The STEAM UP Project

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The STEAM UP Project – Case Studies from SME Industries in Greece

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Co-funded by the Horizon2020 Programme of the European Union

Main scope of project

- ✓ To promote the implementation of energy efficiency measures in steam systems of industries.

- ✓ February 2015 – February 2018

Main project activities

1. Development of comprehensive guidelines for the implementation of energy audits in steam systems (based on EN 16247).

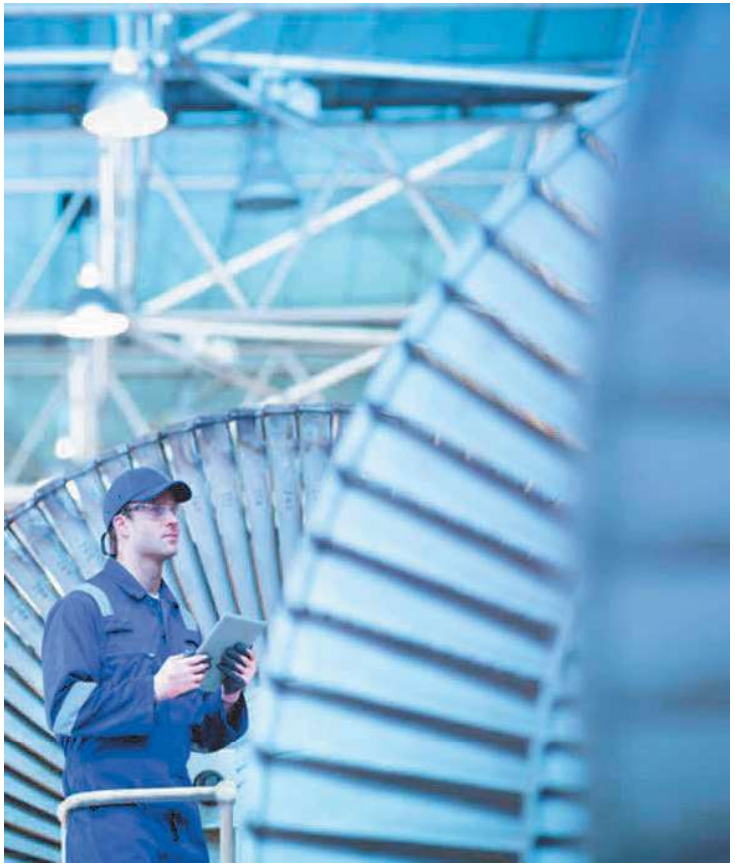
2. Compilation and elaboration of training material concerning energy efficiency measures in steam systems.

3. A capacity building program that includes training and coaching-on-the-job of over 500 energy auditors, ESCOs, internal energy managers and energy management training providers.

4. Implementation of 75 energy audits in industries in Austria, Czech Republic, Denmark, Germany, Greece, Italy, Netherlands and Spain.

Project Deliverables

Available on project website:
https://www.steam-up.eu/



Training Material

Username: steam-up
Password: training2017

Energy audits in 10 SME industries in Greece

- **Minerva S.A.** **Olive Oil**
- Bioser S.A. Medical electrolyte solutions
- **Mandrekas S.A,** **Dairy**
- **Delta S.A** **Dairy**
- Manos S.A Vegetable Oil
- **Rizakos S.A** **Insulating material**
- **Styropan S.A,** **Insulating material**
- **Monotez S.A** **Insulating material**
- Agrino S.A. Rice
- **Elin S.A** **Biodiesel**

General Findings

- Due to the lengthy and sustained recession, most of the SME's are understaffed and the process engineers have an extremely heavy work load. As a result of this, day-to-day management is of primary importance whilst energy efficiency is of a fairly low priority.

- Routine maintenance is regularly performed on the more crucial productive machinery whilst only non-routine maintenance is usually performed for the steam systems.

- The steam systems have a significant energy saving potential with the implementation of low-cost measures.

- None of the industries had energy management systems (e.g. EN ISO 50001).

LEAKS

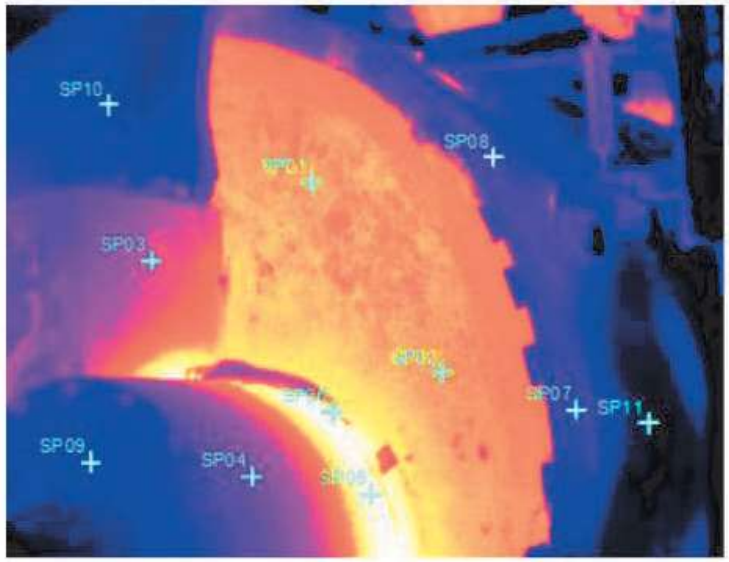
40% of the inspected plants had numerous steam leaks that were not sealed.

Examples of steam leaks in the steam boiler, the steam piping and the steam collectors.

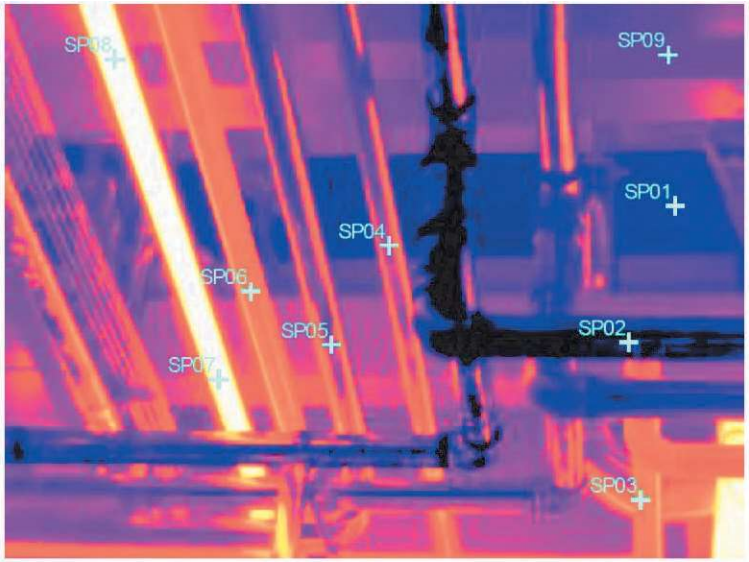
Examples of a steam boiler safety valve left permanently open in order to avoid the increase in pressure of the steam boiler instead of seeking the reasons for the pressure build-u repairing it.

