

Produced Water Treatment Systems



*Advanced Filtration and
Ion Exchange Softener Systems*



Produced Water Treatment

Application

Extraction of heavy oil often involves the production of steam for injection into the formation (steam flooding, cyclic steam, SAGD). In order to minimize or eliminate the consumption of fresh water to feed steam generators, produced water (the water which comes to the surface along with the oil) is often treated and conditioned to a quality suitable for feed to a steam generator.

Once-through-steam-generators (OTSG) can generally be fed produced water which has been filtered and softened. In some cases, initial treatment for silica is also employed.

Problem

Produced water filtration and softening systems which have been used over the past several years often encounter one or all of the following problems:

- **Poor Filtration Quality:**

Media filtration using nutshells or sand media generally do not sufficiently or consistently remove oil or suspended solids to adequate levels required for effective ion exchange softening. This results in fouling of the ion exchange softener resins, which in turn results in:

- Reduction in soft water quality which can affect OTSG performance and maintenance requirements.
 - Increased chemical consumption (salt, acid, caustic) for softener regeneration to try to compensate for partially fouled resin.
 - Lower softener capacity due to shorter service runs, longer regeneration and cleaning procedures.
 - Increased maintenance costs and downtime in order to clean or replace fouled resin.
- **High chemical (salt, acid, caustic) consumption** due to the limitations of convention ion exchange softener designs especially when treating produced water with high hardness or with high total dissolved solids (TDS).
 - **Safety concerns and costs related to handling hydrochloric acid and caustic** which are often used for regeneration of weak acid cation (WAC) softeners.
 - **Large waste volumes** produced during regeneration require disposal.
 - **Large equipment** which requires considerable space and site assembly.

Solution

Eco-Tec's Spectrum Micro-Media Filtration

Greatly improves the quality of filtered produced water to eliminate many of the problems related to softener fouling.

Eco-Tec's RecoPur Ion Exchanger Softeners

Provide significant benefits in softener performance such as:

- 40-80% reduction in salt and waste for regeneration compared with conventional softeners treating an equivalent quality and quantity of water.
- Eliminate the use of acid and caustic for regeneration of WAC softeners.
- Compact, skid-mounted, factory assembled systems.
- Fully automated, easy to operate and maintain with easy adjustment to variable feed water conditions and effective in-situ resin cleaning.

Spectrum Micro Media Filter

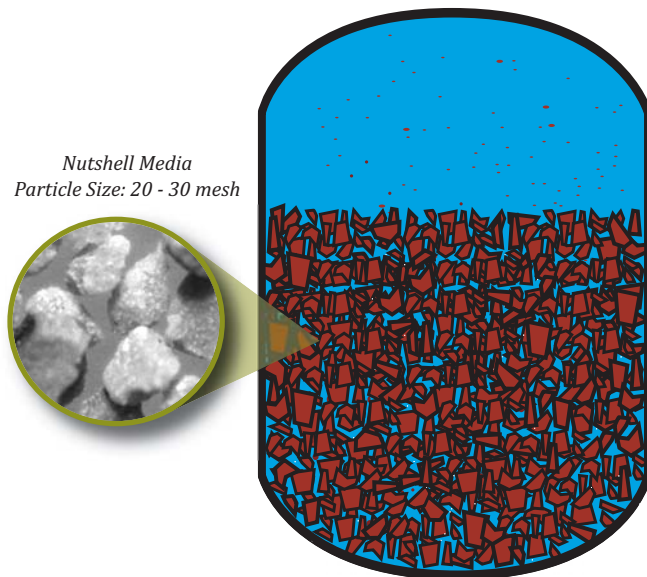
Superior filtration performance to eliminate many of the problems related to ion exchange softener fouling

	Typical Filtrate Quality	
	Conventional Media and/or Nutshell Filters	Spectrum Plus Micro-Media Filter
Free Oil	2 - 5 ppm	< 1 ppm
Suspended Solids	2 - 5 ppm	< 0.2 ppm

