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1 Scope of the Operating Instructions

These Operating Instructions contain basic information. They apply in combination with the following operating instructions:

- A002 Basic Safety Instructions
- B002 Guideline on water characteristics for steam boilers
- B004 Guideline on water characteristics for hot water boilers

For the operation of the system as a whole, the operating instructions for the individual components are binding along with the relevant statutory provisions and official requirements.

2 Use in Accordance with Regulations

Incoming oxygen from the air is corrosive in cooled boiler or system components which are not under pressure. Suitable measures therefore need to be taken. These Operating Instructions describe the basic principles for the conservation of boiler or system components with planned down times of > 1 week.

The operator of the plant, and not the manufacturer, is responsible for personal injury and material damage caused by use that is not in accordance with regulations.

3 Safety

Please read the Operating Instructions:

- A002 Basic Safety Instructions

4 Operating and Maintenance Staff

Please read the Operating Instructions:

- A002 Basic Safety Instructions

The personnel responsible for conservation must be familiar with handling the chemicals in question. The products must be handled with care. Personnel must be familiar with suitable first-aid measures.

5 General Risks and Accident Prevention

Please read the Operating Instructions:

- A002 Basic Safety Instructions

The conservation of boiler or system components, especially the wet conservation, is generally associated with the use of various chemicals.

It is vital that the precautionary measures according to the safety data sheets for the various chemicals used are followed, especially the references to the particular dangers and the advice on safety according to the Order on Dangerous Substances.



Attention! Failure to observe the regulations may cause damage to health and to the environment.

6 Description of Structure and Function / Description of Process

6.1 Wet conservation

Wet conservation is generally recommended when the down time is limited (generally in the range of > 1 week and < 3 months) and relatively fast restarting of the boiler or system components is required.

The wet conservation process is not suitable if there is a risk that the boiler or system components will be exposed to frost during the conservation period. In this case, the boiler or system components are to be dry conserved (see Section 6.2).

6.1.1 Conservation with the oxygen binder sodium sulphite (Na_2SO_3)

Sodium sulphite is added as an oxygen binder during conservation. The sulphite content in the conservation solution depends on the length of the down time and the nature of the filling water.



Important! Traditional sodium sulphite only reacts at temperatures above approx. 40°C. This is sufficient for dosing in normal boiler operation. For conservation, on the other hand, a special catalyzed Na_2SO_3 should be used which binds oxygen at low temperatures.

During the preservation time, the sulphite content should be checked regularly and corrected with subsequent doses if required; see section 6.1.5. In this case, see Table 1 for the guide values for the sulphite content.

Fill water	Dwell time	Sodium sulphite content mg Na_2SO_3 /l	pH value
Low salt or salt-free Water, condensate	1 week	20 - 50	10
Salted water	1 week	40 - 100	11 - 12

Table 1

If a regular check of the sulphite content is not possible during the preservation time, set higher excesses according to Table 2, subject to the planned preservation duration.



Note: Please note Higher levels of sodium sulphite may make it necessary to drain the water content before restarting.

Fill water	Dwell time	Sodium sulphite content mg Na_2SO_3 /l	pH value
Low salt or salt-free Water, condensate	1 week	20 - 50	10
	1 month	100 - 200	
	Longer than 1 month	200 - 500	
Salted water	1 week	40 - 100	11 - 12
	Longer than 1 week	400 - 1000	

Table 2

For filling the boiler or system components (see Section 6.1.4), deaerated filling water according to our Operating Instructions B002 Guideline on water characteristics, steam generator or B004 Guideline on water characteristics, hot water boiler should preferably be used. Non-deaerated water contains approx. 10 g O₂/m³ at 20°C. Since 1 g of air oxygen is bound by approx. 8 g standard commercial water-free sodium sulphite (pure substance), around 80 g Na₂SO₃ per m³ would need to be added in addition if non-deaerated water is used for filling.

Sodium sulphite is available in powder form or as a liquid solution. The powder, which generally has a Na₂SO₃ content of approx. 92-95%, must first be dissolved in the feed water or condensate (30-40°C). An approx. 10% solution should be used, i.e. 10 kg Na₂SO₃ to 90 l water. This must be carried out in a closed container, e.g. the existing dosing container. Otherwise, the sulphite could react with the oxygen in the air during the dissolving process and thus become ineffective.

The use of liquid products is less problematic, since they can also be added directly from the container without any need to produce a solution first. For this reason, the use of sodium sulphite in liquid form is recommended. The Na₂SO₃ solution may have a different Na₂SO₃ content, depending on the manufacturer. The composition as given in the product description should therefore be noted when determining the quantity to be added.



Important! If the boiler system has to be shut down, the operating and maintenance staff must be suitably informed of this. In addition, a sign is to be affixed to the system and to the switchgear cabinet if necessary which expressly points out that the system has been shut down and is thus not operational. This sign should also state the time when the system was shut down and the name of the person who is allowed to start the system up again or who may give the instructions for the start-up.