INSULATION

60% of the inspected plants had numerous surfaces that were not properly insulated.

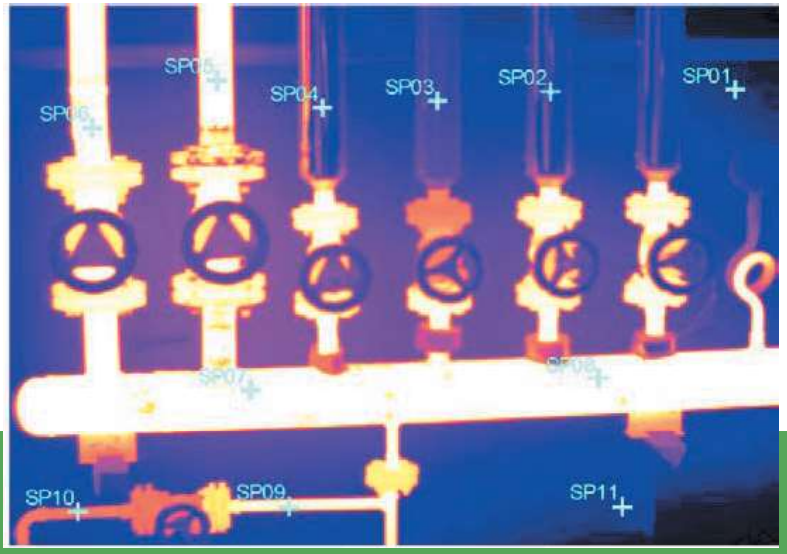


Uninsulated steam boiler (back-end)

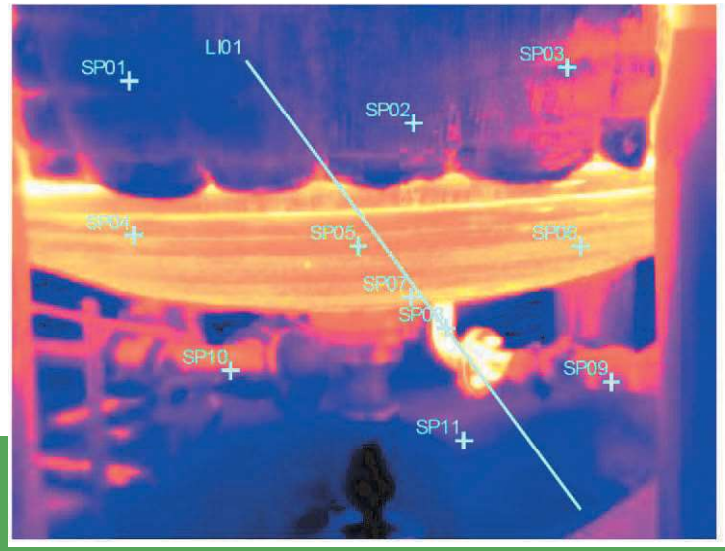


Uninsulated piping

Uninsulated collector and valves



Uninsulated tanks

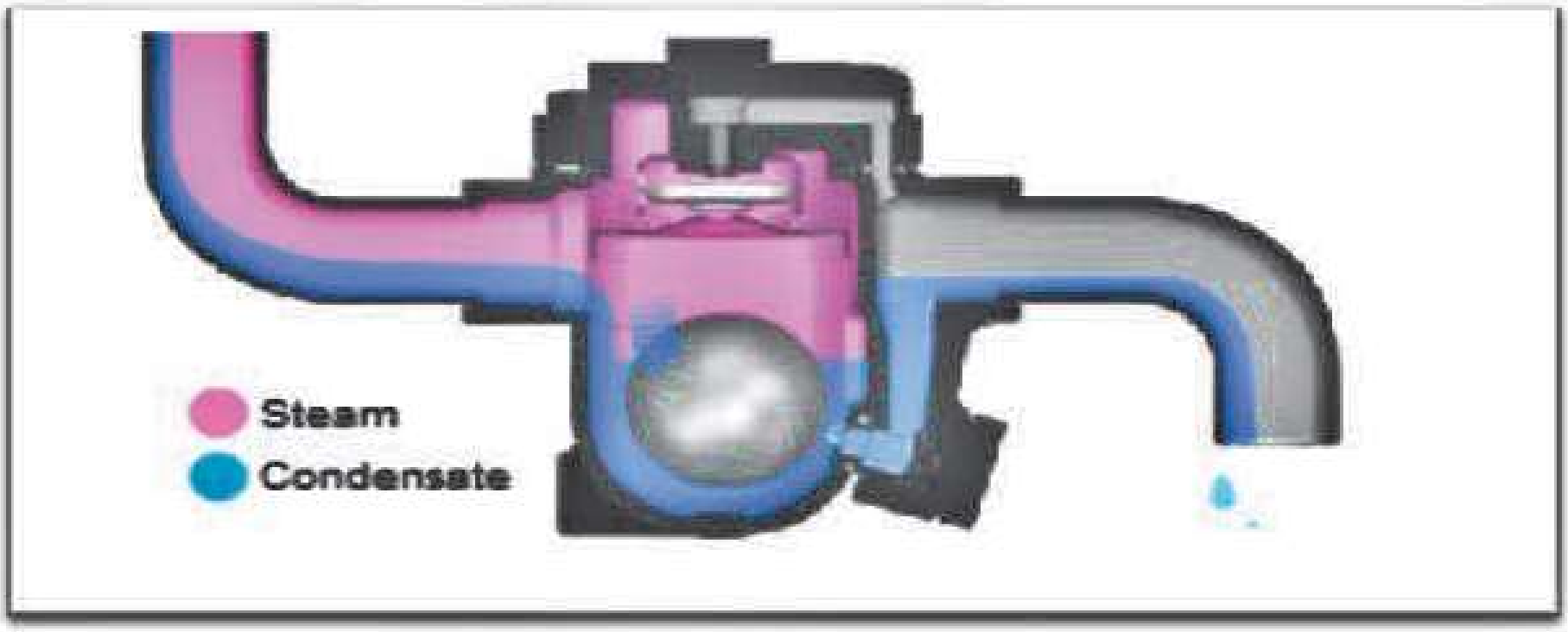


Example of properly insulated valves (with velcro).

Example of properly insulated pipes and collectors.

STEAM TRAPS

In 60% of the inspected plants a significant amount of steam traps were not functioning properly. Steam traps “trap” steam and do not allow it to return to the steam boiler before transferring its heat and condensing.

