ROTARY FILM DEAERATOR

Operation and Maintenance Instruction Manual

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Contents

1.Equipment Overview

1.1 Equipment Purpose and Principle

The rotary film deaerator is one of the important auxiliary machines in the regenerative system. Its main function is to remove non-condensable gases such as oxygen and carbon dioxide from softened water using Henry's Law and Dalton's Law. Additionally, it heats the softened water to the saturation temperature at the operating pressure of the deaerator. The heating steam comes from turbine extraction and other sources of exhaust steam or high-temperature condensate, thereby improving the thermal economy of the system. Saturated water with standard oxygen content is stored in the deaerator's water tank to meet the boiler's needs at any time, ensuring safe operation of the boiler.

1.2 Structural Characteristics

The rotary film deaerator consists of two sections: the rotary film section and the packing section.

1.2.1 The boiler feedwater from the low pressure first enters the deaerator's water chamber. Due to a certain pressure differential, the water is injected through the inlet holes into the film spray nozzle, where it immediately spirals down along the inner wall of the nozzle, forming a hollow rotating water film skirt at the outlet of the film pipe. The inner and outer surfaces of the water film skirt come into full contact with the heating steam, instantly heating the water to the saturation temperature. The vast majority of non-condensable gases are rapidly

released, with the rotary film section achieving approximately 90% initial deaeration.

1.2.2 The water that has been initially deaerated is evenly distributed to the packing layer by a distributor. In the packing layer, the water is further separated into a film-like form, significantly reducing its surface tension, and allowing sufficient residence time for contact with superheated steam. The residual oxygen in the water is further released in the packing layer, ensuring that the oxygen content of the water leaving the deaerator meets standard requirements. Thus, the packing section is referred to as the deep deaeration section.

1.2.3 The oxygen and carbon dioxide removed from both the rotary film and packing sections rise uniformly to the exhaust pipe at the top of the deaerator and are discharged into the atmosphere. The deaerated water that meets the requirements accumulates in the deaerator's water tank, ready to satisfy the boiler feedwater needs at any time.

1.3 Equipment Parameters

Refer to the "Technical Characteristics Table" in the accompanying drawings.

1.4 Equipment Outline Diagram

Refer to the accompanying drawings.

2.Equipment Description

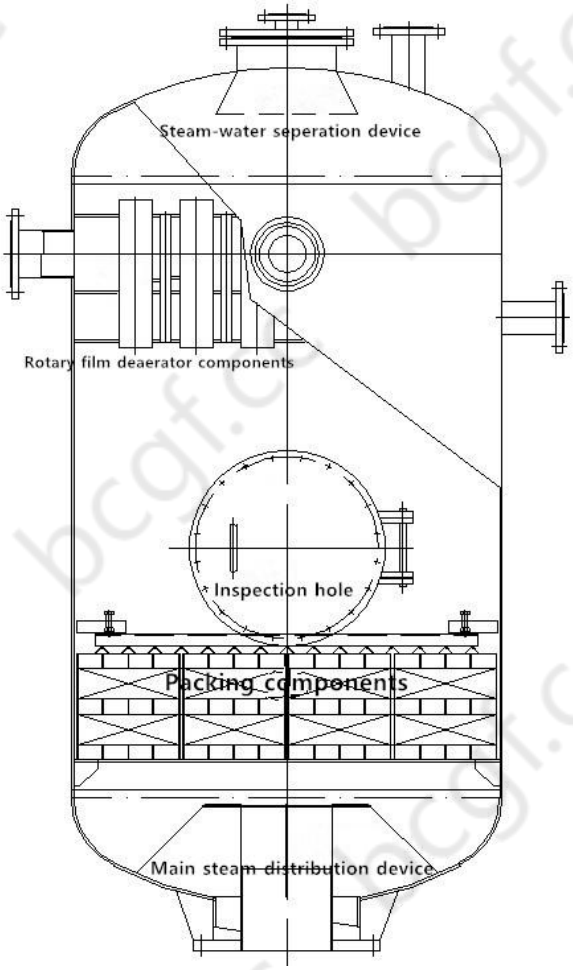
2.1 Structural Layout Description

The main components of the heater include: deaeration head, deaerator water

tank, and supports.

