

# Water treatment for Fire Tube Steam Boilers



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Steam is a commonly used process fluid because of its **excellent heat exchange properties**.

**It represents a strategic component within industry for:**

- ❑ The heating phases of processes
- ❑ Equipment cleaning applications

**Steam is produced using a steam generator:**

- **Fire tubes (low pressure < 30 bar)**
- Water tubes (medium and high pressure)



... in the industries

| Sector                        | Applications                                                                 |
|-------------------------------|------------------------------------------------------------------------------|
| Collective – public buildings | Laundry<br>Steam humidificator                                               |
| Brewerie                      | Pasteurisation, heating the TOD<br>Cleaning of bootling line, TOD...         |
| Dairies                       | Pasteurisation, heating the preparation tank<br>Disinfecting operations .... |
| Textile, Laundry              | Heating washing water<br>Propulsion<br>Dye                                   |
| Sugar Industry                | Evaporators                                                                  |
| Cosmetics                     | Heating and cleaning process reactors                                        |
| Energy                        | Turbines                                                                     |

# 1 > Steam generator system

## 5. Addition of fresh water

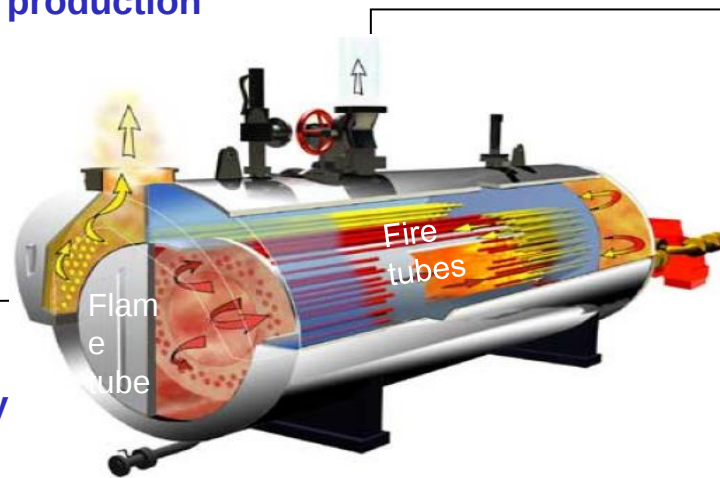
Make-up water

feedwater tank



1. Water supply

2. Steam production



Boiler with fire tubes

3. Distribution and use of the steam

PROCESS

Waste steam

4. Condensate recovery



## The system's inherent risks:

- ☐ High temperatures and pressure
- ☐ Materials: black steel

## The quality of raw water:

- ☐ dissolved minerals: cations, anions.
- ☐ gases: O<sub>2</sub>, N<sub>2</sub>, CO<sub>2</sub>.
- ☐ suspended matter (MES)

**3 adverse conditions may be expected**

## 3 adverse conditions

| Adverse conditions                                                         | Causes                                                                                                                                                                                                                                                                 | Location of the risk              | Consequences for the system:                                                                                                                                                                                                                  |
|----------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Carry-over</b><br>distillation of drops of water during the steam phase | <ul style="list-style-type: none"><li>• Water level too high</li><li>• Demand for steam &gt; the boiler's capacity (drawing from the body of water)</li><li>• Excessive level of mineral salts</li><li>• Presence of loose silt</li><li>• Poor boiler design</li></ul> | Boiler                            | <ul style="list-style-type: none"><li>• Reduction in the steam's heat transfer coefficient</li><li>• Pollution of steam rendering it unfit for use</li><li>• Encrustation by mineral salts on the steam and condensate return lines</li></ul> |
| <b>Scaling</b>                                                             | <ul style="list-style-type: none"><li>• Presence of hardness in the feedwater</li><li>• Excessive level of mineral salts</li></ul>                                                                                                                                     | Boiler – surface of fire tubes    | <ul style="list-style-type: none"><li>• Loss of energy</li><li>• Corrosion</li><li>• Overheating phenomenon</li><li>• Deformation of materials</li></ul>                                                                                      |
| <b>Corrosion</b>                                                           | <ul style="list-style-type: none"><li>• Dissolved oxygen</li><li>• Excessive levels of strong acid salts</li><li>• Acid / alkaline pH</li><li>• Acidification of condensates</li></ul>                                                                                 | Tank<br>Boiler<br>Condensate line | <ul style="list-style-type: none"><li>• Leaks</li><li>• Loss of energy</li><li>• Damage to equipment</li></ul>                                                                                                                                |