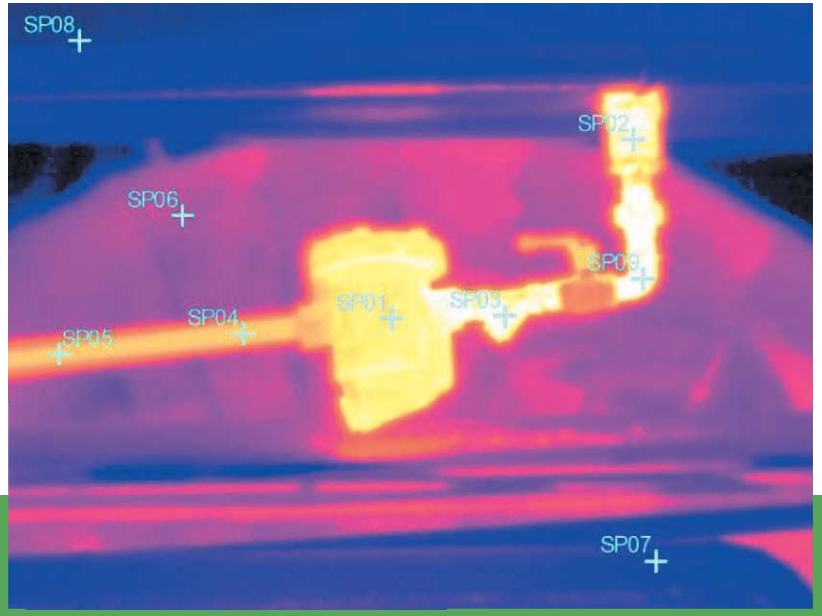


In the inspected plants, the steam traps were inspected, in chronological order, visually, acoustically and thermographically.

Examples of poorly functioning steam traps

Visual inspection

Thermographic inspection



Acoustic inspection

Best case – Steam Trap Testing Area in one of the inspected plants

STEAM BOILERS

50 % of the steam boilers inspected using a flue gas analyzer were inadequately maintained, resulting in relatively low efficiencies and relatively high flue gas temperatures.

Example 1

λ-meter installed, high burner efficiency, excessive O_2 adjustment, reasonable flue gas temperature

Fuel	Natural Gas
Boiler Efficiency	**93,3%**
Excess air	**2,6%**
O_2	0,5%
CO_2	11,59%
CO	**535 ppm**
Flue gas temperature	215 ^{0}C

Example 2

Low burner efficiency, high excess air, high flue gas temperature (?)

Fuel	LPG
Boiler Efficiency	**83,7%**
Excess air	**105%**
O_2	10,7%
CO_2	6,7%
CO	0 ppm
Flue gas temperature	**268 ^{0}C**

STEAM BOILER SET-POINTS

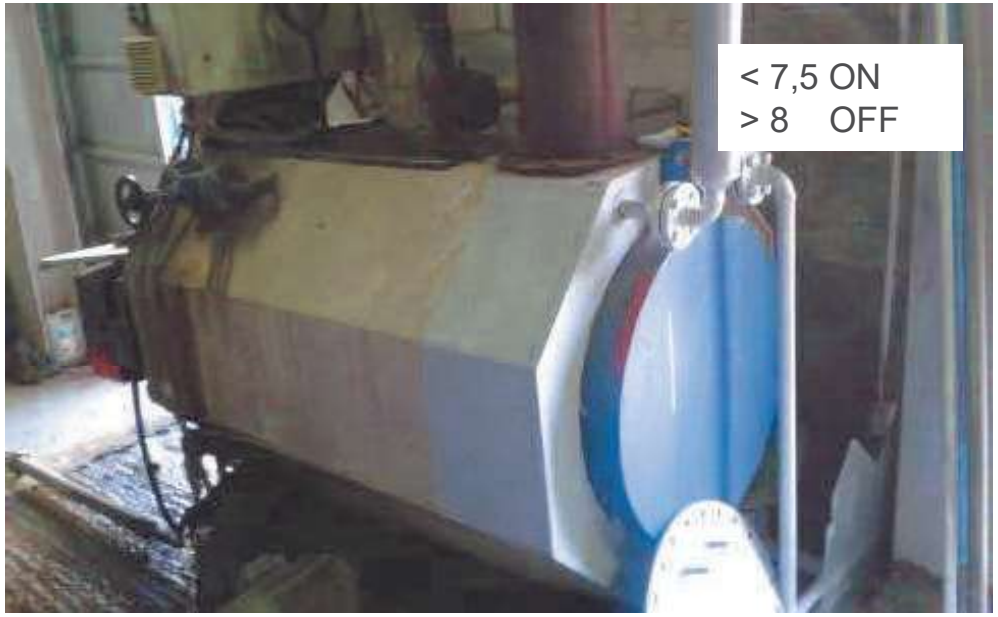
Only in 50% of the inspected plants were the set-points of the steam boilers properly regulated.

Example of a poorly regulated system. In this example the steam boiler with the lowest boiler efficiency has been set as the MASTER steam boiler. This was correct when initially set but not any more due to its reduced efficiency in the last few years.

STEAM BOILER – STEAM GENERATOR SET POINTS

In 50% of the inspected plants that had both steam boilers and steam generators, their set-points were poorly regulated. As a result of this the steam generators which are able to quickly supply relatively poorer quality steam, did not work according to their foreseen role (i.e. as a back-up source of steam for peak demands)

