

Going Soft?

I am sure that there are plenty of discussion points between club members that polarise opinion. I cite the theory and practice of steam injectors as one (but more of that in a future article). I propose the benefits of water softening as another. Although I have no direct experience of members' debates on this matter, I have heard that it has been the subject of some discussion in the past and, at one point we even had a softener ready to install - although it was subsequently decided not to do so. I have not penned this submission to the newsletter to stake my claim to the title of "instant expert", rather to promote further debate on a subject that I think worthy of serious consideration.

I declare an interest in the matter because, with a loco boiler currently under construction, I would like to avoid the problems associated with scaled up fittings and the subsequent need to descale the boiler during its future working life. I have direct experience of installing and running a soft water system at home and can vouch for the benefits to my domestic heating system. I believe that these benefits would be even more clearly seen by all loco owners if we can locate and install a water softener at the Park.

How Does Water Become Hard Or Soft ?

If we are to understand the process of water hardening we should first remind ourselves of the natural water cycle:

- Water from the oceans, rivers, lakes and streams together with stored water in plants and soil is evaporated by the sun's energy and forms clouds;
- When the clouds can no longer support the mass of water contained within them precipitation occurs and rain falls;
- The rain runs off the surface of the land (overland flow) and infiltrates into the land structure towards the ground-water table;
- Underground flow is exploited where it collects as "ground water" by pumping into treatment systems, storage in reservoirs and subsequent delivery to the consumer;
- Consumer waste water is returned to the rivers and oceans after treatment and the cycle begins again.

Rainwater is naturally soft, but as it percolates through chalk and limestone it dissolves and collects minerals from the geological sub-structure. This dissolved chalk, lime and other minerals causes the water to harden depending on the amount of material subsumed. Living on the South coast with the chalk South Downs behind us, the mains water supply that we receive at the park contains a very high level of dissolved material. It is this dissolved material that we see as scale in our kettles, domestic water systems and loco boilers.

Hardness is measured in degrees Clarke (no relation) - the hardness of the water supply in the Hove Park area is 17.5 degrees Clarke and is classified (by Southern Water) as "Very Hard".

The Effects Of Hard Water

The minerals contained in hard water settle out as unsightly deposits of scale whenever water is heated, or when cold standing water evaporates. Examples that we see at home include:

- White marks, stains and scale on sinks, baths, toilet bowls and around the base of taps;
- Blocked shower heads;
- Scale deposits on all water heating elements;
- Clogging of pipework and premature failure of water heaters.

These last two examples are the most germane to our hobby. The efficiency of a model loco boiler can be seriously degraded through the build-up of scale. The efficiency loss in a domestic heating system with $\frac{1}{16}$ " (1.6mm) of scale is in excess of 12%, in a miniature boiler where the tubes are mounted closer together than in a domestic system the loss could be even more pronounced.

Although these levels of scaling may sound extreme, how many of you have realised the extent of scale on your own locos before removing the boiler blowdown valve completely and observing the tell-tale white material which, in extreme cases, has blocked the valve completely?

At its most extreme scale build up around the foundation ring of a boiler can deny access to the boiler water and result in irreparable damage to the boiler around the firebox base. I leave it to the reader to consider the consequences of neglecting a boiler to such an extent.

Boiler Descaling

Despite the potentially disastrous consequences of not descaling a boiler which uses hard water, there remains some debate over the benefits of boiler descaling. Some suggest that the descaling process causes more trouble by loosening deposits which remain in the boiler and can become detached during subsequent steamings. Others, although disliking the process, appreciate the improvements in steaming that a "clean" boiler can bring and are prepared to put up with the inconvenience of routine descaling.

But wouldn't it be better if we could provide treated water so that members need not descale their loco boilers at all? Think of all the savings in time, materials and anxiety that providing soft water would bring. Commercial water softeners for domestic use are widely available now. They occupy a small amount of space (many are designed for mounting under a kitchen sink) and are simple to install. I am sure that we could install one at the Park easily and with minimal disruption to the existing plumbing.

Water Treatment Methods

Water Softening

Water **softening** is the only process which eliminates scale completely. Commercial water softeners remove water hardness through ion exchange. The hard water is passed through a cylinder containing ion-exchange resin in the form of millions of tiny beads. The resin attracts and exchanges the hardness minerals in the water producing soft water as a result. Periodically the resin is automatically "regenerated" (or cleaned) by rinsing a small amount of brine through the cylinder. The brine reactivates the resin and the waste is discharged to a drain.

