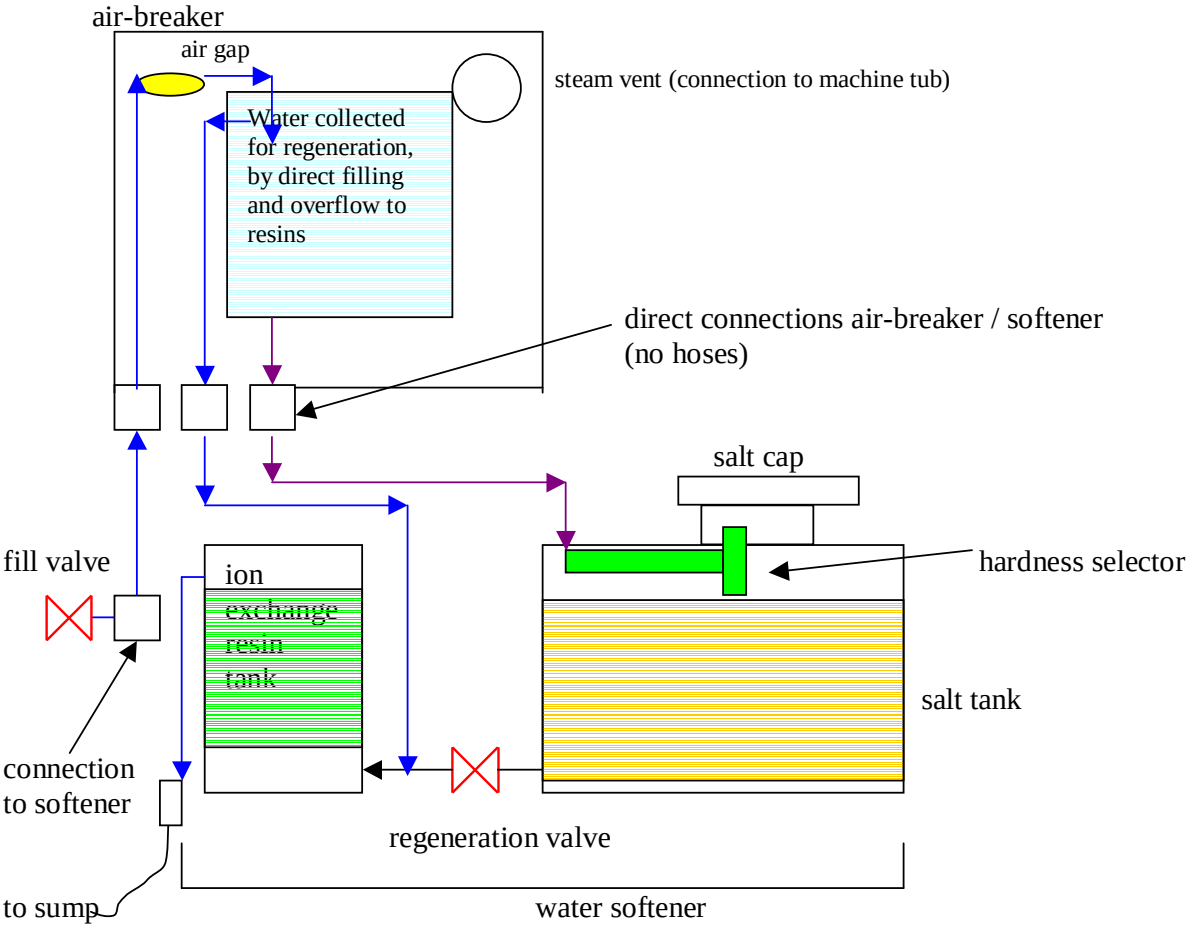
TECHNICAL DESCRIPTION
MODEL M24

Water softener model M24 is composed by a body, a cover and a bottom, injection-molded in natural PP and hot-plate welded (two welding operations, of course), and includes 600 cc of ion exchange resins, retained in position by a screen molded into the body, and another screen on the top, made of black PP. The softener also includes a regeneration valve, used to activate the regeneration phase of ion exchange resins (water placed in the side tank of dish washers drops by gravity into the salt container and releases salt – brine to the ion exchange resins).

From a point of view of functions, we can distinguish among different parts: a salt container, a resin container, a regeneration valve between them, plus a sensor to detect the presence/absence of salt, aside the salt container.



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Of course we cannot speak of softener without involving the air-breaker, which must be used with the softener for three main reasons: providing an air gap according to EN 61770, providing a water amount for regeneration, providing a connection of tub to atmosphere (through steam vent), providing a (small) area cor condensing of steam, for better drying performances.