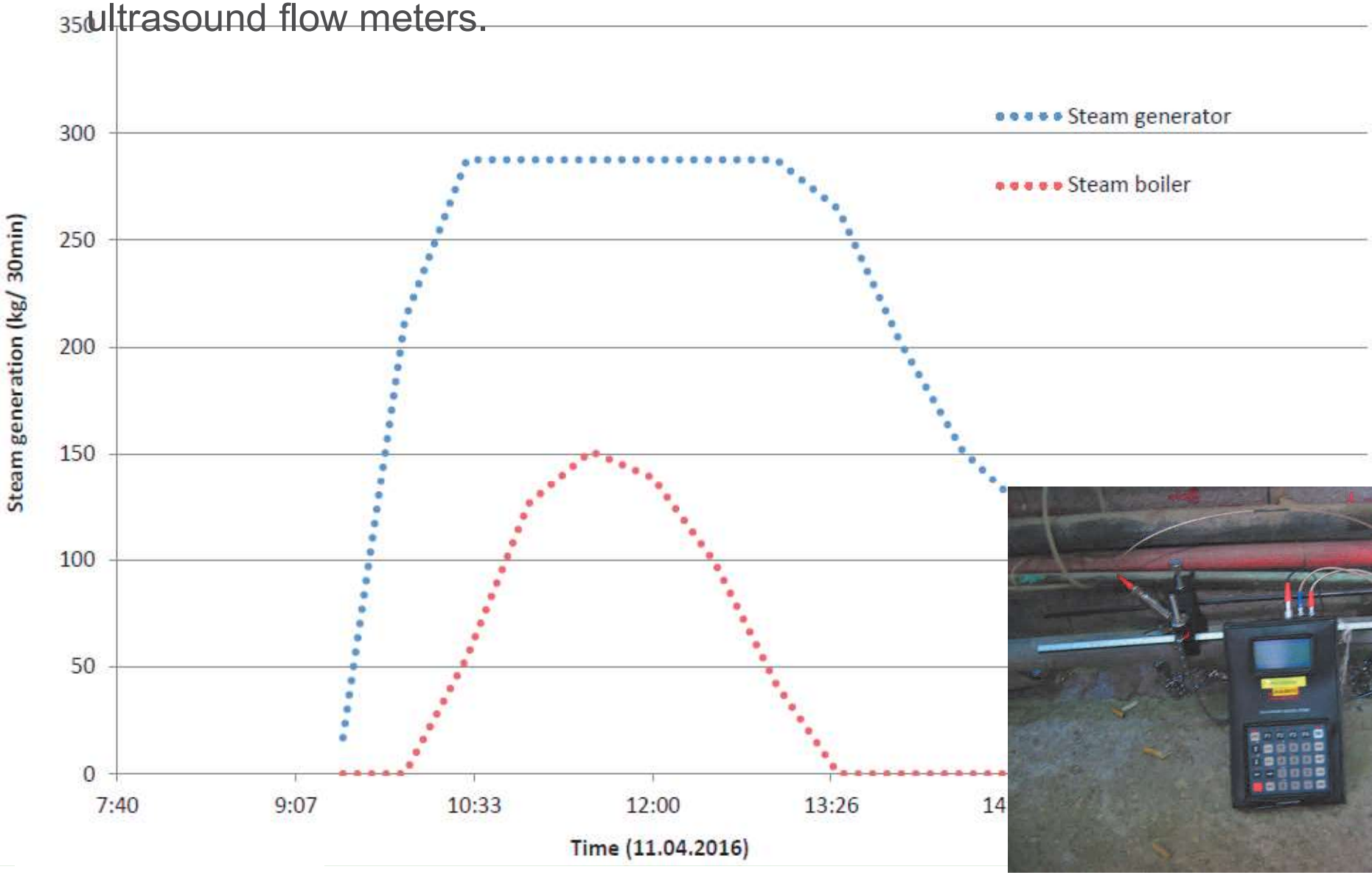
Steam boiler set-points



Steam generator set-points

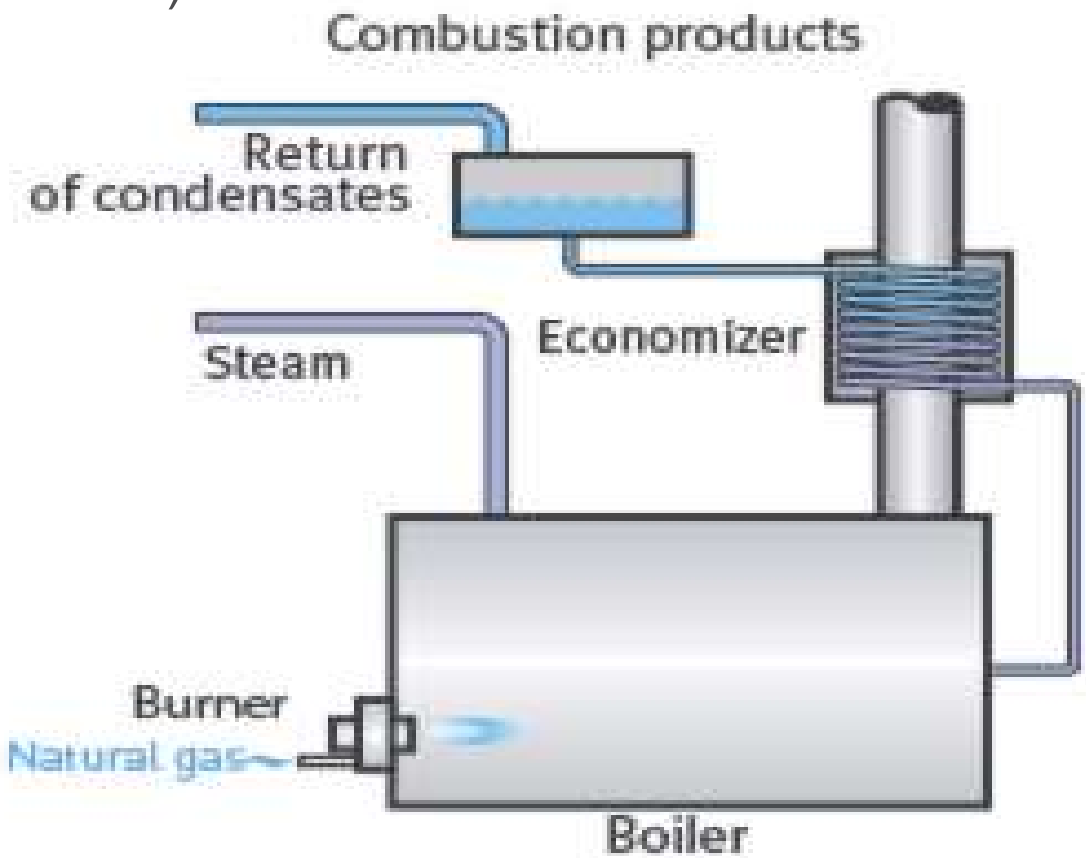
Examples of poorly regulated steam boiler and generator set points.

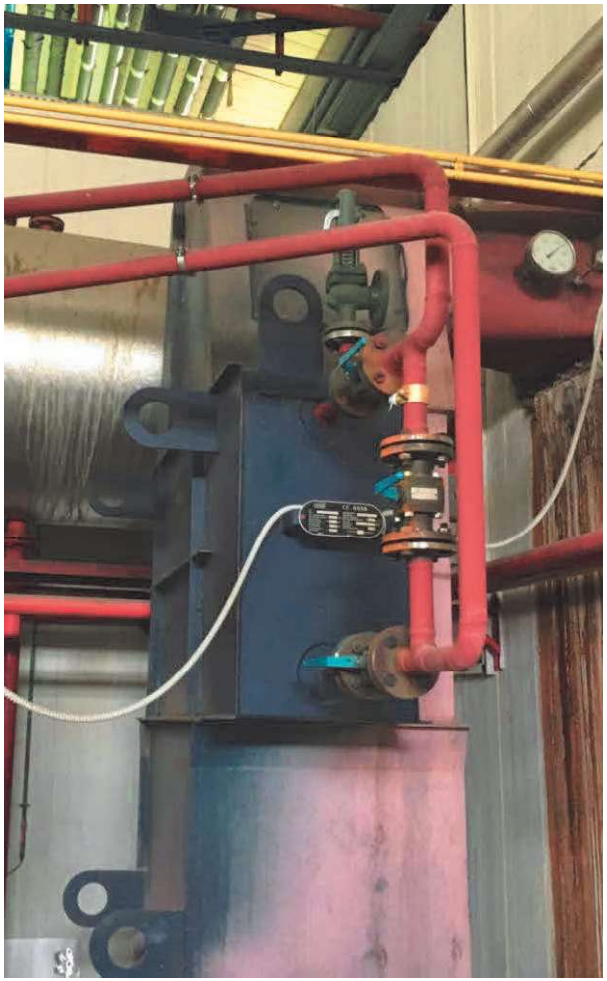
In this inspected plant the roles were inverted. This was ascertained by measuring the steam generations of both boiler and generator using ultrasound flow meters.



