Practical Mainline Water Treatment in the 21st Century

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Things to talk about:

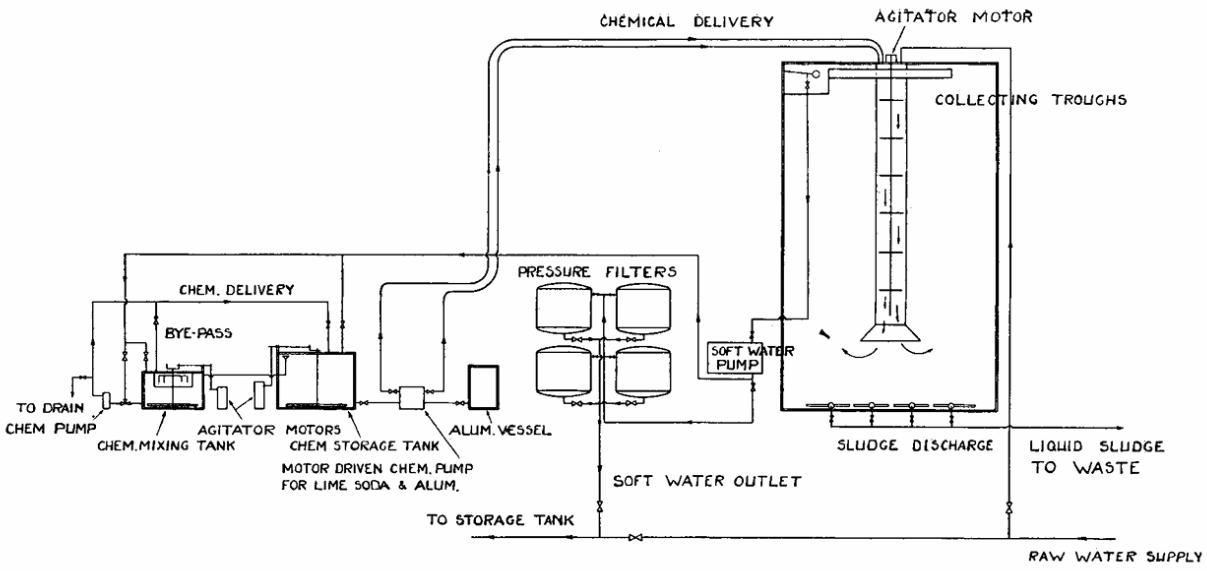
- Historical water treatment in the UK and overseas
- Porta’s system
- Current UK standard practice

Important Definitions

- Internal Treatment – on the loco/tender
- External Treatment – anything done before the water is added to the loco/tender

Early British Practice

- Very rare before 1930
- Softening plants using soda, lime and sodium aluminate
- Also ‘conditioning plants’ to increase the alkalinity
- Tannin also added as developments made
- By 1952 antifoam part of the treatment



TYPICAL ARRT OF WATER SOFTENING PLANT PIPEWORK

FIG. 13.

Reference: Papers by Hancock 1937 and 1957

TIA

- Whole system of management
- Similar chemical and scheme to Porta
- Porta roughly a development of this