1). **Deaeration Head**

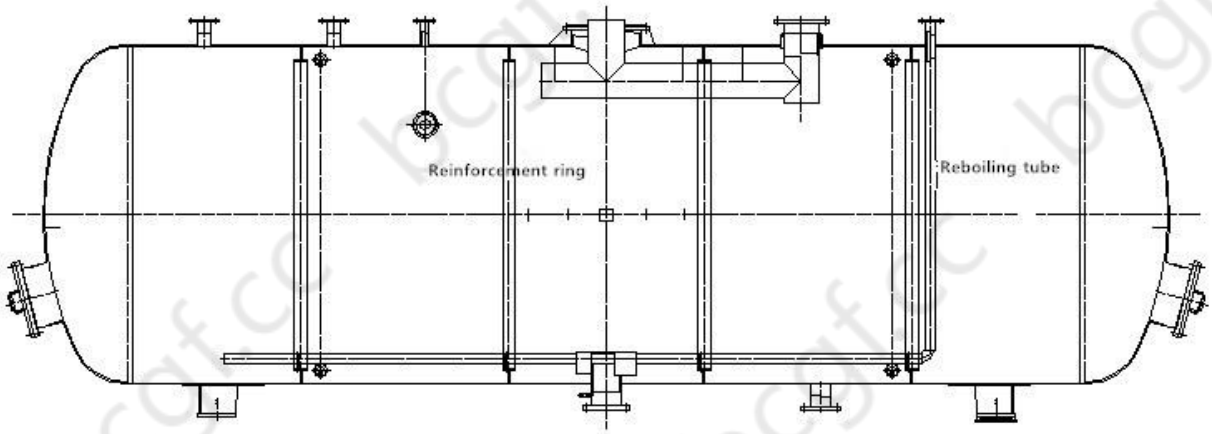
The deaeration head is a structure consisting of standard elliptical end caps welded to a cylindrical section. The internal structure includes a steam-water separation device, rotary film assembly, packing group, and steam distribution device. The external interfaces include the main condensate inlet, demineralized water inlet, auxiliary steam inlet, connection pipe to the water tank, inspection holes, etc. The structural schematic is as follows:



2). **Deaerator Water Tank**

The deaerator water tank consists of standard elliptical end caps welded to a

cylindrical section. The internal structure includes a main steam distribution pipe, reinforcing ring, and reboiling pipe. The external interfaces include the main steam inlet, reboiling pipe, connection pipe to the deaerator tower, deaerated water outlet, liquid level control device interface, inspection holes, etc. The structural schematic is as follows:



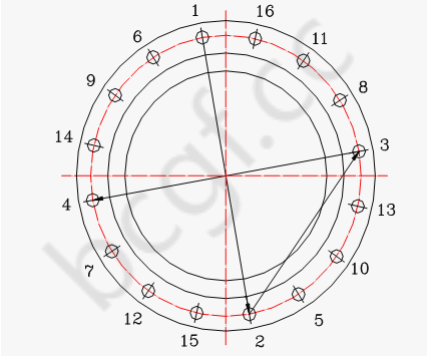
3). **Supports**

The heater is equipped with two supports (one fixed and one rolling or sliding) to eliminate thermal displacement of the equipment.

4). **Accessories**

(1) **Instrumentation**

The deaeration head, rotary film assembly, and deaerator water tank are equipped with local pressure gauge and local thermometer interfaces.



(2) **Liquid Level Control**

Each device is equipped with multiple pairs of liquid level device interfaces. The description of the condensate level interlock control is detailed in the accompanying drawings. Relevant construction of the control system can be found in the thermal control engineering documentation.

(3) **Safety**

a. Safety valves are installed on the deaerator tower and deaerator water tank to prevent damage from sudden increases in steam pressure.

b. An overflow port is provided on the deaerator water tank to prevent excessive water levels from jeopardizing safe operation.

c. Each device is equipped with liquid level device interfaces for starting and stopping various safety devices, ensuring safe operation of the equipment.

2.2 Factory Documentation

a. Product quality certificate;

b. Quality certificate;

c. Completion drawings;

d. Installation, operation, maintenance, and user manuals;

e. Delivery list.

3.Installation

3.1 Pre-Installation Checks

(1) Check whether the equipment appearance meets the drawing requirements and if there are any damage from transportation.