FLUE GAS ECONOMIZERS

- Even though many of the steam boilers had relatively high flue gas temperatures whose heat could be recovered, only **10% of the inspected steam boilers had installed flue gas economizers** (heat exchangers used to either pre-heat the make-up water of the steam boiler or used directly in the plant processes).





None of the inspected steam boilers had ceramic economizers which allow for the exploitation of flue gas temperatures below the dew point of water.

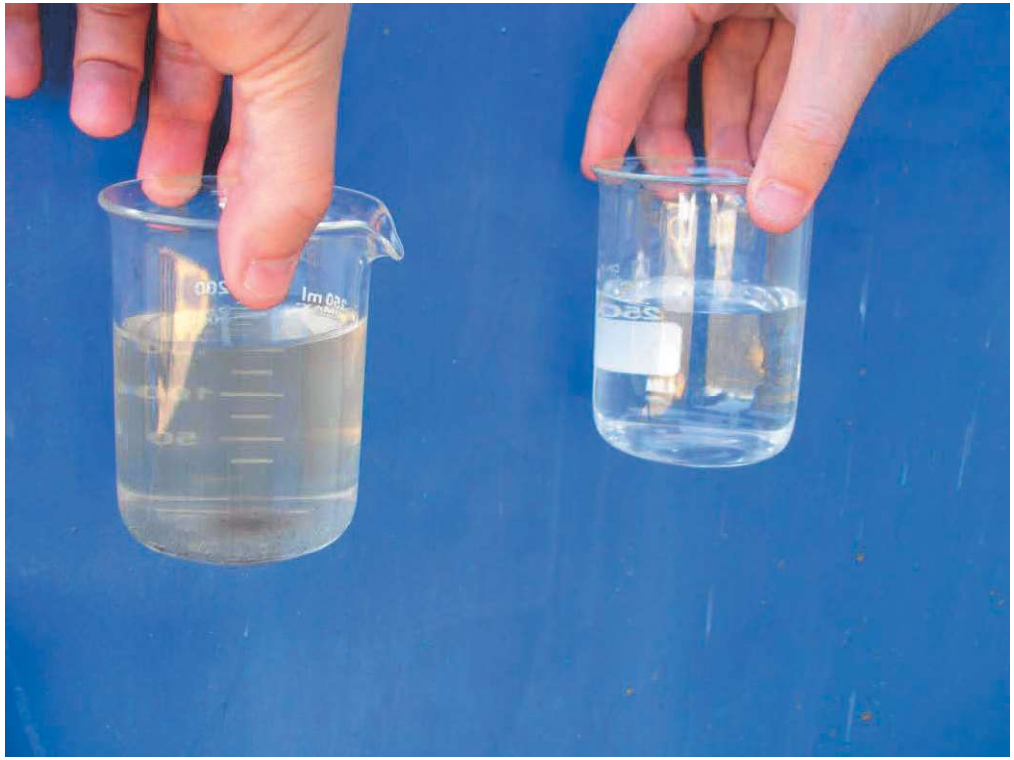
BOILER BLOW-DOWN

80% of the inspected plants had fairly recently installed reverse osmosis systems for the processing of the make-up water of the steam boiler. Therefore, boiler blow-down requirements (the removal of impurities – hardness – from the water in the steam boiler) have been significantly reduced.

On **90% of the inspected steam boilers, surface blowdown was usually performed manually**. As a result of this either:

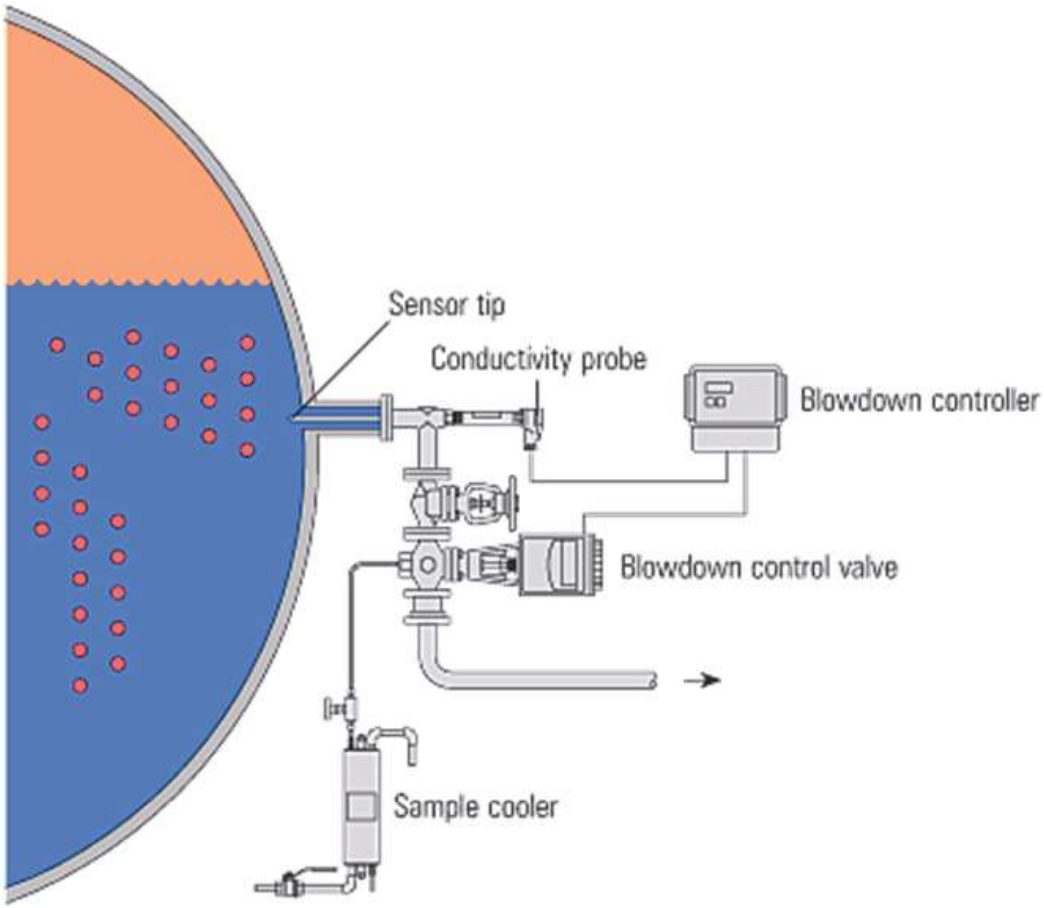
- Too much water was blown-down (rejected) resulting in energy losses or
- Too little was blow-down resulting in frothing, uptake of water into the steam distribution system and subsequent damages.