# Objectives of the treatment programme

- To guarantee optimum steam quality
- To keep exchange/transfer surfaces clean  
(preservation of heat transfer coefficients on the surface of fire tubes and at steam / re-heated fluid exchangers).
- To protect the installation against corrosion

**Control the quality of make-up water**

**Maintain a quality of water appropriate to its use in steam generators**

|                                      | < 10 bar                                                                                                                               | 10-15 bar        | 15-25 bar        | 25-35 bar        |
|--------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|------------------|------------------|------------------|
| <b>Eau d'alimentation</b>            |                                                                                                                                        |                  |                  |                  |
| pH                                   | ≥ 8,5                                                                                                                                  | ≥ 8,5            | ≥ 8,5            | ≥ 8,5            |
| TH (°f)                              | < 0,5                                                                                                                                  | < 0,5            | < 0,2            | < 0,1            |
| O <sub>2</sub>                       | Elimination physique de l'oxygène dissous par dégazage thermique et/ou utilisation de réactifs réducteurs ou inhibiteurs de corrosion. |                  |                  |                  |
| <b>Eau de chaudière</b>              |                                                                                                                                        |                  |                  |                  |
| pH                                   | 10 à 12                                                                                                                                | 10 à 12          | 10 à 12          | 10 à 12          |
| TH (°f)                              | < 0,5                                                                                                                                  | < 0,5            | < 0,2            | < 0,1            |
| TAC (°f)                             | ≤ 120                                                                                                                                  | ≤ 100            | ≤ 80             | ≤ 40             |
| TA (°f)                              | 0,5 à 0,8<br>TAC                                                                                                                       | 0,5 à 0,8<br>TAC | 0,5 à 0,8<br>TAC | 0,5 à 0,8<br>TAC |
| SiO <sub>2</sub> (mg/l)              | < 200                                                                                                                                  | < 200            | < 150            | < 40             |
| SiO <sub>2</sub> (mg/l)/TAC (°f)     | ≤ 2,5                                                                                                                                  | ≤ 2,5            | ≤ 2              | ≤ 1              |
| Conductivité (µS/cm)                 | ≤ 10000                                                                                                                                | ≤ 8000           | ≤ 6000           | ≤ 4000           |
| Cl <sup>-</sup> (mg/l ou °f)         | ≤ 800 ou<br>112                                                                                                                        | ≤ 600 ou 85      | ≤ 400 ou<br>56   | ≤ 200 ou 28      |
| PO <sub>4</sub> <sup>3-</sup> (mg/l) | ≥ 30                                                                                                                                   | ≥ 30             | ≥ 30             | ≥ 20             |
| Sulfites (mg/l)                      | ≥ 30                                                                                                                                   | ≥ 30             | ≥ 30             | ≥ 30             |

## Control the quality of the Feed Water

### 1/ Limit contents of minerals

- Enhance Concentration rate
- Savings in water, energy and chemicals

For highly mineralised raw water :

