely and include with the sample.
4. Ensure that all the relevant information pertaining to the sample is listed in the Sample Information section of the form:
   - **Sample ID:** Specific for each sample
   - **Water Type:** i.e. Waste, Process, Raw etc.
   - **Sampler:** Name or initials
   - **Filtered:** If the sample was filtered, list the micron rating.

5. List the reason for the analysis, and how the information will be used in the Notes section of the form.

Secure and ship samples along with the completed form to:

ResinTech Inc.
Attn: Water Testing Laboratory
160 Cooper Road
West Berlin, New Jersey 08091

Any questions, please contact Greg Knoettner:
Direct - 856-336-6860 • Email - gknoettner@resintech.com

**TURNAROUND:** Typical turnaround time for a standard analysis is one week, however “rush” analysis can be provided in most cases within three business days. **NOTE:** A 50% markup to standard pricing will apply for all rush testing.

**DISCLAIMER:** Water samples must be NON-HAZARDOUS. ResinTech lab services cannot accept solutions that are classified as Hazardous or contain high concentrations of Solvents, Acids, Bases, Radionuclides etc. Please call for confirmation if there are any questions.

WATER ANALYSIS PRICING

<table>
<thead>
<tr>
<th>Service</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>☑ Standard Water Analysis (pH, Conductivity, Alkalinity, Turbidity, Hardness)</td>
<td>$275.00</td>
</tr>
<tr>
<td>☐ Trace Metals, ICP/MS</td>
<td>$165.00</td>
</tr>
<tr>
<td>☐ Volatiles, GC/MS</td>
<td>$125.00</td>
</tr>
<tr>
<td>☐ TOC (Total Organic Carbon)</td>
<td>$65.00</td>
</tr>
</tbody>
</table>

Other, Wet Chemistry $85.00 each
☐ Iron ☐ Silica ☐ Arsenic ☐ Chromium, Hexavalent ☐ Nitrate
☐ Ammonia ☐ Dissolved Oxygen ☐ Fluoride ☐ Phosphate

MIST-X® RESIN PERFORMANCE PREDICTION

ResinTech’s proprietary MIST-X® (Multiple Ion Simulation Technology) platform provides accurate information about how ion exchange resins are likely to perform under specific conditions.

MIST-X algorithms combine mass action & selectivity relationships with the chemical profile of water (or liquid) for almost any ion exchange application. The result is a detailed simulation of the exhaustion and regeneration cycles for most types of ion exchange resin. Variations in operating conditions can be studied quickly and efficiently. MIST-X provides a (calculated) effluent history for every ionic substance passing through the resin bed.

MIST-X arms engineers with the data necessary to make informed decisions about the resin(s) best suited for their environment and make accurate forecasts regarding the useable life of each resin and operating costs needed to maintain them going forward.
The ResinTech Column Test Kit is used to perform in-house bench scale pilot tests with ion exchange resins, activated carbon, or other specialty adsorbent medias. Bench scale tests are an effective tool to evaluate the performance of ion exchange resins and other media. Performance data from column tests can be used to judge if ion exchange technology is a viable process for removal of a specific contaminant. Bench scale tests are also useful when scaling up to a full size system. ResinTech proprietary Multiple Ion Simulation Technology (MIST-X) can be used to extract constants from bench scale results that are then used to model other process conditions, minimizing the need of further column tests.

The column test kit contains either one or two complete lab columns and up to four media samples. Each column is constructed of 1” OD clear acrylic tubing with a custom screened outlet fitting. Additional miscellaneous hardware required to connect the inlet and outlet of the columns to customer supplied tubing is also provided. The columns are versatile and are specifically designed for resin, carbon, and adsorbent medias, providing ease of use and simple operation. Each 16 ounce sample jar contains enough media for at least one column test.

**PRICING**

The column test kit is available with one or two complete column configurations. Ion exchange resins sold separately.

<table>
<thead>
<tr>
<th>COLUMN TEST KIT</th>
<th>PRICE EACH*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Column Kit (One Column)</td>
<td>$135.00</td>
</tr>
<tr>
<td>Expanded Column Kit (Two Column)</td>
<td>$195.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ION EXCHANGE RESINS (16 OZ.)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon</td>
<td>$30.00</td>
</tr>
<tr>
<td>Cation Resins</td>
<td>$30.00</td>
</tr>
<tr>
<td>Anion Resins</td>
<td>$50.00</td>
</tr>
<tr>
<td>Selective Ion Resins†</td>
<td>$75.00</td>
</tr>
<tr>
<td>Specialty Adsorbents</td>
<td>$100.00</td>
</tr>
</tbody>
</table>

* Plus Shipping & Handling  
† Excludes SIR-1000 & SIR-1200

ResinTech technical support is available by email or phone to help select the medias most likely to be effective and to help calculate likely throughputs for most potential contaminants. Our technical staff can also review results and recommend any additional test work needed for scaleup.