We can consider three phases during the usage of water softener:

- water filling, in order to treat incoming water, and namely strongly reduce water hardness, for use during wash of dishes;
- resins' regeneration, in order to recover the treatment capacity after absorption of calcium, magnesium and other positive ions (cations) causing water hardness; this regeneration is made by means of sodium ions, coming from a dense brine composed by a solution of NaCl;
- resins' rinse, in order to eliminate excess of NaCl (used for regeneration) and of calcium / cations (exchanged out of resins during contact with salt brine).

Water filling and treatment of water

Filling valve is energized, and water flows into the system, passing in series:

- the hose between filling valve and water softener inlet
- a first channel (in pressure) inside the softener
- the conncetion (with o-ring) between softener and air-breaker
- a second channel inside the air-breaker
- the air gap, prescribed by EN 61770 against backsiphonage in the main water supply
- a direct entrance into the collecting chamber for regeneration water
- an overflow outlet, once the chamber for regeneration water is full
- a third channel, into air-breaker
- the connection (with o-ring) between air-breaker and resin tank
- the channel taking to bottom of resin cylinder
- the bottom filter
- the ion exchange resins
- the top filter
- the outlet to sump
- the hose between softener outlet and sump
- the sump.

The lower the flow rate, the better. In fact in terms of speed through the ion excahnge resins, a lower flow rate allows a longer time of contact between flow and resins' bed (cylinder). A good project of water softener must be a compromise for optimization of resin tank geometry: if the tank is taller and narrower, it is better for the performances, because preferential paths within resins can be avoided; but at the same time, a reduced cross section is increasing the speed through the resins, and this is worsening performances.

Resins' regeneration

Regeneration valve is energized, so to release the potential energy of the water amount above, in the air-breaker, and allow a movement of water:

- the water amount in the air-breaker drops, and pushes forward the same amount contained into the salt tank;
- the brine amount is pushed ahead into the resin tank, where comes in contact with the resins and activates the ion exchange Ca-Na;
- the fresh water contained in the resin tank, replaced by the brine, moves forward into the sump.

This is an ideal path, because in practise the regeneration water is not simply pushing ahead the water/brine downstream, indeed there is a certain mixing of brine and regeneration water. The ideal regeneration must be slow, in order to increase the time of contact between the brine and the resins during the water drop. Also, a slow regeneration can give a better removal of salt, taking away only particles of NaCl practically in elementary form, even completely dissolved in water; otherwise, with a quick regeneration, larger particles of NaCl, not completely dissolved, can be taken in the flow, giving rise to an effective waste of salt, or to a not adequate usage.

Resins' rinse

After regeneration has occurred, calcium is replaced by sodium in the ion exchange resin beads. But in reality it is impossible to use exactly the sufficient amount of NaCl, in other words, there is always a waste of salt. In the best softening systems available in the dish washer market, a good performance for regeneration efficiency is to use 20-25% of the salt effectively taken into the resin tank. For example, of 60 grams released from the salt tank, only 12-15 grams are really excahnged with calcium.

Secondly, also the calcium released during this exchange is very concentrated: basically the water coming out of resin tank after the contact with brine, can be as hard as 300-400 °F or more, depending on the water amount in which it is diluted.

The purpose of resins' rinse is to remove the excess (waste) of salt, and the excess (exchanged) of calcium and other cations contributing to hardness, in order to avoid chloride or hardness to go in the tub, during washing phases. Normally 5 times the amount of resins (3 liters for 600 cc of ion exchange resins) is an adequate amount.

A certain benefit is obtained by means of some flow 'shots', which help shaking the resins and removing the excess of NaCl and calcium. For example, 6 shots of 0.5 liters are better than 3 liters continously.

In order to execute the resins' rinse, the filling valve is energized, on a time base, until the requested amount – let's say 3 liters – have flown through the ion exchange resins.

The passages into the hydraulic circuit are the same as for water filling.

Other technical data

The electrical components used in softener model M24 are a regeneration valve (the same type used in T&P water valves, already approved by Certification Bodies in Europe), and a reed switch (switching whenever a floater inside the salt container – equipped with a magnet – is sinking into the salt solution, indicating low density of brine, or low presence of salt).

By the point of view of Certification Bodies, water softener identified as model M24 is characterized by the following features:

- Regeneration coil build-in device, not electronic;
- Type of action: 1
- Pollution situation: dirty;
- Water softener with regeneration valve with direct closure;
- Water softener with regeneration valve mounted with vertical axis, upside down (anyway a spring inside will close the plunger), no screws (rotation snap-fit) and one o-ring for sealing;
- Water softener not forecast for direct connection to main water supply (Remark: an air gap must be placed upstream, according to Standard EN 61770);
- Maximal operating pressure: 0.2 bar (Remark: dynamic pressure entering the softener);
- Maximal water temperature: 70 °C;
- Maximal ambient temperature: 60 °C;
- Service: 3 min on / 5 min off;
- Nominal voltage: 220/240 V AC 50/60 Hz 8 VA or 120 V 60 Hz 8 VA; available also low voltage (12 V and 24 V, AC or DC);
- Max flow rate through the regeneration valve: 1 liter/minute (suggested 0.2-0.4 liters/minute);
- Reed switch for salt density detection: soldered with terminals 6.3 x 0.8 mm (linked to a black PC plastic base).