Conductivity > 500  $\mu\text{S/cm}$   
Chlorides > 100 ppm  
Silica > 30 ppm

**Target :**  
Cond. = 6000  $\mu\text{S/cm}$   
TAC : 120 °F  
Cl- = 800 ppm  
SiO<sub>2</sub> : 200 ppm

**Reverse Osmosis Unit**

### 2/ Hardness Removal

- Prevent scale

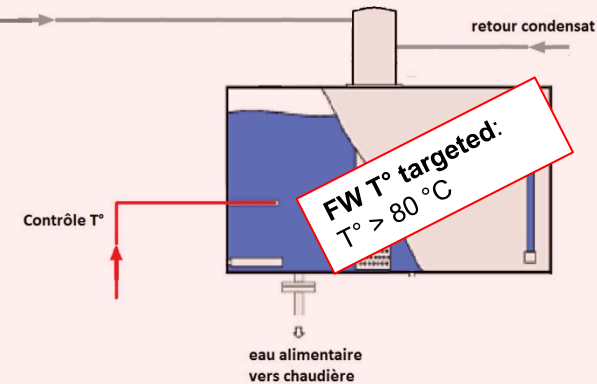
For every raw water quality !

(osmosed as well)

**Target on FW:**  
TH = 0 °F

**Softeners**

### 3/ FW heating



- Reduce O<sub>2</sub> concentration
- Prevent thermal chocs

For every raw water quality !

**FW TANK**

## Conditioning / control the quality of the boiler's water

**1/ Limit the concentration of the minerals**

**Limit the carryover phenomenon**

→ Continuous bleeding – high level

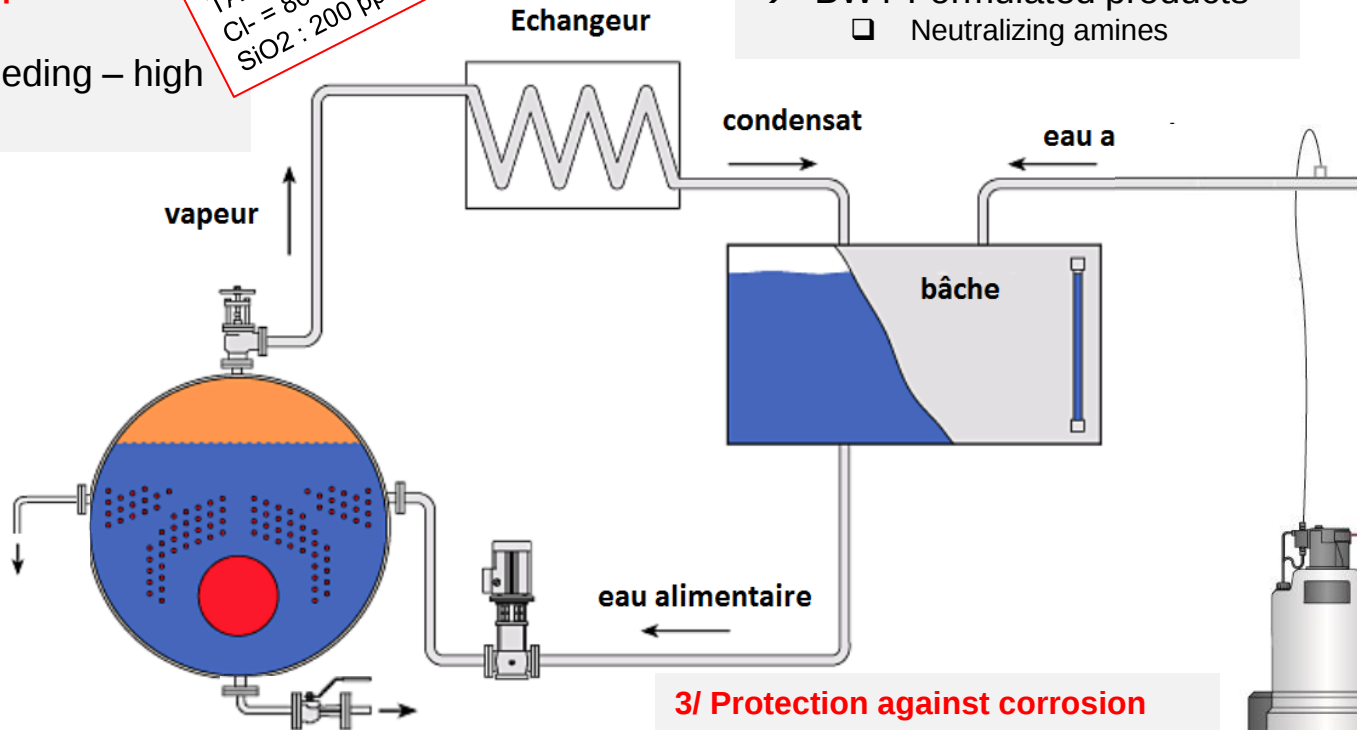
**Target :**  
Cond. = 6000  $\mu\text{S/cm}$   
TAC = 120 °F  
Cl<sup>-</sup> = 800 ppm  
SiO<sub>2</sub> = 200 ppm

