Industrial filtration

Degassing boiler feedwater with Liqui-Cel membrane contactors

Introduction

ShenLan Environment Inc. located in Shanghai, China uses Thermo Scientific™ Liqui-Cel™ Membrane Contactors in their boiler feedwater treatment systems. These systems realize lower operating costs with the added benefit of reducing the chemicals added to the boiler feedwater.

Background

Proper treatment of boiler feedwater is an important component of a boiler system. As steam is produced, dissolved solids become concentrated and deposited inside the boiler. This leads to poor heat transfer and reduced efficiency of the boiler. Dissolved gasses such as oxygen and carbon dioxide will react with the metal surfaces inside the boiler, promoting corrosion. Degassing is an important step for protecting the boiler.

Liqui-Cel membrane contactors offer many advantages over forced draft deaerators, vacuum towers, and chemical treatment programs for feedwater treatment. Membrane contactors utilize microporous membranes to create 10X the surface area per unit volume compared to mechanical technologies. Contactors are highly efficient and compact and can be used inline under pressure.

Chemical treatment

Chemical treatment is widely used to control dissolved oxygen in a boiler. The cost of operating a chemical treatment program consists of chemical costs and blow down costs. Periodically, the water in the boiler must be flushed out to remove nonvolatile compounds. They are flushed out of the boiler in a process called blow down. Chemical addition to the water can increase the frequency of blow down, which increases the operating cost of the boiler.

There are two components of blow down costs. Water and steam that is purged from the boiler during blow down is sent to drain.



Figure 1. Thermo Scientific™ Liqui-Cel™ Membrane Contactors

This water must be replenished by fresh makeup water and there is a cost associated with it. The second cost is heat or energy cost. The water blow down from the boiler is hot. It is replaced with cold water that must be reheated in order to produce steam.

Example using Liqui-cel membrane contactors

Liqui-cel membrane contactors can be used to remove the dissolved oxygen from water. By removing the dissolved oxygen, the volume of chemicals added to the boiler will be reduced. By reducing the chemicals added to the boiler, the frequency of blow down can be potentially reduced. Table 1 compares operating costs of two systems. One system is a chemical-only treatment system with a blow down rate of 10%. The other system assumes that the oxygen content of the feedwater is reduced to 0.5 ppm and that the blow down rate can be reduced to 5% due to the reduction of chemicals in the boiler.

The boiler specifications used in this example are for reference. These calculations can be modified in order to apply them to boilers with different operating conditions.

Table 1. Operating cost comparison of chemical treatment system to degassing system

Operation	Chemically treated feedwater	Degassed feedwater	Savings
Boiler capacity	10,000 lbs/hr (4.536 t/hr)		
Pressure	50 psig (3.4 barg)		
Fuel	Natural gas		
Fuel cost	$4.50/1,000 ft^3 ($158.90/1,000 m^3)		
Fuel efficiency	1,000 BTU/ft^3 (8,900 KCal/m^3)		
Boiler blow down rate	10%	5%	
Hours of operation	6,600 hrs/yr (275 days/yr)		
Feedwater cost	$1.20/1,000 gal (3,785 liters)		
Sodium sulfite cost	$0.50/lb ($1.10/kg)		
Feedwater temperature	60°F (15.5°C)		
Inlet dissolved O_2	9.0 ppm	0.5 ppm	
Chemical cost	$2,299	$128	**$2,171**
Blow down water cost	$1,055	$500	**$555**
Energy cost due to heat loss in blow down	$11,095	$5,256	**$5,839**
Total yearly cost/savings	$13,997	$5,669	**$8,565**



Membrane system operating cost

A Liqui-Cel membrane contactor system can be used to produce feedwater with low levels of dissolved oxygen. The operating cost of a membrane degassing system is comprised of electricity and seal water for the vacuum pump.

When comparing this to the chemical treatment system, annual savings reach $2,170. When the savings associated with blow down is included, the operating cost savings can be more than $8,500 per year. A typical membrane system designed to degas the water outlined in this example can have a payback in less than two years.

Summary

Dissolved oxygen control in boiler feedwater is an important process that protects the boiler from corrosion. Chemical treatment is often used to control the dissolved oxygen. Liqui-Cel membrane contactors can be used to replace or supplement the chemical treatment program. The contactors can minimize the volume of chemicals added to the feedwater and offer savings to the end user by reducing chemical as well as energy costs.

Technical Information: The technical information, guidance, and other statements contained in this document or otherwise provided by Thermo Fisher are based upon records, tests, or experience that Thermo Fisher believes to be reliable, but the accuracy, completeness, and representative nature of such information is not guaranteed. Such information is intended for people with knowledge and technical skills sufficient to assess and apply their own informed judgment to the information. No license under any Thermo Fisher or third party intellectual property rights is granted or implied with this information.

Product Selection and Use: Many factors beyond Thermo Fisher's control and uniquely within user's knowledge and control can affect the use and performance of a Thermo Scientific product in a particular application. As a result, customer is solely responsible for evaluating the product and determining whether it is appropriate and suitable for customer's application. Failure to properly evaluate, select, and use a Thermo Scientific product and appropriate safety products, or to meet all applicable safety regulations, may result in injury, sickness, death, and/or harm to property.

Learn more at **thermofisher.com/industrialfiltration**

© 2026 Thermo Fisher Scientific Inc. All rights reserved. All trademarks are the property of Thermo Fisher Scientific and its subsidiaries unless otherwise specified. **APN-13712419 GBL 0426**