6.1.2 Setting up the necessary pH-value

If low-salt or salt-free filling water is used, the pH value must be at least 10, or at least 11-12 in the case of water containing salt. The necessary alkalinity can be achieved by adding trisodium phosphate and/or soda lye.

6.1.3 Use of other dosing agents

In addition to sodium sulphite, other dosing agents are available on the market which are recommended by the manufacturers for conservation. These are generally strong oxidation agents, such as ascorbates or carbohydrazides.

Because of the suspicion that it may be carcinogenic and the associated official requirements laid down for its use, hydrazine is generally no longer used for boiler conservation.

If dosing agents other than sodium sulphite are used, the instructions for use and safety recommendations issued by the manufacturer must be noted in any case. The manufacturer offers no guarantee that these products are suitable or effective.

6.1.4 Carrying out the conservation

The following instructions apply in general for boiler or system components. The product-specific instructions for carrying out conservation are described in detail in the Operating Instructions for the individual boiler or system components.

Before conservation, the boiler or system component must first be emptied and checked for existing corrosion. After this, the boiler or system component must be completely refilled with water.

Filling must be carried out using prepared water in accordance with our Operating Instructions B002/B004 Guideline on water characteristics, to which a sufficient quantity of dosing agent is added (see Sections 6.1.1 and 6.1.2).

All valves on the boiler or system component must then be closed tightly to prevent any penetration of air-borne oxygen during the down time.



Important! The boiler or system component should only be sealed off once it has cooled down completely in order to avoid negative pressure.



Important! With longer down times, the water content should be checked regularly (1 x week) to see that the pH is sufficient and that there is surplus oxygen binder, and topped up if necessary.



Note: If there are no shut-off valves at the incoming and outgoing outlets of the boiler or system component, it will be necessary to close these connections tightly using blanking plates, in the case of flange connections, or screw plugs, in the case of threaded connections.



Note: If the wet preservation is carried out at outside temperatures of $< 3^{\circ}\text{C}$, suitable frost protection should be provided in the boiler house.

6.1.5 Measures during the down time

Analyse the preservation solution weekly for sodium sulphite excess (or the relevant excess if using a different dosing agent) and the pH value. If the Na_2SO_3 excess drops below the lower limit according to the table above, add an additional dose of sodium sulphite. If the pH value drops, add an additional dose of alkalising agent.

To determine the sulphite surplus, you should use the special test sets or test strips for rapid testing recommended by the manufacturers of the dosing agents (e.g. sulphite test made by Merck). The pH can be measured with a measuring device or simple litmus paper.

According to the product-specific instructions for carrying out preservation in the operating instructions for the individual boiler or system components, the preservation solution should be circulated regularly.

6.2 Re-connexion after conservation

The following instructions apply in general for boiler or system components. The product-specific instructions for carrying out conservation are described in detail in the Operating Instructions for the individual boiler or system components.

The volume of preserving agent added may mean the salt content of the preservation solution is too high for regular operation, especially if the sulphite content is as in Table 2. Before restarting therefore, ensure that the levels given in operating instructions B002/B004 directive on water quality are maintained. In addition, it may be necessary to partially or fully drain the water content.

After this, the system is to be refilled with prepared, suitably treated water and restarted as for a cold start.

When the conservation solution is drained off, the local regulations for draining waste water into the sewerage system must be followed.

6.3 Dry conservation

Dry conservation processes are generally used with longer down times (> 3 months) if the boiler or system components do not need to be started up again at short notice or wet conservation is not possible, because of the danger of frost, for example.

6.3.1 Overview of drying agents

The easiest drying agents to handle are bags of drying agent with a defined absorption capacity (drying agent unit).

- Silica gels are suitable for use as drying agents. Silica gels with an indicator dye are reliable in use. A change in the colour shows that the absorption capacity of the material is exhausted.



Attention! The particularly well-known blue gel should not be used any more! Its blue indicator dye, cobalt dichloride, has been classified as a Category 2 carcinogen and must be labelled with the danger phrase 49 (R phrase) "Can cause cancer if inhaled".

- As a rule, silica gels with safe moisture indicators free from heavy metals, e.g. silica gel orange.
- It is also possible to use simple silica gel without a moisture indicator. To check its absorption capacity, there are indicator cards which can be attached to the drying agent bags. These also change colour to show that the absorption capacity is exhausted.
- Activated clay (bentonite) is also a suitable drying agent. There are also special indicator cards for this product.
- Other drying agents include, for example, calcium chloride and calcium oxide. However, since these are problematic to handle, we advise against using them.

Dosage:

Approx. 500 g silica gel or 600 g drying clay, which is 16 drying agent units, as they are called, should be used per cubic metre of the volume to be dried. Drying agent bags are available in standardised sizes, containing 16, 32 or 80 drying agent units.

