DEAERATION OF BOILER FEEDWATER

Dissolved gases are present as solutions in all natural waters. Gases, such as carbon dioxide and oxygen, when dissolved in water, greatly increase the corrosivity of water. At boiler system temperatures and pressures, small amounts of oxygen can cause severe damage in the form of oxygen pitting. Removal of oxygen, carbon dioxide and other non-condensable gases from boiler feedwater is vital to boiler longevity as well as safety. The term given to the mehanical removal of dissolved gases is deaeration. Mechanical deaeration of these dissolved gases is typically utilized prior to the addition of chemical oxygen scavengers such as sodium sulfite or hydrazine.

PRINCIPLES OF MECHANICAL DEAERATION

Charles' and Henrys' laws of physics are the basis for the operation of mechanical deaseration. Simplified, these lawas state that removal of gases dissolved in feedwater can accomplished by heating and reducing the concentration of oxygen and carbon dioxide in the atmosphere surrounding the feedwater. The easiest way to accomplish this is to force a gas, devoid of oxygen and carbon dioxide, counterflow to the feedwater. This scrubbing action releases oxygen and carbon dioxide gases that are then vented from the system.

Steam is typically used to "scrub" the feedwater because:

1. The presence of oxygen and carbon dioxide are essentially devoid.

2. Steam is readily available and adds the heat required to complete the reaction.

For efficient operation, deaerating equipment must satifsy the following requirements:

1. **Heating of the feed water:** The operating temperature in the unit should be the boiling point of water at the measured pressure. The pressure/temperature relationship is important since boiling must take place rapidly for quick and efficient removal of gases.
Most commercial building deareators operate at 15 PSI or less.

2. **Agitation:** Agitation is required to decrease the time and heat energy necessary to remove dissolved gases from the water.

3. **Increased surface area:** The water must be finely dispersed to expose maximum surface area to the stream. This enables the water to be heated to saturation temperature quicker and reduces the distance the gases have to travel to be liberated.

4. **Venting to atmosphere:** The liberated gases must be allowed to escape from the system as they are released.

TYPES OF MECHANICAL DEAERATORS

These are two types of pressure deaerators commonly used in boiler systems: spray and tray type, and spray type.

SPRAY AND TRAY DEAERATORS

Typically the spray and tray deaerator is composed of two sections: a deaerating sections and a feedwater storage section. Incoming water is sprayed through a perforated distribution pipe into a steam atmosphere. There it is heated to within a few degrees of the saturation temperature of the steam. Most of the non-condensable gases (primarly O2 and CO2) are released to the stream as the water enters the unit. The water then cascades through the tray section, breaking into fine droplets, which immediately contacts incoming steam. The steam heats the water to the saturation temperature of the steam and removes all but a trace of oxygen. Deaerated water falls on the feedwater storage section below and is protected from recontamination by a blanket of steam. As the non-condensable gases are liberated, they as well as a small amount of steam are vented to the atmosphere. It is essential that sufficent venting is provided at all times or deaeration will be incomplete.

SPRAY-TYPE DEAERATORS

Spray-type deaerators work on the same general principle as the spray and tray types. The spray-type deaerators do not, however, use trays for dispersion of the water. In this case, spring loaded nozzles located in the tip of the unit, spray water into a steam atmosphere, which is heated to within a few degrees of the saturation temperature of the steam. Most of the non-condensable gases are released to the steam, and the heated water falls to a water seal and drains to the lowest section of the steam scrubber.

The water is scrubbed by large quantities of steam and heated to the saturation temperature prevailing at this point. The intimate steam to water contact achieved in the scrubber efficiently strips the water of dissolved gases. As the steam-water mixture rised in the scrubber, a light pressure loss causes the deaerated water temperature to remain a few degrees below the inlet steam saturation temperature. The deaerated water overflows from the steam scrubber to the storage section below.

The steam, after flowing through the scrubber, passes up into the spray heater section to heat the incoming water. Most of the steam condenses in the spray section to become part of the deaerated water. A small portion of the steam, vented to atmosphere, removes non-condensable gases from the system.

TRACE OXYGEN REMOVAL

While Mechanical deaerators do reduce oxygen to very low levels, even trace amounts of oxygen may cause corrosion damage to a system. Consequently, good operating practice requires removal of that trace oxygen with a chemical oxygen scavenger such as sodium sulfite or hydrazine. Free carbon dioxide can be removed by deaeration, but this process releases only small amounts of combined dioxide. The majority of combined carbon dioxide is removed with the steam of the boiler, subsequently dissolving in the condendsate, frequently causing corrosion problems. These probelms can be controlled though the use of volatile neutralizing amines or filming amines.