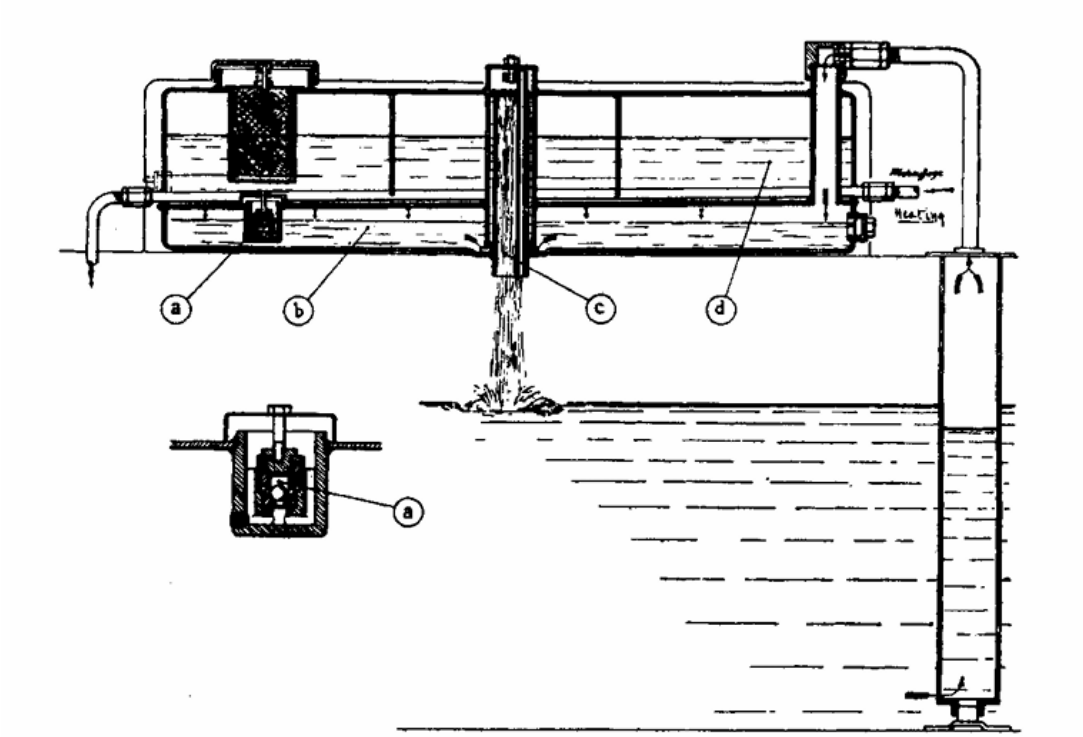


FIG. 15

HYDROSTATICAL COMPOUND BALL-DOSER—22 GALLONS

Reference: 1949 paper by Armand

AFLOC

- Brand from ICI
- Tender/Tank feeder for Briquettes
- sodium carbonate, sodium bicarbonate, sodium phosphate, sodium aluminate and tannin

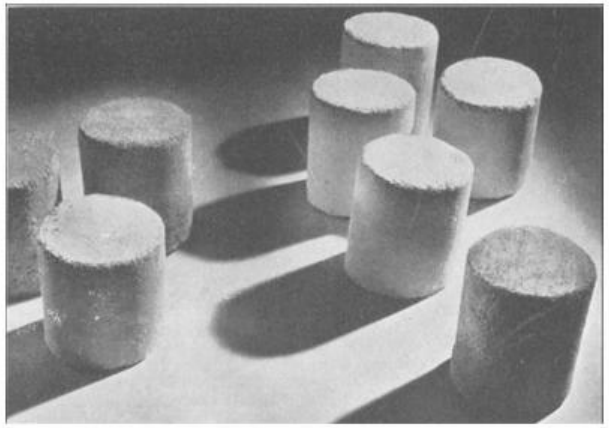


FIG. 7
"ALFLOC" WATER TREATMENT CHEMICALS IN THE FORM OF READY-MIXED BRIQUETTES FOR EASY APPLICATION TO TUBE FEEDERS.

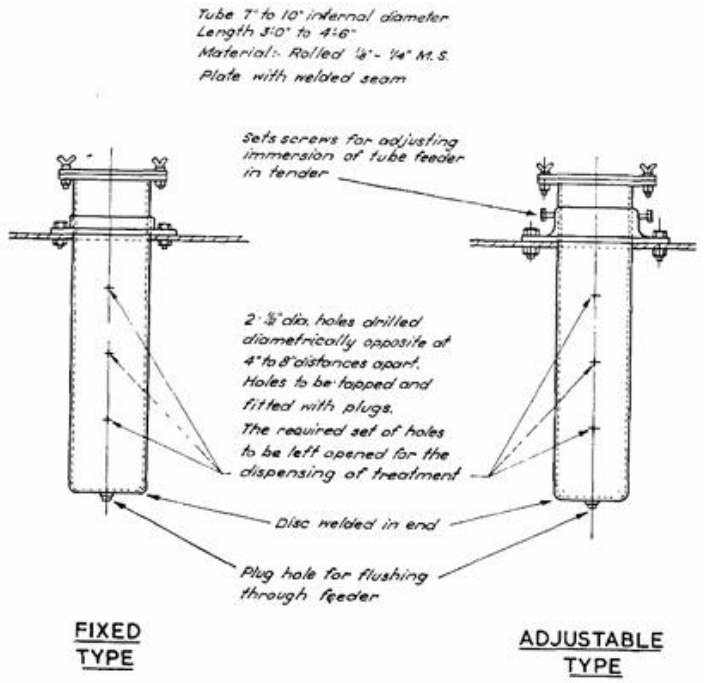


FIG. 8
SKETCH SHOWING TYPES OF BRIQUETTE TUBE FEEDERS.