6.3.2 Carrying out the conservation

The Boiler or system components must be emptied completely. This should be carried out still in the warm (approx. 70 - 80 °C) state if possible, so that the residual moisture is evaporated by the warmth still stored in the material.

If the residual warmth is not enough to evaporate the moisture, drying out can be supported by blowing in warm air.

It is essential that any coatings in which moisture could be bound or salt deposits must be removed before the preservation measures.



Important! Drying agents are generally only suitable for the absorption of water in vapour form. Drying agents may decompose if brought into contact with liquid water.

When the inside of the Boiler or system components is dry, flat containers filled with a drying agent are placed in the system. The system is then sealed. The drying agent container should be positioned in such a way that no enclosed cavities can form underneath them.

All valves on the boiler or system component must then be closed tightly to prevent any penetration of air-borne oxygen during the down time.



Note: If there are no shut-off valves at the incoming and outgoing outlets of the boiler or system component, it will be necessary to close these connections tightly using blanking plates, in the case of flange connections, or screw plugs, in the case of threaded connections.

6.3.3 Measures during the down time

If the drying agent is exhausted, it can generally be regenerated by heating (at 110 - 140°C, depending on product, please follow manufacturer's instructions). However, the absorption capacity is not completely restored in regeneration. It will be approx. 90% of the original capacity.

The state of the drying agent should be checked every month, or every one to two weeks at the start of preservation. If the unit has to be opened, and humidity from the air thus, the drying agent must be regenerated before the unit is closed again, or fresh drying agent should be used.

It is also possible to use moisture indicators with a small viewing window which can be screwed into a threaded connection piece, thus allowing monitoring from outside. However, there is a risk that these indicators are not representative, since they are situated a long way from the drying agents, in a connection without air circulation.

6.4 Re-connexion after conservation

After the down time, the drying agents are removed and the system is checked for corrosion. Any blanking plates, with flange connections, or screw plugs, in the case of threaded connections, are to be removed. The procedure is then the same as for the initial start-up of the boiler or system component.



Note: The competent monitoring organisation should be consulted beforehand to clarify whether a new acceptance procedure is necessary. The instructions in the safety data sheet should be followed with regard to disposal of the drying agents.

6.5 Alternative methods

In principle, it is possible to fill the boiler after emptying with nitrogen or ammonia and in this way to expel the oxygen in the air, which promotes corrosion, from the boiler. Ammonia will also ensure that any residual moisture left in the boiler becomes alkaline. However, because of the large boiler capacities, large volumes of gas are required. With nitrogen in particular, the oxygen content must be < 0.1%. This ultra-pure nitrogen is generally very expensive.



Warning! Ammonia is highly toxic! The presence of ammonia can be detected by its characteristic odour. Before any inspection, the boiler or system components and installation area must be thoroughly ventilated.



Warning! Nitrogen has no smell. During any internal inspection of the boiler or system components, there is a risk of suffocation if there are still pockets of nitrogen in the boiler or system components. The oxygen content must therefore be checked before entering the boiler or system components if this method is used.

7 Technical Data (Dimensions, Weight, Operating Conditions)

The technical data for the oxygen binders are given in the relevant manufacturer's information sheets and safety data sheets.

8 Transport and Storage

Oxygen binders are supplied in closed containers. Unopened, liquid products can be stored for up to 1 or 2 years, depending on manufacturer. Powder products can generally be kept for several years in unopened sacks that are stored in a dry place.

After opening, there is a risk that the products may react with oxygen in the air, thus reducing their effectiveness. For this reason, liquid oxygen binders in particular can generally only be stored for a limited period after opening, and should be used as quickly as possible. Products in powder form may become unusable after opening due to the effect of the humidity in the air.

Chemicals should generally be stored at ambient temperature, at temperatures not higher than 40°C and not below freezing point.

In general, the recommendations provided by the relevant manufacturer should be followed for storage.

9 Setting and Adjustment

You should use the measurement equipment provided by the chemicals suppliers to regularly check the surplus oxygen binder and the pH.


10 Measures in the event of unusual observations and operating faults

If anything unusual is observed and/or operating faults are displayed, the following table provides initial information on repair:



Observation/fault: Surplus oxygen binder too low when measured (with wet conservation)		
Cause	Repair	By whom?
Supplementary dosage too low	Increase dosage of chemicals	
Oxygen has leaked in	Check the leak tightness of all devices that seal the boiler or system components off from its surroundings	

Wet and Dry Conservation

Observation/fault: pH too low (with wet conservation)

Cause	Repair	By whom?
Dosage too low	Add more alkalisation agents	

Observation/fault: Discoloration of Contents water (with wet conservation)

Cause	Repair	By whom?
Oxygen leakage, corrosion	Check the leak tightness of all devices that seal the boiler or system components off from its surroundings	
	Increase dosage of chemicals	
	Check circulation process	