**4/ anti-corrosion for Condensate line (if carbon steel)**

→ BWT Formulated products

☐ Neutralizing amines

**Target on condensate:**  
pH : 8,5 - 9



**2/ Sludges removal**

→ Bottom extractions

**Target :**  
Clear water

**3/ Protection against corrosion and deposits**

→ BWT Formulated products

- Oxygen scavengers
- Passivating agents
- Alcalinizer
- Dispersing agents

**Targets :**  
Sulfites: 20 – 50 ppm  
Phosphates: 20 – 50 ppm

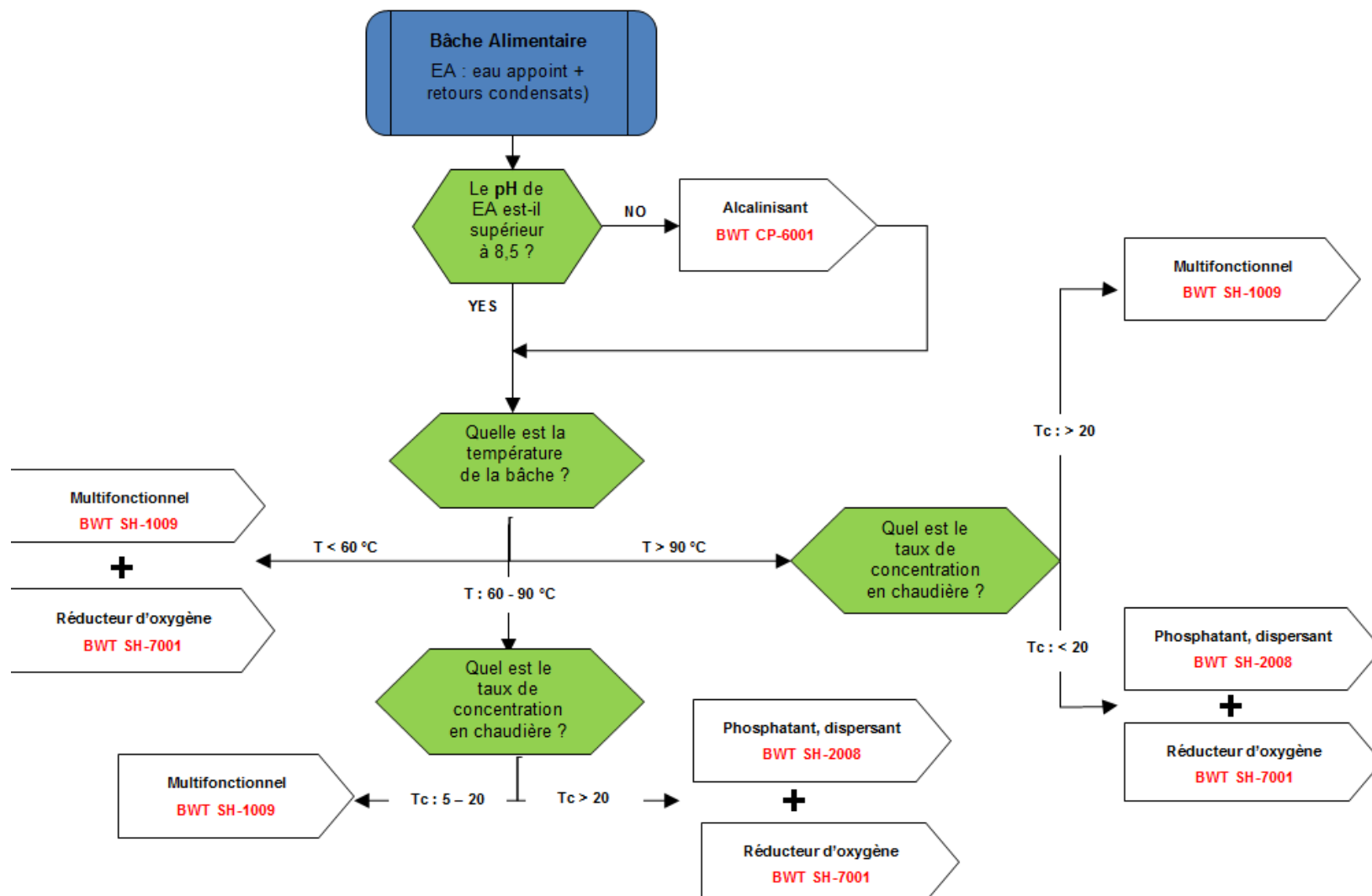
## 4. Water conditioning: Formulated products