Example of poorly maintained and old steam distribution systems (i.e. galvanized steel piping) resulting in the deposition of filings. As a result of this inspection, one of the inspected plants commenced the gradual replacement of the pipes with stainless steel pipes.



Inspection of the electrical conductivity of the water in the steam boiler (which indicates the concentration of impurities). In most cases it was found that the conductivity was either well below or well above the steam boiler threshold.

Only 10% of the steam boilers had installed automatic steam boiler blowdown (which blows down water when its electrical conductivity exceeds the threshold limit).

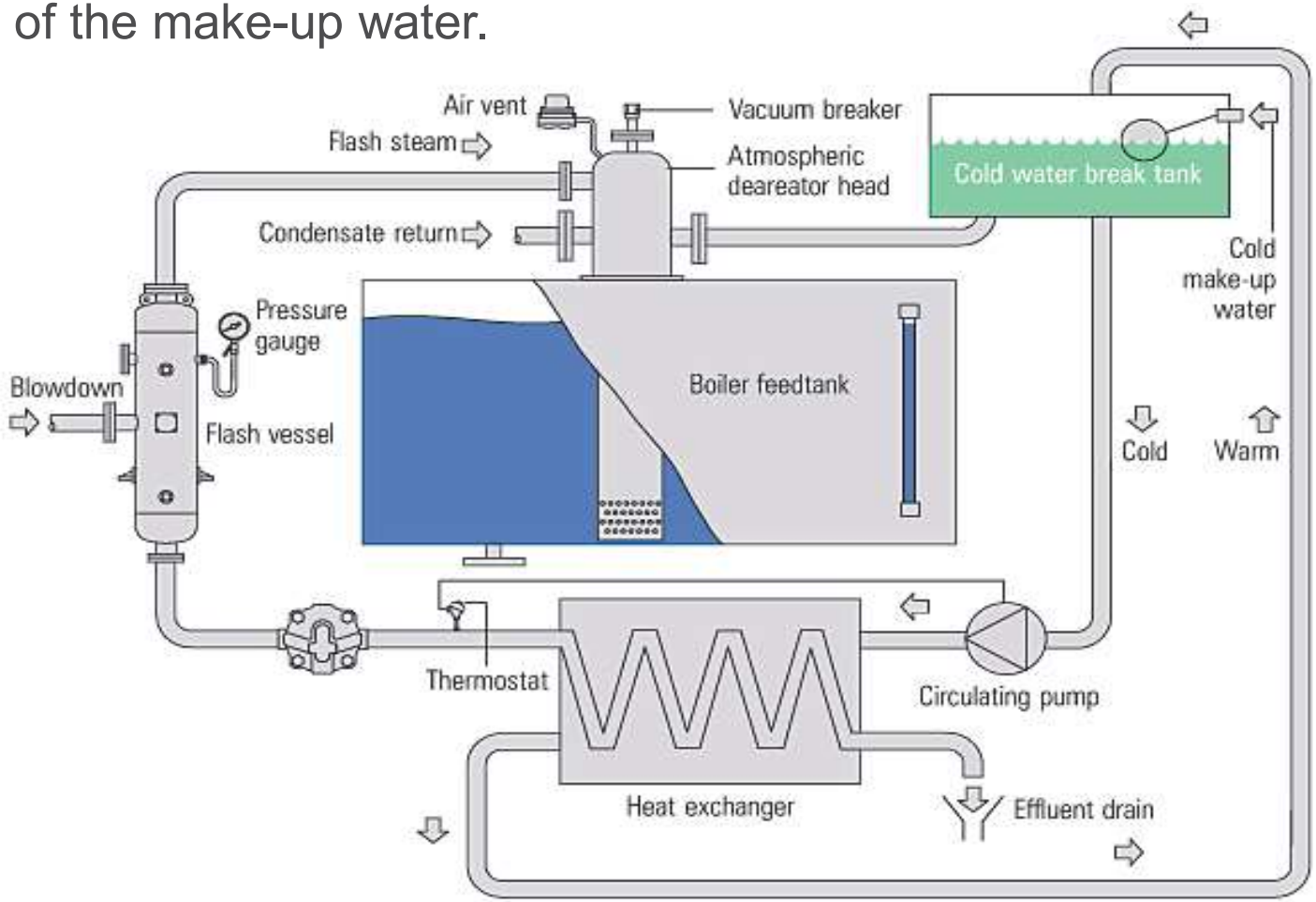


Example of an installed automatic blowdown that is no longer functional due to poor maintenance.

Example of a poorly time-regulated boiler blowdown. The regulation was set-up (15 seconds every 30 minutes) before the installation of the reverse osmosis system (i.e. when the make-up water was very hard water from an underground aquifer). This was not corrected when the reverse osmosis system was installed!

HEAT RECOVERY OF DISCHARGED CONDENSATE/BOILER BLOWDOWN

None of the inspected plants had installed heat recovery systems from the discharge of steam condensate and/or boiler blowdown. This heat can be used either for preheating the make-up water or directly in plant processes. Furthermore, flash steam from the boiler blowdown can be used for the de-aeration of the make-up water.