Pictorial description

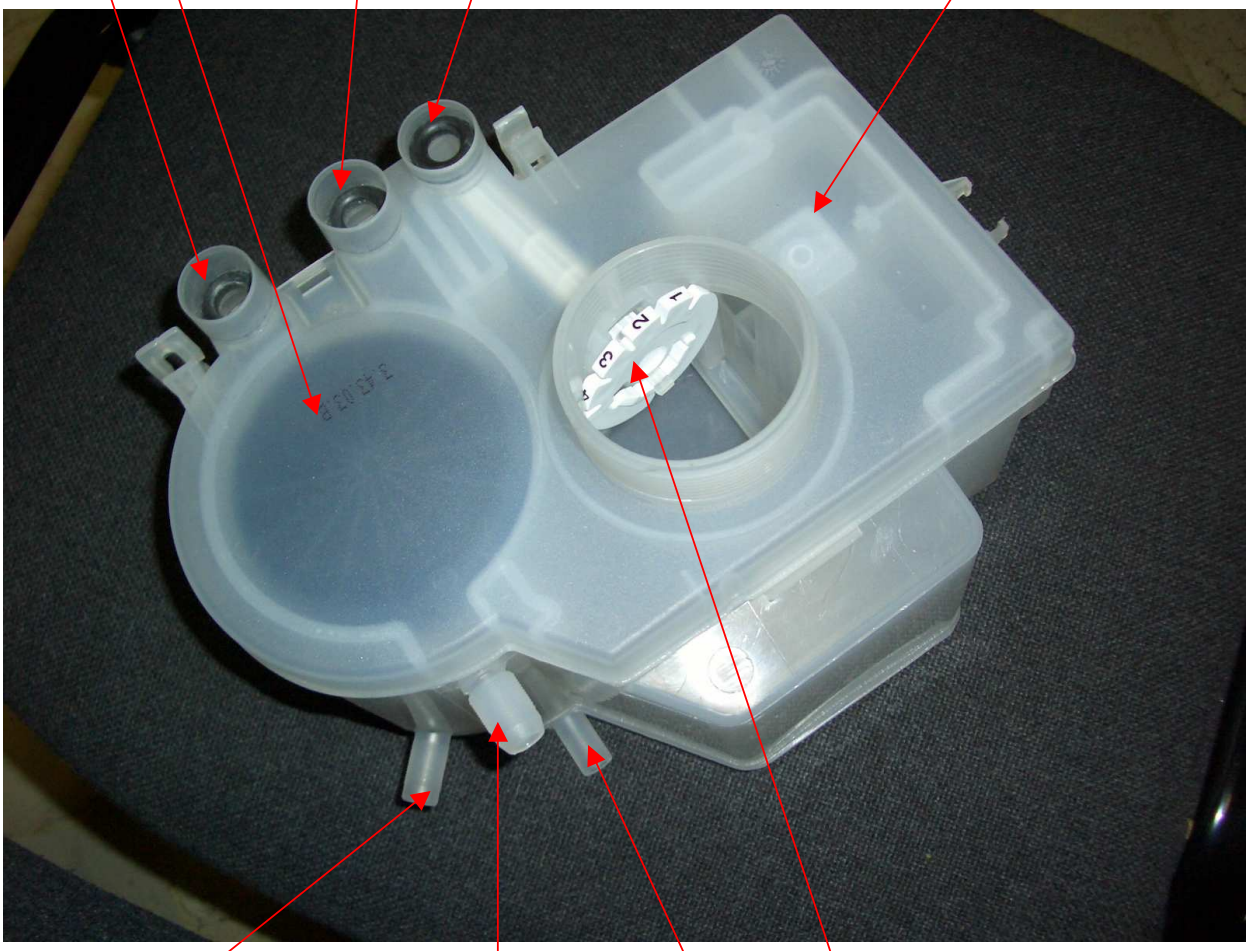
connection: flow for filling from valve to air-breaker

salt tank

resin tank

connection: flow for filling to the resins

connection: regeneration water from air-breaker



water inlet (from filling valve)

water outlet (to sump)

option for sensor of automatic regeneration
(not used)

hardness selector
(only electromechanical d.w.)

regeneration coil

sensor for salt detection (floater inside)