### Range of BWT's formulated products – LP & MP Boilers

| Role                                 | BWT product code | Type of action                                                                                                  | Dose:                                                                                                                                                       |
|--------------------------------------|------------------|-----------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Multi-purpose                        | BWT SH-1009      | <ul style="list-style-type: none"> <li>Oxygen reducer</li> <li>Phosphating agent</li> <li>Dispersant</li> </ul> | 20 -100 ppm<br>(depending on the feedwater tank T° – as a multi-purpose product<br>Depending on the residual phosphates if combined with an oxygen reducer) |
|                                      | BWT SH-1001      | <ul style="list-style-type: none"> <li>As for SH-1009</li> <li>+ alkalinising agent</li> </ul>                  |                                                                                                                                                             |
| Alkalinising agent                   | BWT CP-6001      | <ul style="list-style-type: none"> <li>alkalinising agent</li> </ul>                                            | 10 – 50 ppm<br>(depending on the feedwater pH)                                                                                                              |
| Oxygen reducer                       | BWT SH-7001      | <ul style="list-style-type: none"> <li>Sulphites</li> </ul>                                                     | 10 – 80 ppm<br>(depending on the feedwater tank T°)                                                                                                         |
|                                      | BWT SH-7007      | <ul style="list-style-type: none"> <li>Sulphites</li> </ul>                                                     |                                                                                                                                                             |
| Dispersant                           | BWT SH-2010      | <ul style="list-style-type: none"> <li>Polymers</li> </ul>                                                      | 5 – 20 ppm<br>(depending on the concentration level)                                                                                                        |
| Anti-entrainment agent               | BWT SH-4001      | <ul style="list-style-type: none"> <li>Surfactants</li> </ul>                                                   | 5 – 20 ppm<br>(depending on the concentration level)                                                                                                        |
| Condensate line corrosion prevention | BWT SH-7014      | <ul style="list-style-type: none"> <li>Neutralizing amines</li> </ul>                                           | 5 – 15 ppm<br>(depending on the boiler water complete alkalinity titration)                                                                                 |

## 4. Selection Guide

For You and Planet Blue.



## 4. Water conditioning: Formulated products

For You and Planet Blue.