(2) Inspect each interface for rust that may affect sealing.

(3) Check for looseness, rust, or spots on each fastening component.

3.2 Site and Foundation

(1) Sufficient space should be left at both ends of the installation for disassembly and maintenance, based on the equipment's structural form.

(2) Foundation dimensions should match the support dimensions. The foundation can be made of poured concrete or steel structure. When using a concrete foundation, the base of the movable support should have embedded foundation pads, which must remain flat and smooth.

3.3 Equipment Hoisting

(1) Equipment hoisting must strictly follow on-site operational specifications.

(2) Pay attention to the center of gravity position when lifting the equipment.

(3) Use lifting lugs if the equipment has them. If there are no lifting lugs, the equipment body or other safe methods must be used for hoisting. Under no circumstances should components like lifting lugs or pipe connections be used for lifting the equipment.

3.4 Equipment Positioning Installation

(1) The deaerator water tank should be placed on the foundation, leveled horizontally, with a centerline deviation of less than ±4 mm; the deaeration head should be placed on the deaerator water tank, vertically aligned, with a centerline deviation of less than ±4 mm.

(2) Movable supports with anchor bolts should be equipped with two locking nuts, leaving a gap of 1–3 mm between the nuts and the base plate.

(3) After installation, the movable or rolling support ends should not obstruct the thermal expansion of the equipment.

(4) The equipment should connect piping and fittings without any stress to avoid forced assembly.

(5) Valves and instruments must be installed according to the drawings and system control requirements before testing the equipment.

4.Operation

4.1 Testing

(1) A pressure test should be conducted before testing the equipment. Bolts should be re-tightened before the test, following the illustrated sequence to avoid leakage at the sealing surfaces.

(2) Check the drawings for any special requirements or instructions before testing.

(3) When starting the equipment, first open the reboiling port to ensure that the

water in the tank is in a saturated state.

(4) Sequentially open the steam and water inlet valves to achieve normal working conditions.

(5) During startup or shutdown, gradually increase or decrease the temperature to avoid excessive pressure differentials and thermal shocks.

(6) After the equipment is running normally, switch to automatic control mode.

4.2 Operation and Maintenance

(1) The equipment must not operate under conditions exceeding those specified on the nameplate.

(2) Regularly check the operation of valves and measuring instruments during operation for any leaks; any abnormalities should be repaired or replaced promptly.

(3) Continuously monitor the medium's temperature, pressure, flow, and the equipment's vibration during operation. If any anomalies are found, analyze the causes in a timely manner, perform repairs and maintenance as necessary, and ensure maintenance during shutdown periods.

(4) The inlet pressure should be 0.1–0.35 MPa greater than the normal operating pressure of the equipment.

(5) The main steam pressure should be 0.05–0.3 MPa greater than the normal operating pressure of the equipment.

(6) The temperature rise of the rotary film deaerator is generally 70°C; if

necessary, increase the inlet water temperature to ensure the deaerator's effectiveness.

(7) When the equipment stops running, drain the internal water, blow dry, and promptly close all valves to prevent air from entering the steam and water systems, keeping the internal humidity below 20%.

(8) For long-term shutdown, corrosion prevention measures should be taken.

a. **Nitrogen Charging Method**: Completely drain and blow dry the water, apply rust inhibitors and desiccants inside the equipment, seal all valves, then fill with nitrogen maintaining a purity of not less than 99% at a pressure of 0.05 MPa.

b. **Wet Preservation Method**: Fill the deaeration equipment and feedwater system with a certain concentration of ammonia water solution, and charge with nitrogen to maintain a pressure of 0.05 MPa.

(9) **Regular Inspection**

a. The periodic inspection of the equipment should follow the regulations of the "Safety Technical Supervision Regulations for Fixed Pressure Vessels."

b. Internal inspections should focus on checking for cracks in the welds of the rotary film assembly within the deaeration head, and any damage to the packing.

c. Check if safety valves, level adjusters, control valves, etc., are functioning correctly.

5.Precautions:

5.1 Sudden pressure drops in the equipment are strictly prohibited.

5.2 If the equipment has been disassembled and the gaskets have been loosened, all gaskets must be replaced with new ones during reassembly.