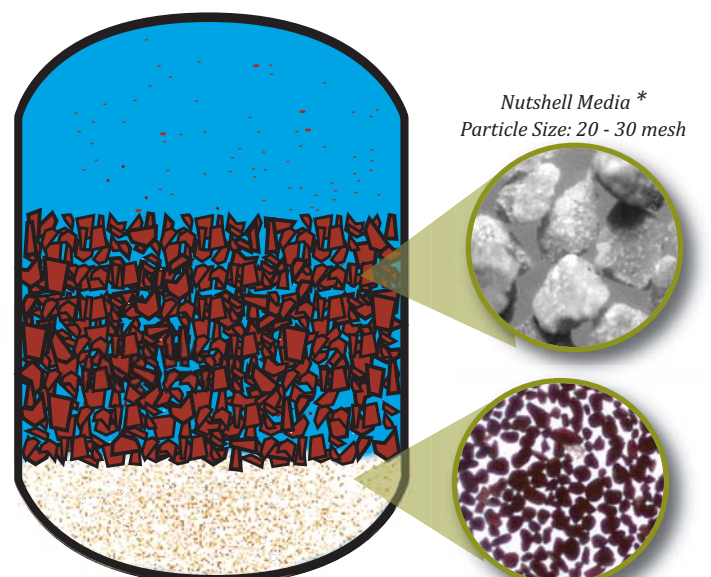
- Conventional Nutshell filtrate contains significant particles in the 0-10 micron size range
- Spectrum removes virtually all particles > 2 micron and significantly reduces < 2 micron particles

Superior Design

Conventional Nutshell Filter



Spectrum Micro Media Filter™



* Spectrum Plus filter is used with oily water and has nutshell coarse media. When very little oil is present, a Spectrum Filter with anthracite as coarse media is used.

The layer of micro media has a very small particle size and acts as a barrier to small suspended solid particles. The Spectrum micro media is proprietary, inert, long-life (virtually permanent) media. It is much heavier in density than nutshells or sand which ensures that it reclassifies (resettles below the nutshells after backwashing) and is virtually impossible to backwash out of the filter vessel.

Designed for simple, low cost operation

- Media is effectively scoured using air or gas - no separate pumps or agitators are required
- 15 standard models ranging from 1,500 - 60,000 BPD (50 - 2,000 gpm, 11 - 450 m³/hr)



RecoPur Ion Exchange Softeners

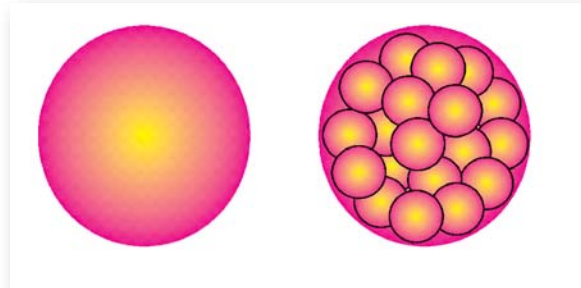
RecoPur softeners use Eco-Tec's proprietary Recoflo ion exchange process which improves the performance of ion exchange.

Recoflo has been used for over 40 years in a variety of industrial water treatment and chemical process applications with more than 1,500 systems installed worldwide.

Key features include:

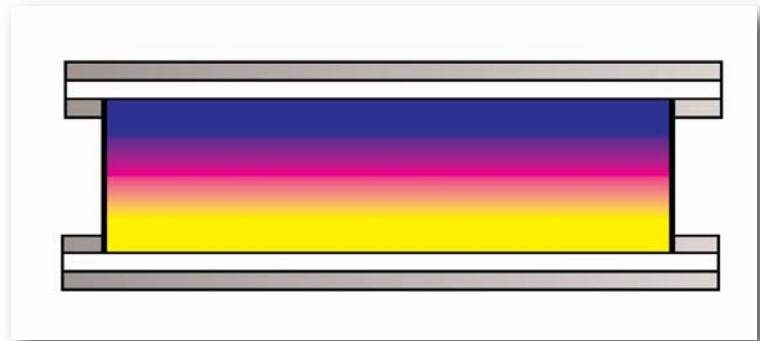
- **Fine Mesh Resin**

Finer mesh resin pack more surface area into the same volume



- **Compressed Short Resin Beds**

Compressed resin beds promote uniform flow distribution and plug flow conditions.