**Range of BWT's formulated products – low pressure and medium pressure boilers**



BWT PERMO has developed a range of products, which are approved for use in the production of food grade steam

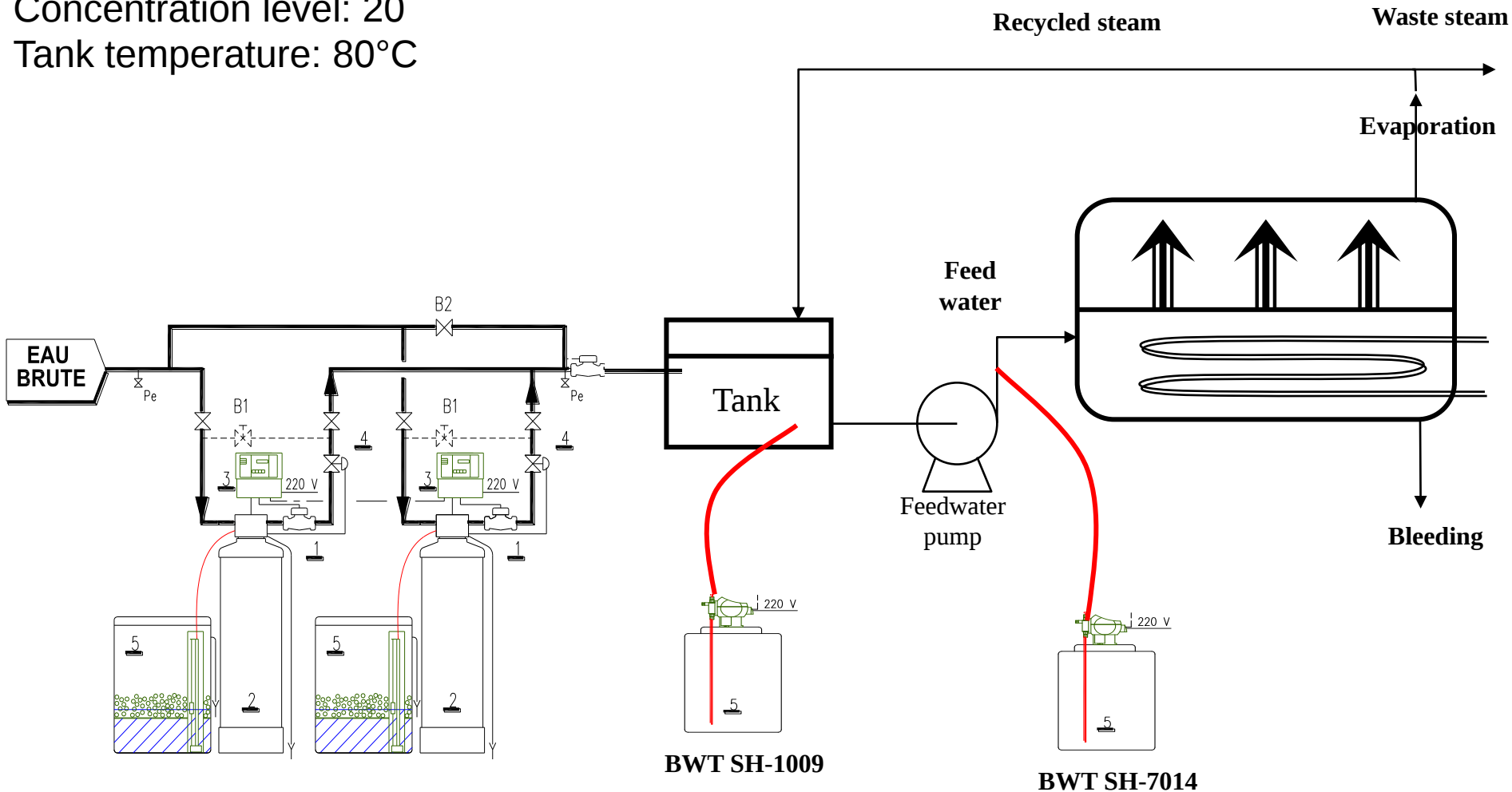
(ref. FDA 21-173.310)



**In the dairy industry, no treatment of the steam phase is tolerated.**

**For You and Planet Blue.** | **BWT**  
BEST WATER TECHNOLOGY

Raw water = borehole water (Th = 20°F)  
Concentration level: 20  
Tank temperature: 80°C



## 4. Water conditioning: Formulated products

For You and Planet Blue.