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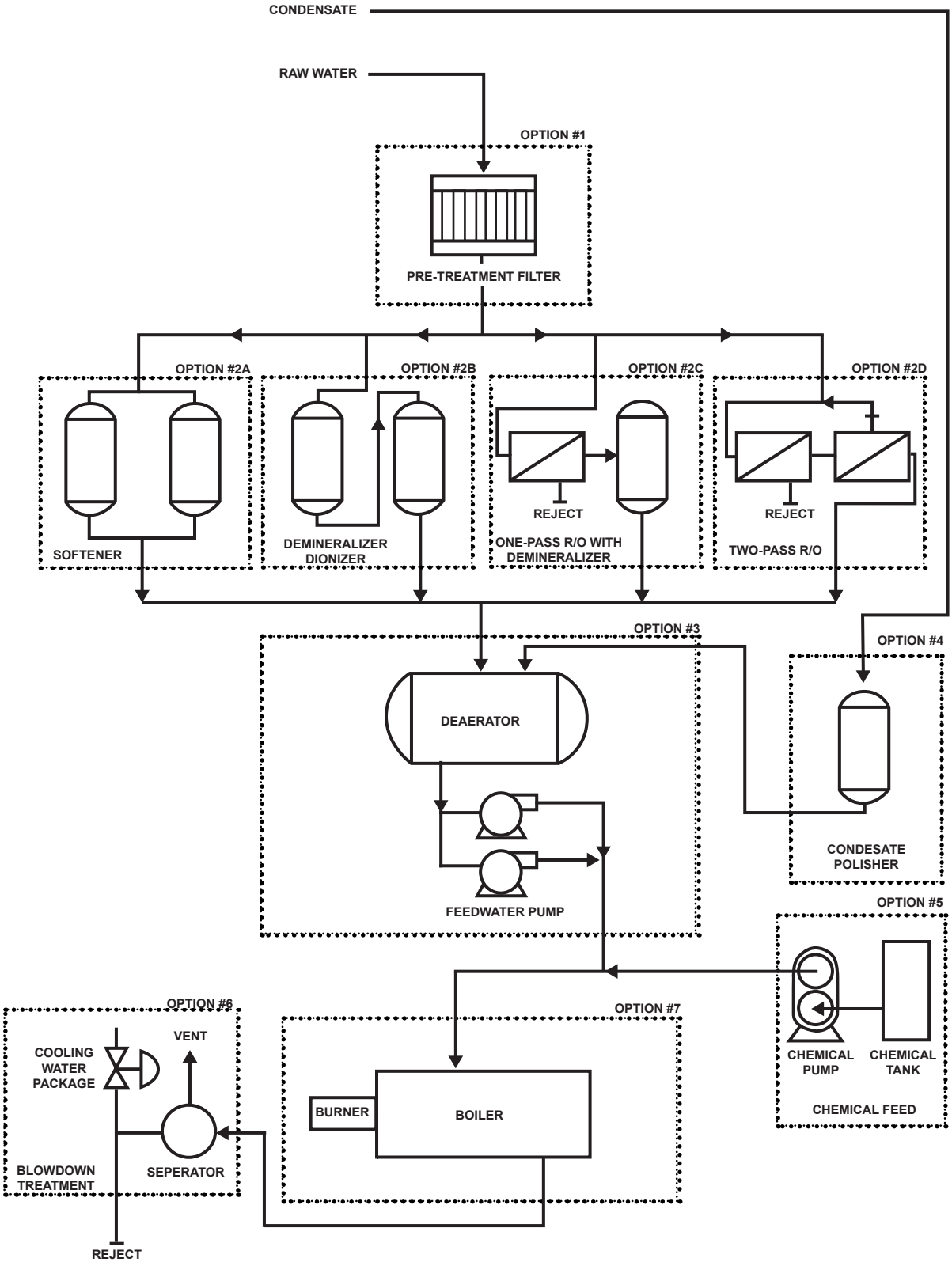
STEAM PLANT
WATER TREATMENT OPTIONS



LEVEL CONTROLS COMPETITION COMPARISON

	BRYAN	FISHER	KECKLEY	K&M (2)	WATSON MCDANIEL
313	HT (3)	38 (1)	---	---	---
375	---	273 (1)	20M	284 (1)	---
377	---	220C (1)	20	260 (1)	---
320L	---	---	---	---	---
322L	---	---	62	2100 (1)	---
326L	---	171L	73	2300 (1)	5080 (1)

NOTES: (1) DISCONTINUED
(2) K&M PURCHASED BY LESLIE
(3) HT IS ORIGINAL HOPPES TRAP.

WARREN CONTROLS

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