- **Counter-current Regeneration:**

With counter-flow regeneration, the brine passes in the opposite direction to the service flow water.

The combination of Recoflo features allow:

- High capacity, compact equipment.
- Production of high purity water.
- Low chemical consumption.
- Low waste production.

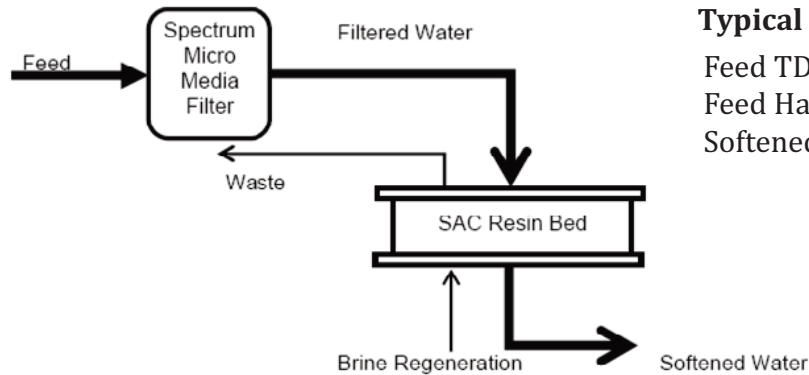


RecoPur Softener

RecoPur Ion Exchange Softeners

A Variety of Softener Configurations:

SAC (Strong Acid Cation)



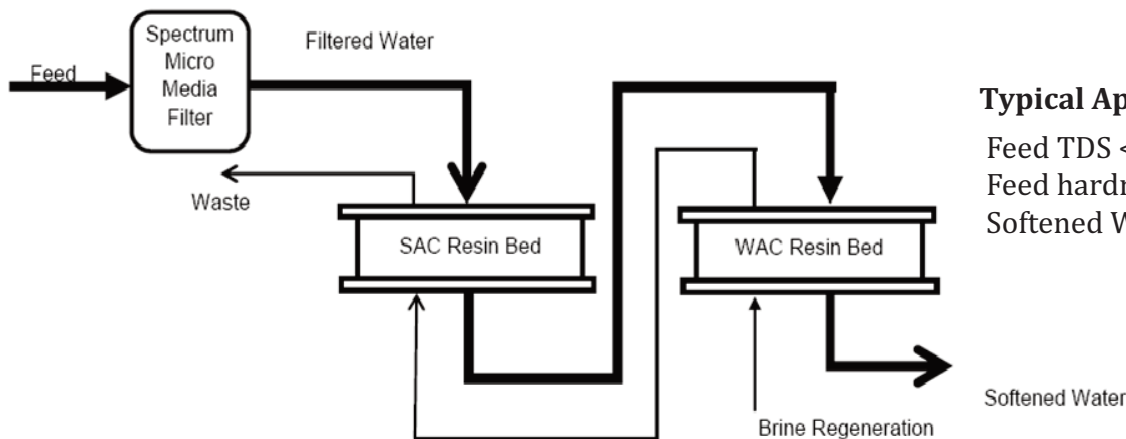
Typical Application:

Feed TDS < 12,000 ppm
Feed Hardness < 1,200 ppm
Softened Water Quality < 0.5 ppm

Features:

- Very simple system with compact foot print.
- Salt consumption is typically 30-60% less than conventional softeners.
- No need for two stage (SAC/SAC) to achieve performance.