### Treatment monitoring



#### Analytical monitoring:

Sampling points

Laboratory equipment and reagents

Monitoring frequency



#### Monitoring consumption of BWT's formulated products:

reagent container level reading

make-up water meter reading

| Paramètres   | avant adoucisseur | Eau adoucie      | Bâche alimentaire | Eau de chaudière | retour condensats |
|--------------|-------------------|------------------|-------------------|------------------|-------------------|
| pH           | 1 fois / semaine  | 1 fois / semaine | 1 fois / jour     | 1 fois / jour    | 1 fois / jour     |
| Conductivité | 1 fois / semaine  | 1 fois / semaine | 1 fois / jour     | 1 fois / jour    | 1 fois / jour     |
| TH           | 1 fois / jour     | 2 fois / jour    | 1 fois / jour     | 1 fois / jour    | -                 |
| TA           | -                 | -                | 1 fois / jour     | 1 fois / jour    | -                 |
| TAC          | -                 | -                | 1 fois / jour     | 1 fois / jour    | -                 |
| Chlorures    | 1 fois / semaine  | 1 fois / semaine | 1 fois / semaine  | 1 fois / semaine | 1 fois / semaine  |
| Silice       | 1 fois / semaine  | 1 fois / semaine | 1 fois / semaine  | 1 fois / semaine | -                 |
| Phosphates   | -                 | -                | -                 | 1 fois / jour    | -                 |
| Sulfites     | -                 | -                | -                 | 1 fois / jour    | -                 |
| Fer          | 1 fois / semaine  | 1 fois / semaine | 1 fois / semaine  | 1 fois / semaine | 1 fois / semaine  |

The interpretation of results enables the corrective actions to be implemented to be defined (pre-treatment, bleeding, dosing pump settings).

## 4. Water conditioning: Formulated products

For You and Planet Blue.



### Technical data to be gathered from the client

#### ☐ Quality of make-up water

CONDUCTIVITY, TH, COMPLETE ALKALINITY TITRATION, CHLORIDES, SILICA  
% RETURNED CONDENSATE IN THE FEEDWATER TANK

#### ☐ The system's characteristics

|                                    | unit | Boiler 1 |
|------------------------------------|------|----------|
| Boiler make                        |      |          |
| Capacity                           | T/h  |          |
| Operating pressure                 | bar  |          |
| Feedwater tank temperature         | °C   |          |
| Presence of a thermal deaerator    |      |          |
| Materials - Boiler                 |      |          |
| Materials - Tank                   |      |          |
| Materials - Condensate return pipe |      |          |

→ Drafting of the technical proposal

# Your strengths:

For You and Planet Blue.



## Being able to offer



Formulated  
products



Equipment



Service and  
spare parts

## While being



Competitive



Environmentally  
conscious



Innovative



For You and Planet Blue.



Country: Tunisie  
Agent: THERMECATEX (team)  
Customer Activity: Oil refinery

#### Données clients:

2 chaudières 20 T/h – Pression 15 bars  
Eau alimentaire: eau de ville adoucie / 20% de condensat

T° bêche: 80°C

Matériaux: Acier noir

#### Traitement proposé :

- $T_c = 12$
- Multifonctionnel:  
BWT SH-1009 : 70 g/m<sup>3</sup>
- Anticorrosion ligne condensat:  
BWT SH-7014: 10 g/T de vapeur

#### Annual Consumption:

19 T BWT SH-1009

2,5 T BWT SH-7014

C.A.: 60 k€

Return