Reference: 1957 paper by Parsons

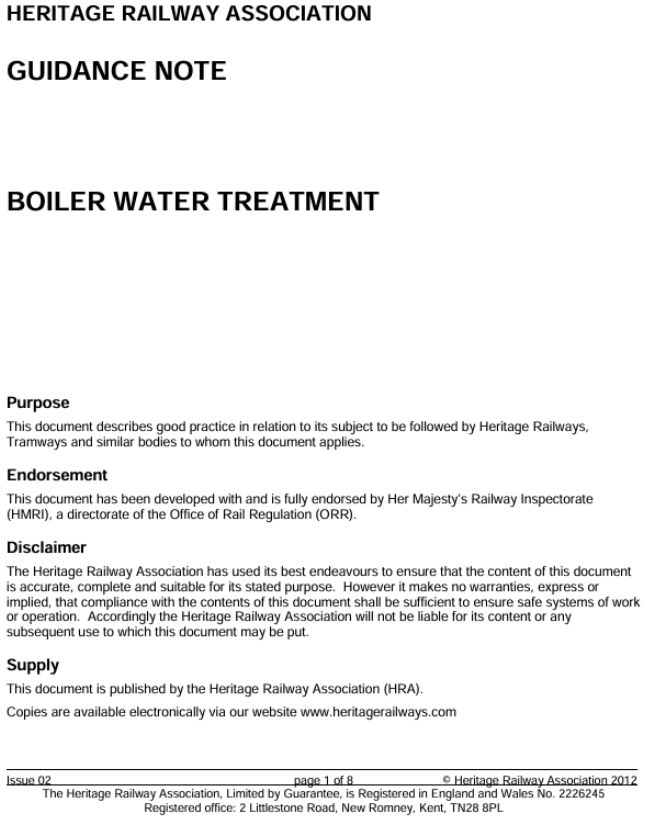
Porta

- Developed from AFLOC and TIA.
- Boiler condition aimed for:
  - TDS of 10-20000 (ppm)
  - Total alkalinity of 1000-3000 (ppm of $CaCO_3$)
  - Equivalent to a pH of 11.5 to 14 (depending on the boiler material)
- Dosing:
  - 13ppm of $NaCO_3$ and Tannin in the feedwater
  - 0.4ppm antifoam
  - Sodiumhexametaphosphate 3ppm
  - Any extra $NaCO_3$ to keep pH correct

Reference: Porta Papers Volume 4 - ASTT

Current UK Practice

- HRA recommendations
  - Alkalinity (pH) - 10.5 to12
  - Tannin (ppm) - 120 to 160
  - TDS (ppm) - 3500 max
- Recommendation on testing is once per day but can decrease frequency



HERITAGE RAILWAY ASSOCIATION

GUIDANCE NOTE

BOILER WATER TREATMENT

Purpose

This document describes good practice in relation to its subject to be followed by Heritage Railways, Tramways and similar bodies to whom this document applies.

Endorsement

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Internal boiler water treatment.

This is where chemicals, usually soda ash (sodium carbonate) or caustic soda (sodium hydroxide) and tannin, are added directly to the boiler or boiler feed water either as powders or solutions. If the TDS reaches a level where carry-over occurs, suitable antifoams can be employed or the boiler water can be blown down or changed. It is safe to use where copper fireboxes are employed and will deal with most feed waters supplied in the British Isles. Regular boiler water sampling is recommended and subsequent variation of the chemical dosage may be necessary to ensure that the boiler water conforms to the specification stated in British Standard 2486(1997).