SAC/WAC (Strong Acid Cation/Weak Acid Cation)



Typical Application:

Feed TDS < 14,000 ppm
Feed hardness < 1200 ppm
Softened Water Quality < 0.2 ppm

Features:

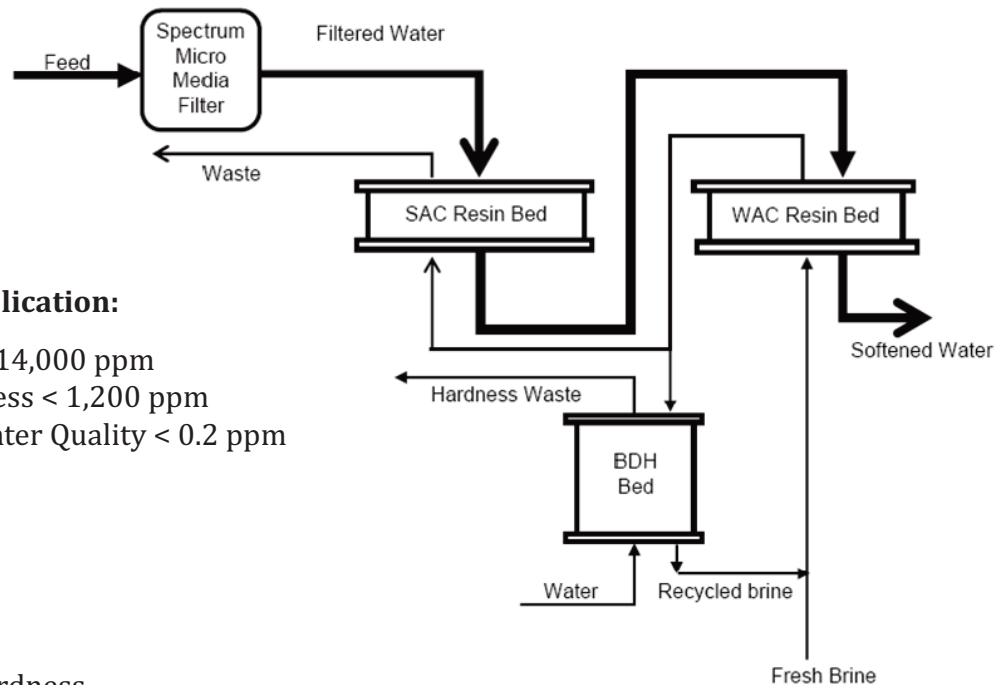
- Achieves very low hardness.
- Use only brine for WAC regeneration
- Less brine consumption than SAC only configuration.
- No hydrochloric acid or caustic used.

RecoPur Ion Exchange Softeners

A Variety of Softener Configurations:

SAC/WAC/BDH

(Strong Acid Cation/Weak Acid Cation/Brine Dehardener)



Typical Application:

Feed TDS < 14,000 ppm
Feed Hardness < 1,200 ppm
Softened Water Quality < 0.2 ppm

Features:

- Achieves very low hardness.
- Uses less brine than SAC / WAC configuration so greater economy for larger capacity systems.
- Can be configured to any salt – even salt containing hardness
- No hydrochloric acid or caustic used

How Is WAC Regeneration Achieved Using Only Brine?

- *Since WAC is only a polisher, it has low hardness loading.*
- *A large excess of brine is used for the WAC but the waste brine from the WAC is used directly to regenerate the SAC efficiently.*
- *Brine must contain low hardness by either using low hardness salt or by softening brine with the Brine Dehardener (BDH).*