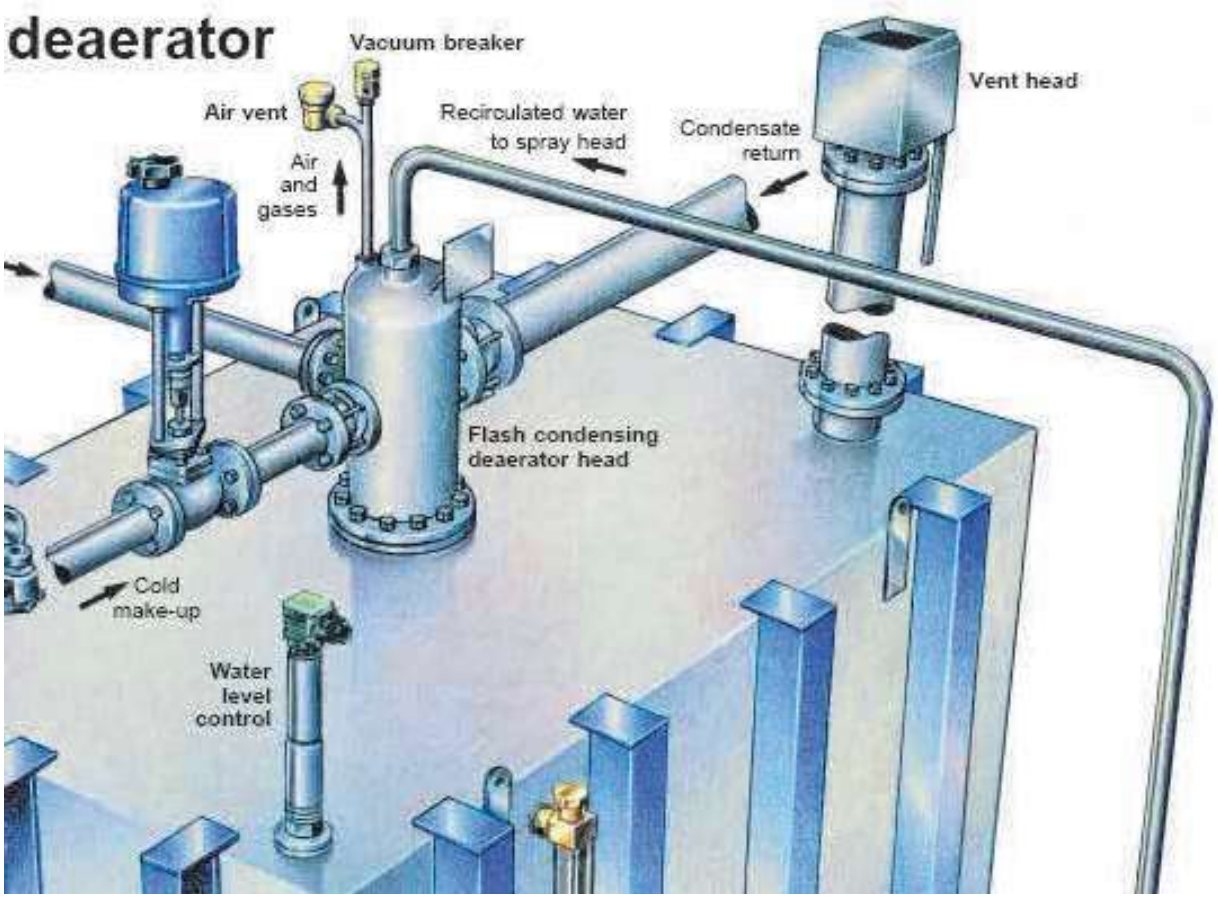


Example of the heat content of rejected condensate not being used. The condensate resulting from the use of steam in the expansion of Polystrene in moulding machines is rejected due to the chemical impurities contained within.

Example of the heat content of boiler blow down not being used. This example concerns one of the inspected plants without an installed reverse os system with more frequent boiler down.

DEAERATION OF MAKE-UP WATER

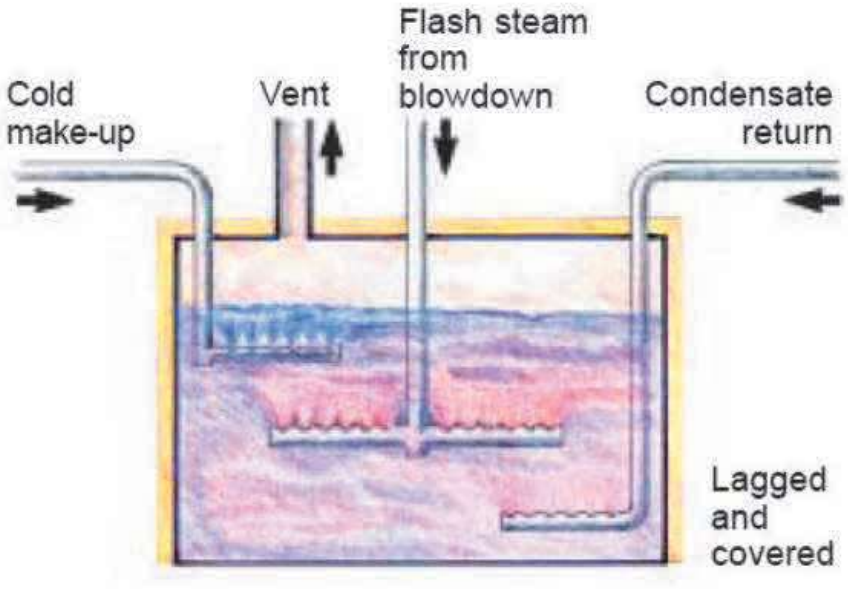
Only in 10% of the inspected plants is flash steam from boiler blowdown and condensate return used to de-aerate the make-up water using flash condensing deaerator heads.



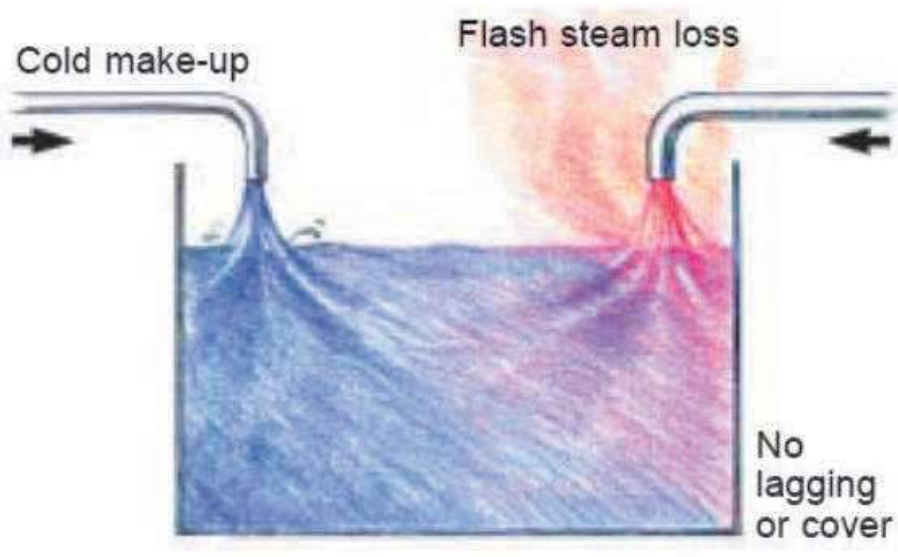
Instead, chemical deaeration is used. This is an alternative that is less environmentally friendly, more expensive and logistically more complex.

STEAM CONDENSATE TANK

In 50% of the inspected plants the steam condensate tanks were inadequately designed.