Alkalinity (pH)	**10.5 to 12.0**
Tannin (ppm)	**120 to 160**
Total Dissolved Solids (TDS) (ppm)	**3500max**

Issues

- Chlorine Content in water
- Law changes have focused more on water cleanliness than steam generation
- If NaOH is used chlorine in water forms NaCl
- Destroys tannin and treatment system fails leading to issues
- 8% Cl in scale tested
- Suppliers changing product composition without updating users

- References taken from Gov.uk and the DWI(drinking water inspectorate)

				YSK (7)
Aluminium	200µg/l	47,361	8	PRT (1), PRT (1), SES (1), UUT (4), YSK (1)
Benzo(a)pyrene	0.01µg/l	12,436	2	ANH (1), SES (1),
Chloride	250mg/l	13,014	3	ISC (3)
Chromium	50µg/l	12,822	2	SRN (2)
Copper	2mg/l	10,747	6	TMS (1), SRN (4), WSX (1)
Fluoride	1.5mg/l	12,423	0	

DWI report 2020

Bromate	10 µg/L	11,257	0	Only if fails
Cadmium	5 µgCd/L	12,328	0	Only if fails
Chloride	250 mgCl/L	10,390	4	ISC (4)
Chlorine – residual (free)[2]	2 mg/L	106,536	0	
Chlorine – residual (total)[2]	2 mg/L	101,634	0	
Chromium	50 µgCr/L	12,330	0	

DWI Report 2021

Issues

- Led to a break down of the treatment on multiple occasions
- A new and unusual scale began forming – **Extremely** Hard
- Treatment began to remove it
- Came off in Huge flakes
- We were too late – older boiler material failed

Taken from 35028 Clan Line - A Dramatic Run Up Hemerdon Bank - The Cornishman 2018

Result of issues

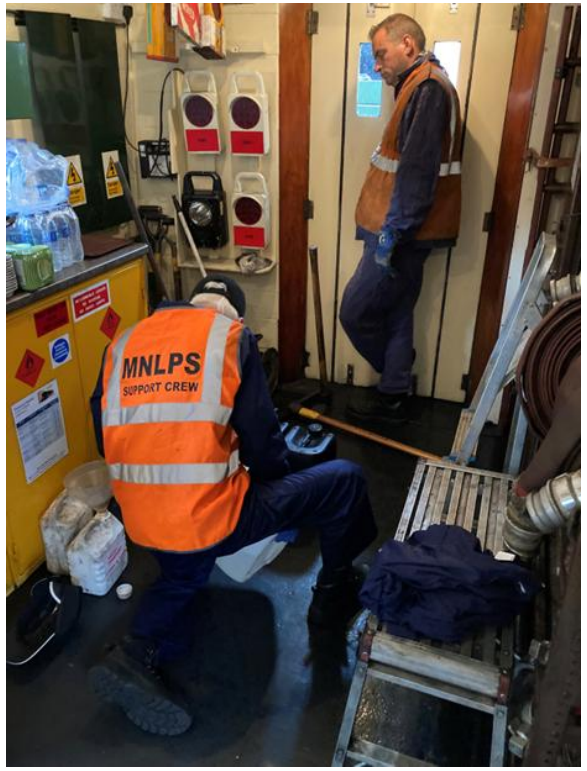
- Had to Descale boiler by hand
- Spend 18-24 months at leaky finder in Devon
- Complete boiler overhaul and retube
- Replaced Syphons and Firebox side

Solution

- Reverse Osmosis
  - Softens water
  - Removes salts
- Allows water to be accurately dosed in the shed
- Better control of the numbers
- Means the treatment works effectively
- Carbonate and tannin now used

MNLPS Treatment Plan

- Based off HRA guidelines and experience
- 1L per 1000 gallons of tender water (tannin and carbonate)
- Dose antifoam only at shed
  - Accepta 2586 (0.5ppm)
- Testing once per trip (roughly every 3 days in steam)
- Normally when loco is cold
- Blowdown once per trip at the end of the tour



MNLPS Blowdown Procedure

- 3-4 support crew
- 1 on footplate, 1 lookout, 1 operating Blowdown Valve
- Blowdown ½ a glass of boiler water
- Duty engineer is informed by Chief engineer whether more is needed
- May put on an injector to lengthen blowdown
- May also drain tender to refill with fully treated water to get right conditions in boiler

MNLPS Washout Procedure

- Every 15 days or 6 months, Maximum of 20 days in steam
- Cold washout
- Boiler drained and inspected
- Washed out systematically
- Inspected again
- Refilled with treated water

Thank You – Any Questions?