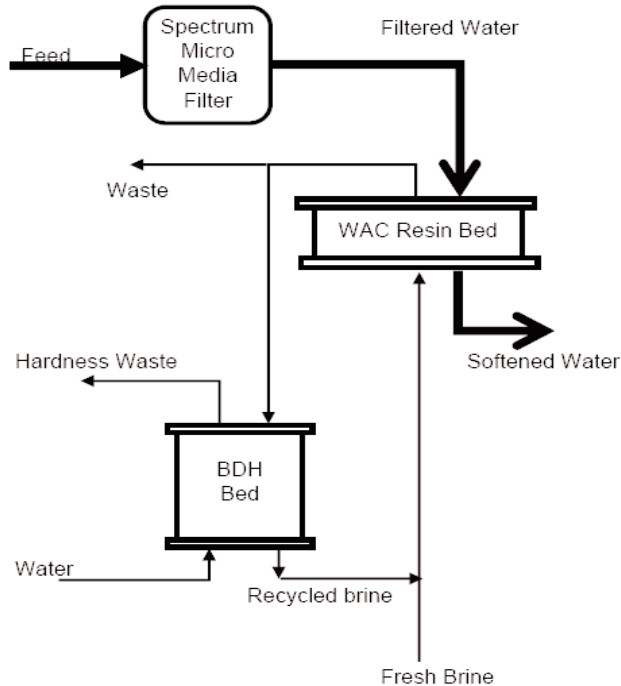


SAC/WAC Skid-mounted Softener

RecoPur Ion Exchange Softeners

A Variety of Softener Configurations:

WAC/BDH(Weak Acid Cation/Brine Dehardener)



Typical Application:

- Feed TDS < 25,000 ppm
- Feed Hardness < 800 ppm
- Softened Water Quality < 3 ppm

Features:

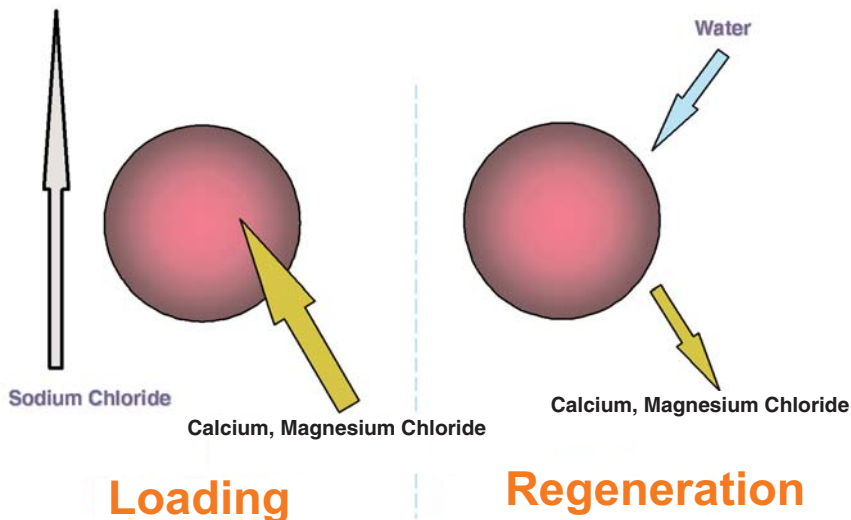
- Allows softening of very high TDS water.
- No hydrochloric acid or caustic required.

What is a Brine Dehardener (BDH)?

A Brine Dehardener (BDH) is a RecoPur ion exchanger (fine mesh resin, compact, packed resin bed) using a proprietary resin that can separate hardness salts (CaCl_2 , MgCl_2) from brine (NaCl) using only water for regeneration. This allows waste brines to be treated and reused to minimize salt consumption and brine waste. The waste solution contains the dissolved hardness salts and can be injected into a waste well since it contains no solids.

Eco-Tec has supplied hundreds of "water regenerated" resin systems for acid-salt (APU) and salt-salt (SSU) separation.

Hardness removal from brine (separation of $\text{CaCl}_2/\text{MgCl}_2$ and NaCl)



Brine Dehardener (BDH)

Offering The Complete Package



Innovations

- Eco-Tec has been building Recoflo® ion exchange systems for industrial treatment and water purification applications since 1970 with more than 1,500 systems installed in over 55 countries
- Eco-Tec continues to develop product improvements and new processes with its in-house Research and Development facility



Quality Design and Construction

- ISO 9001 registered design and manufacturing facility in Pickering, Ontario
- Built to global industrial standards
- Compact, skid mounted (including resin installation) and wet tested at Eco-Tec's ISO factory



Technical Service and Support

- On-site commissioning supervision, performance demonstration, and operator training
- Performance monitoring and technical support program (Eco-SERV™)
- 24/7 telephone access to technical services support
- Extensive spare parts inventory for next day shipment of most replacement parts

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