Water softeners are normally installed "in line" with the mains water supply, downstream of the drinking water tap. They need a mains power supply (240V AC) and a drain. Routine maintenance only involves topping up the salt supply which is held within the unit.

Chemical Water Conditioning

Chemical water conditioners normally dissolve polyphosphates into the water stream as it flows through the conditioner. Polyphosphates are a compound of Sodium, Calcium and Hexametaphosphate. Polyphosphates have been used for many years in the water treatment industry and are recognised as "food safe" i.e. they can be used directly in the drinking water supply. The dissolved polyphosphates suspend the hardness minerals thus significantly **reducing** hard water scale. No softening of the water is involved.

Chemical conditioners are normally installed "in line" with the mains water supply at any point after the mains stopcock. They require no electrical supply but do contain a phosphate cartridge which requires changing from time to time (typically every 12-15 months in a domestic environment).

Magnetic Water Conditioning

Magnetic water conditioners work by passing the hard water through a very strong (up to 600 gauss) magnetic field. When the water is subsequently heated the hardness minerals precipitate into the body of the water as individual particles rather than clusters of particles which stick together and form scale. As a result the scale should pass through hot water systems easier. Magnetic water conditioners are thus scale **reducers** rather than scale **eliminators**.

Magnetic conditioners are normally installed "in line" with the mains water supply at any point after the mains stopcock. They require no electrical supply and only contain a magnet which should not require servicing.

Advantages Disadvantages and Costs

The table below shows the relative merits and typical cost of each of the methods described above:

	Water Softening	Chemical Treatment	Magnetic Treatment
Advantages	1. Full water treatment 2. Scale elimination 3. Scale reduction of existing contamination	1. Cost 2. Does not need electrical supply 3. Does not need drain	1. Cost 2. Does not need electrical supply 3. Does not need drain
Disadvantages	1. Cost 2. Needs electrical supply 3. Needs drain 4. Consumables (salt)	1. Introduces chemicals into the water supply 2. Less effective than water softening 3. Consumables (phosphate cartridges) 4. Does not eliminate scale 5. Does not reduce existing contamination	1. Less effective than water softening 2. Less effective than chemical treatment 3. Does not eliminate scale 4. Does not reduce existing contamination
Typical Cost	£500	£100	£50

Some Practical Experience

Three years ago I installed a water softener in our current house when I replaced the boiler and hot water cylinder as part of a general refurbishment of the plumbing and heating systems. The softener serves both a holding tank and an "on demand" electric shower quite successfully.

At the time of installation I noted that the pipework in the hot water system was fairly well scaled-up and it was clear that the system was not operating at peak efficiency. We could not afford to replace all the copper pipework at the time so settled for the installation of the water softener to prevent further scaling and hopefully reduce or eliminate the existing scaling.

Recent re-plumbing in the bathroom has necessitated the removal and re-routing of some of the original boiler to hot water cylinder pipework. The change in the state of the pipes is remarkable - the scale has disappeared and the system is clearly more efficient. The soft water has actually dissolved away the original hard water scale.

Summary

Water softeners are not cheap but, if you consider that one of the club's greatest assets is the goodwill of those members who regularly run their locos for passenger hauling, and that those members overhaul and service these locos at their own cost, you might suggest that we should be doing all that we can to minimise that cost. Boiler maintenance and refurbishment is itself an expensive component of the running costs of a loco - some would argue a dominant cost. Without doubt installing a water softener would be a major investment but one that would, in the long term, benefit the "internals" of many locos which run regularly at the park, and indirectly the "internals" of many member's wallets.

If the club feels that the cost of a water softener cannot be justified then I suggest that we should seriously consider the installation of one of the other types of conditioner - either chemical or magnetic. Neither of these alternatives will eliminate the scale problem in the way that a softener will, but they will go a long way to reducing the problem and allowing members' locos more steaming hours between those awful descalings.

I'm sure that many readers of the Lobby will have their own ideas on the pro's and con's of providing treated water at the Park. I look forward to the usual spirited debate and hope that we can all give the subject a good and fair airing.

Although one should never volunteer for anything, if we do choose to proceed further with the provision of treated water at the park, I am happy to "champion" the process and do some more groundwork (even the installation!).

Andy Clark