In addition to resin and water analysis, ResinTech offers a variety of laboratory services for more complicated and/or detailed testing, where contaminants are not well known.

**CAUTION:** Acrylic columns are not pressure rated and are not recommended for temperatures above 120˚F or for strong acids and bases. Safety Data Sheets are available on ResinTech.com and provide important information regarding safe use of our products. Wear appropriate personal protection gear at all times when handling ion exchange resins. These suggestions and data are based on information we believe to be reliable. They are offered in good faith. However, we do not make any guarantee or warranty. We caution against using these products in an unsafe manner or in violation of any patents; further we assume no liability for the consequences of any such actions. ResinTech is a registered trademark ® of RESINTECH INC.
Step 1 - Set Up
Set up the column as shown in the diagram below. It is sometimes more convenient to pull the liquid through the column rather than push it through.

Sample Bottles

Influent tube liquid supply

# 5.5 Stopper

Column
- Column limits
- Resin volume approx. 300 ml (approx. 24")
  (at least 50 ml and not more than 350 ml)
- Flow rate approx. 100 ml per minute
  (at least 15 ml per minute and not more than 500 ml per minute)
- Temperature not to exceed 120˚F

Liquid

Resin

Screened Stop

Valve

Step 2 - Loading
Load the resin as a slurry by first wetting with DI water and then pouring into the column through a funnel. This procedure minimizes the formation of air bubbles in the resin bed.

NOTE: To prevent separation, load mixed bed resins dry
DO NOT BACKWASH

Step 3 - Backwashing
Backwash the resin with DI water to classify the bed and remove any leachables that may have accumulated during storage. Rinse with DI Water and then drain to slightly above the resin bed. Mark the resin height. Leave the resin covered with DI water until ready to start.

Step 4
Backwash media

Step 5
Mark final resin depth
**Step 5 & 6 - Fill Column and Establish Flow**
Fill test column with solution and establish flow rate. Begin flowing inlet solution through the column and collecting the effluent. It is suggested that the effluent be portioned into at least 10 successive samples so that the exhaustion curve can be determined.

**Step 6 - Establish solution flow rate**

<table>
<thead>
<tr>
<th>Units</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date</td>
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<tr>
<td>Conductivity</td>
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<tr>
<td>Flow Rate</td>
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<td>Ion 1</td>
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<td></td>
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<tr>
<td>Ion 3</td>
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<tr>
<td>Ion 4</td>
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</tr>
</tbody>
</table>

**Test Notes:**

**Step 7 - Analysis**
Analyze the samples for the presence or absence of any contaminants of interest. Don’t forget to analyze the inlet solution as well.
## TRACE METALS (ICP/MS)

ResinTech uses Inductively Coupled Plasma - Mass Spectrometry to detect metals in water. The following is a list of the metals we are able to analyze:

<table>
<thead>
<tr>
<th>Metal</th>
<th>Metal</th>
<th>Metal</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALUMINUM (Al)</td>
<td>NICKEL (Ni)</td>
<td>SILVER (Ag)</td>
</tr>
<tr>
<td>VANADIUM (V)</td>
<td>COPPER (Cu)</td>
<td>CADMIUM (Cd)</td>
</tr>
<tr>
<td>CHROMIUM (Cr)</td>
<td>ZINC (Zn)</td>
<td>BARIUM (Ba)</td>
</tr>
<tr>
<td>MANGANESE (Mn)</td>
<td>ARSENIC (As)</td>
<td>THALLIUM (Tl)</td>
</tr>
<tr>
<td>IRON (Fe)</td>
<td>SELENIUM (Se)</td>
<td>LEAD (Pb)</td>
</tr>
<tr>
<td>COBALT (Co)</td>
<td>STRONTIUM (Sr)</td>
<td></td>
</tr>
</tbody>
</table>

NOTE: Sodium, Potassium, Calcium, and Magnesium come with standard analysis.

## VOLATILES (GC/MS)

ResinTech uses Gas Chromatography - Mass Spectrometry to detect volatile organic compounds in water. The following is a list of volatiles we are able to analyze:

<table>
<thead>
<tr>
<th>Volatile</th>
<th>Volatile</th>
<th>Volatile</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,2,3-TRICHLOROBENZENE</td>
<td>IODOMETHANE</td>
<td>PROPYL ACETATE</td>
</tr>
<tr>
<td>BENZENE</td>
<td>1,3,5-TRIMETHYLBENZENE</td>
<td>CIS-1,3-DICHLOROPROPENE</td>
</tr>
<tr>
<td>2-HEXANONE</td>
<td>N-BUTYLBENZENE</td>
<td>CIS-1,4-DICHLORO-2-BUTENE</td>
</tr>
<tr>
<td>DICHLORODIFLUOROETHANE</td>
<td>ALLYL CHLORIDE</td>
<td>AMYL ACETATE</td>
</tr>
<tr>
<td>TOLUENE</td>
<td>1,1-DICHLOROETHENE</td>
<td>TRANS-1,3-DICHLOROPROPENE</td>
</tr>
<tr>
<td>METHYL ISOBUTYL KETONE</td>
<td>1,3-DICHLOROBENZENE</td>
<td>ETHYL ACETATE</td>
</tr>
<tr>
<td>CHLOROMETHANE</td>
<td>ACETONE</td>
<td>N-BUTYL ACETATE</td>
</tr>
<tr>
<td>CHLOROBENZENE</td>
<td>METHYLENE CHLORIDE</td>
<td>1,3-DICHLOROPROPANE</td>
</tr>
<tr>
<td>METHYL ETHYL KETONE</td>
<td>SEC-BUTYLBENZENE</td>
<td>2-NITROPROPANE</td>
</tr>
<tr>
<td>VINYL CHLORIDE</td>
<td>METHYL ACETATE</td>
<td></td>
</tr>
<tr>
<td>1,1,1,2-TETRACHLOROETHANE</td>
<td>TRANS 1,2-DICHLOROETHENE</td>
<td>BROMOFORM</td>
</tr>
<tr>
<td>1,1,2,2-TETRACHLOROETHANE</td>
<td>1,2,4-TRIMETHYLBENZENE</td>
<td>METHYL METHACRYLATE</td>
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<tr>
<td>BROMOMETHANE</td>
<td>CHLOROPRENE</td>
<td>TETRAHYDROFURAN</td>
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<td>1,1-DICHLOROETHANE</td>
<td>1,2-DICHLOROPROPANE</td>
</tr>
<tr>
<td>ETHYL BENZENE</td>
<td>4-CHLOROTOLUENE</td>
<td>METHACRYLONITRILE</td>
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<td>ACRYLONITRILE</td>
<td>PROPIONITRILE</td>
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<td>DIBROMOMETHANE</td>
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<tr>
<td>M,P-XYLENE</td>
<td>P-ISOPROPYLTOluene</td>
<td>ACETOPHENONE</td>
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<tr>
<td>TRICHLOROFLUOROMETHANE</td>
<td>VINYL ACETATE</td>
<td>CIS-1,2-DICHLOROETHENE</td>
</tr>
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<td>STYRENE</td>
<td>CHLOROFORM</td>
<td>2-CHLOROETHYL VINYL ETHER</td>
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<tr>
<td>O-XYLENE</td>
<td>1,4-DICHLOROBENZENE</td>
<td>HEXACHLOROBUTADIENE</td>
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<tr>
<td>DIETHYL ETHER</td>
<td>ETHYL ACETATE</td>
<td>BROMODICHLOROMETHANE</td>
</tr>
<tr>
<td>ISOPROPYL BENZENE</td>
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<td>1,1,2-TRICHLOROETHANE</td>
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<td>NAPHTHALENE</td>
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<tr>
<td>CARBON DISULFIDE</td>
<td>ISOPROPYL ACETATE</td>
<td>BROMOCHLOROMETHANE</td>
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<tr>
<td>N-PROPYLENENZENE</td>
<td>CARBON TETRACHLORIDE</td>
<td>TETRACHLOROETHENE</td>
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<td>2-CHLOROTOLUENE</td>
<td>NITROBENZENE</td>
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</tr>
<tr>
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<td>1,4-DIOXANE</td>
<td>DIBROMOCHLOROMETHANE</td>
</tr>
<tr>
<td>TERT-BUTYLBENZENE</td>
<td>TRICHLOROETHENE</td>
<td>1,2-DICHLOROETHENE</td>
</tr>
<tr>
<td>1,2,4-TRICHLOROBENZENE</td>
<td>TRANS-1,4-DICHLORO-2-BUTENE</td>
<td>1,2-DIBROMOETHANE</td>
</tr>
</tbody>
</table>
ResinTech is a global leader in the field of ion exchange technology. Our premium quality media, legendary technical support, and patented technologies help dealers, and operators worldwide ensure optimal water quality for softening, demineralizing, conditioning, condensate polishing and radwaste treatment applications. ResinTech’s world-class laboratory offers our customers valuable insights into the composition of their feed and process water and the health of the media in their ion exchange vessels.

Together with its corporate subsidiaries, ACM Technologies, and Aries FilterWorks, the ResinTech family of companies provide products and services to support all phases of the IX resin life cycle from media formulation to ion-exchange application to resin regeneration.

ResinTech is headquartered in West Berlin, NJ and maintains facilities in Forest Hill, MD, Sarasota, FL, Houston, TX, and Gardenia, CA.

For more information, visit www.RESINTECH.com

856.768.9600
ixresin@resintech.com
160 Cooper Road
West Berlin, New Jersey USA