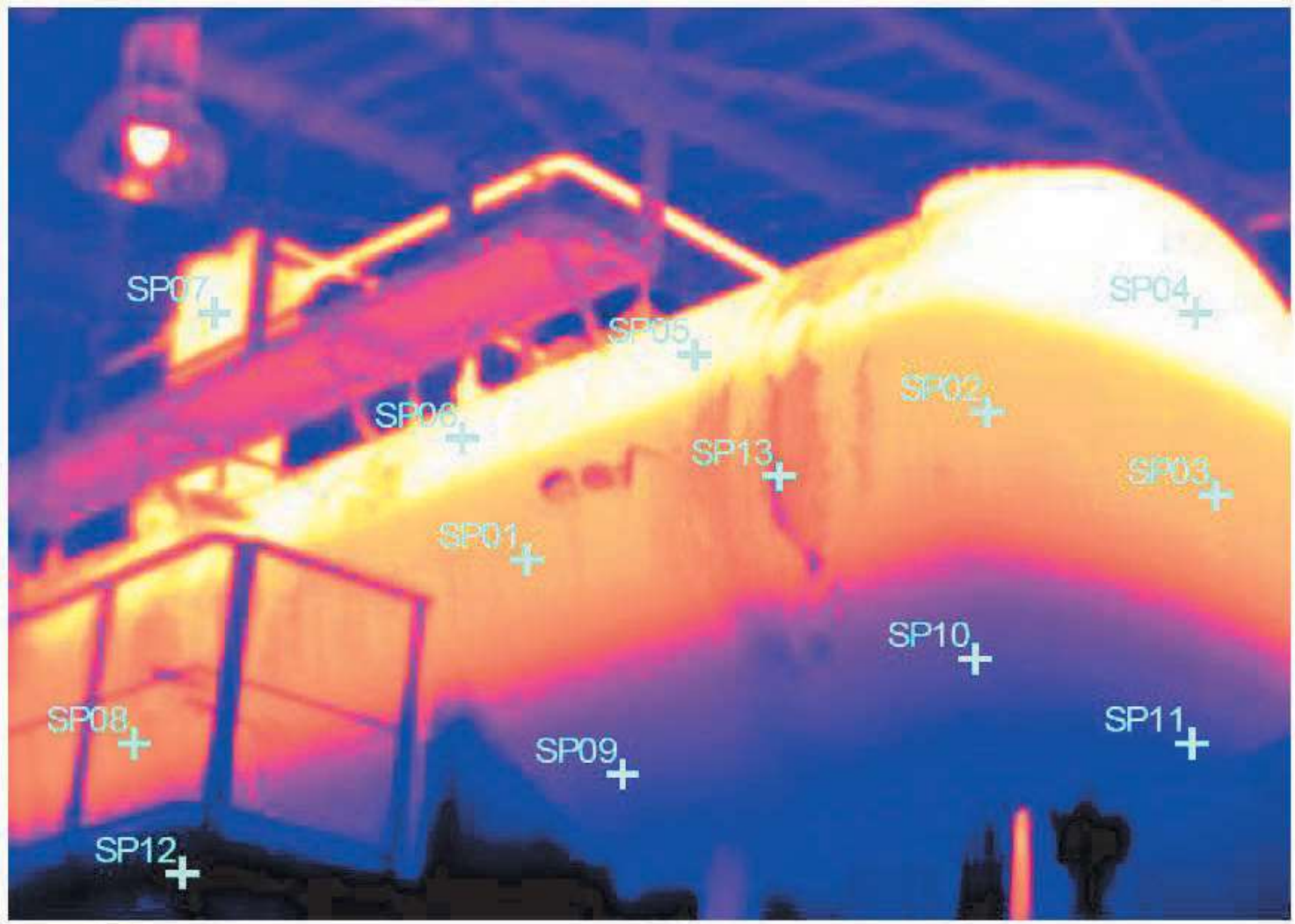
Good Practice



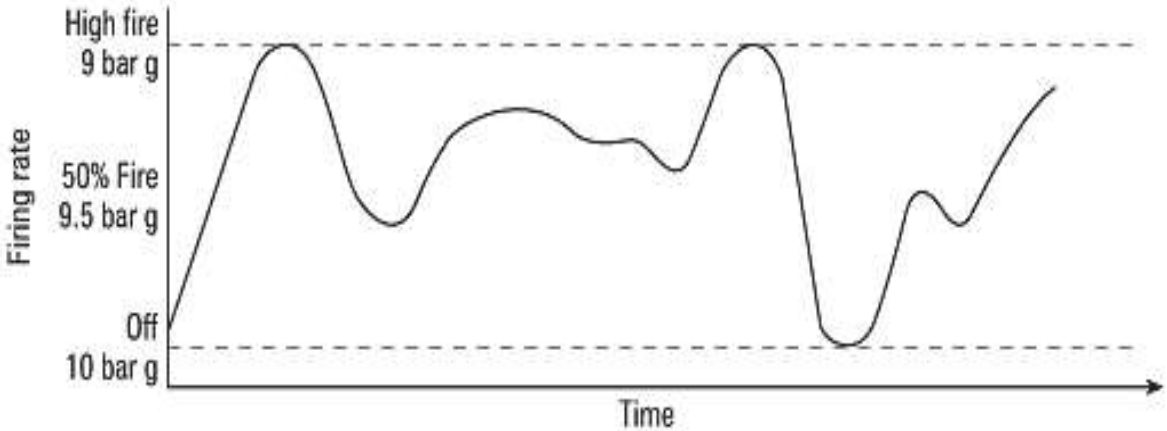
Bad Practice

Examples of an inadequately designed condensate tank. In which the flash steam can be seen escaping the condensate tank.

Examples of an inadequately designed condensate tank. In which the make-up water is fed to the bottom of the tank and the condensate returns are fed to the top of the **uninsulated** tank. Feedwater to the steam boiler is drawn from the bottom of the tank.

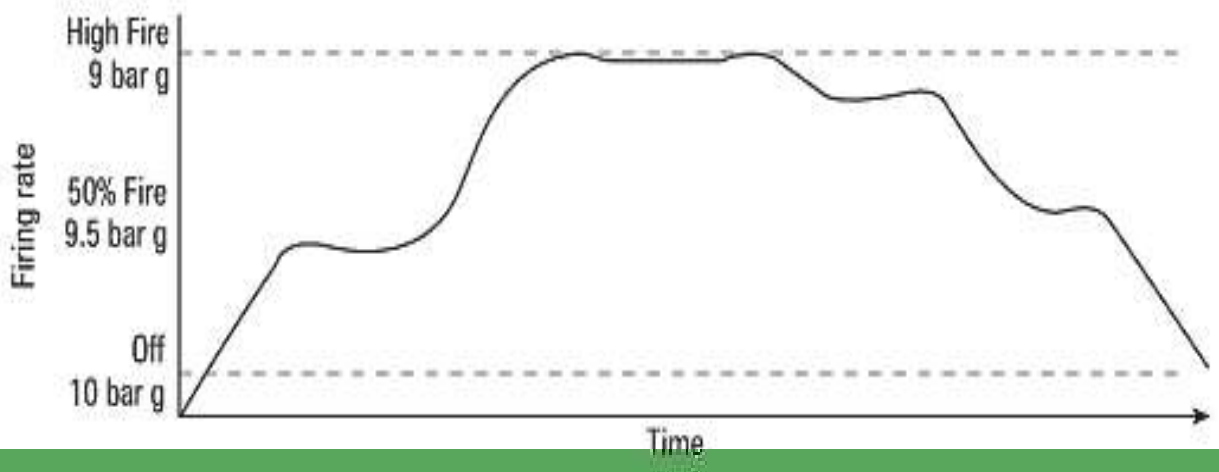


STEAM ACCUMULATOR



Steam boiler operation without an accumulator

Only 20% of the inspected plants had installed steam accumulators.



Steam boiler operation with an accumulator

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