Liquid phase corrosion

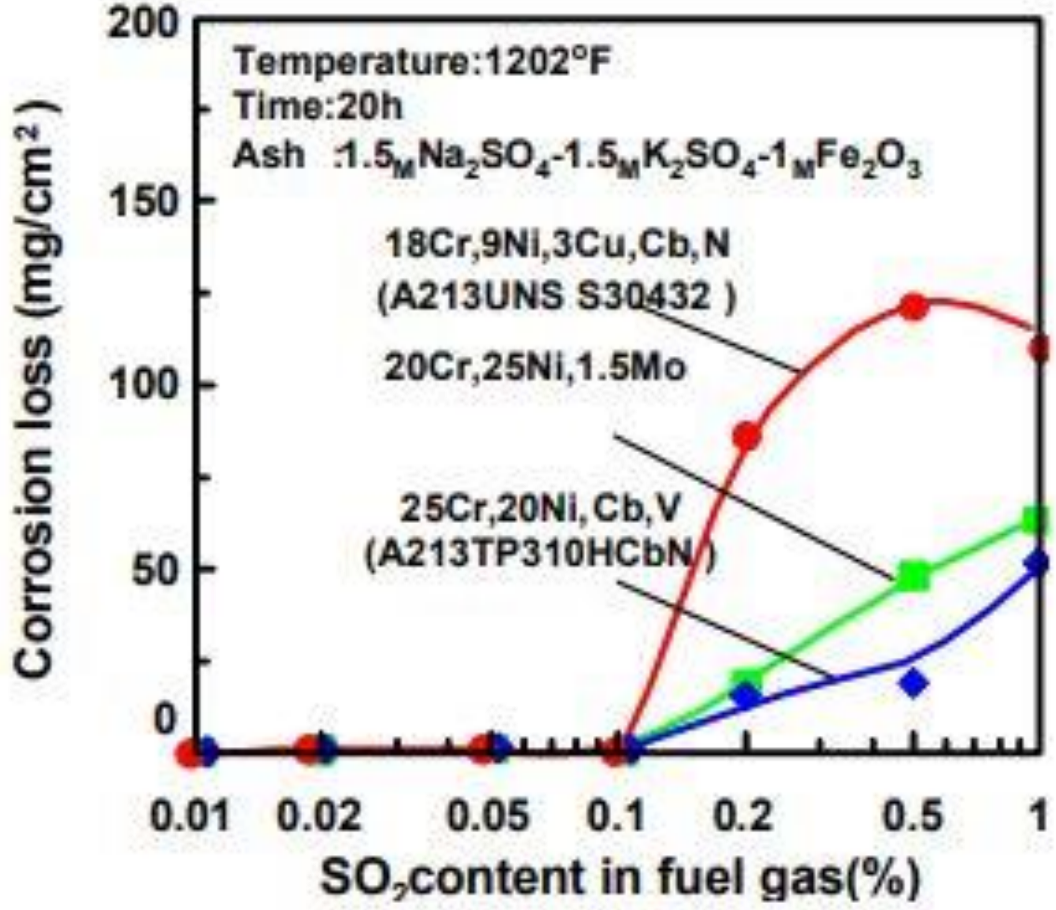
Liquid phase corrosion of stainless steel tubes at high temperature zones is a phenomenon that depends on the sulfur dioxide content in the combustion gas, the tube metal temperature, and the material composition.

Figure shows the effect of the SO2 content in a simulated gas on the corrosion rate of the newly developed austenitic stainless tube materials. The corrosion test was made using an experimental apparatus and a standard corrosion mixture (SCM) at 1202ºF (650ºC).

The results show that liquid phase corrosion (or simply high temperature corrosion) is strongly dependent on the SO2 conten,t and the critical concentration for corrosion at the test temperature was around 0.1% for any of the tested materials.

The SO2 content in the flue gas is controlled by the sulfur content of the coal burned, and 0.1% of SO2 corresponds to approximately 1% of sulfur in the coal.

Therefore, for fuels with a sulfur content of less than 1%, such as the PRB coal to be fired in the CBEC 4 boiler, liquid phase corrosion of austenitic stainless steel tubes is considered insignificant.



Temperature:1202°F
Time:20h
Ash :1.5M Na2SO4-1.5M K2SO4-1M Fe2O3
18Cr,9Ni,3Cu,Cb,N
(A213UNS S30432)
20Cr,25Ni,1.5Mo
25Cr,20Ni,Cb,V
(A213TP310HCbN)
Corrosion loss (mg/cm²)
200
150
100
50
0
0.01
0.02
0.05
0.1
0.2
0.5
1
SO2 content in fuel gas(%)

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FACULTY OF ENGINEERING & TECHNOLOGY

COOLING TOWER BASICS

Basic of Cooling Tower:- Water flow rate. Approach (difference between outlet water & wet bulb temperature) Range (difference between inlet & outlet temperature). Hot water temperature (HWT). Cold water temperature (CWT). Wet bulb temperature (WBT). Liquid to air ratio (L/G).

• What factor affecting for CT performance:- Inadequate or excess water flow. Inadequate or excess air flow. Type, quality & spacing of fills. Type of drift eliminators. Type & spacing of nozzles. Motor rating, Fan & Gear box type.

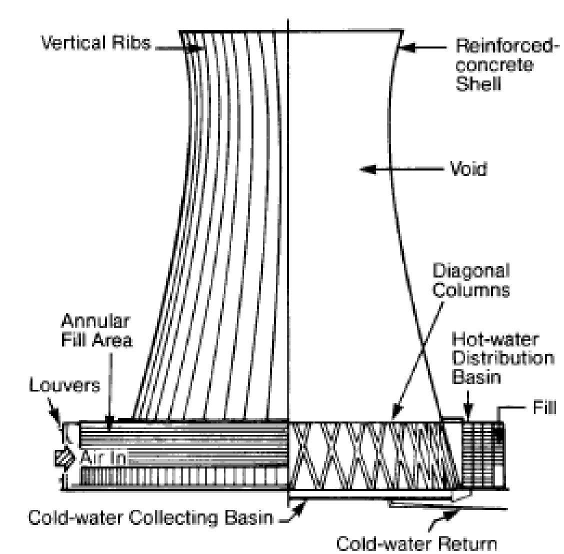

Figure 2. Cross flow natural draft cooling tower

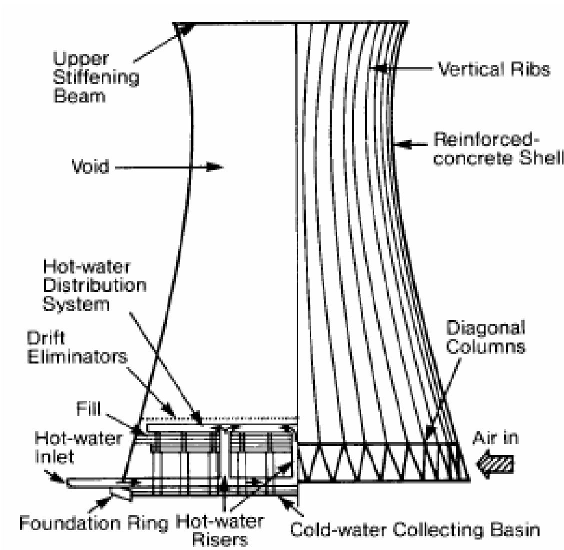

Figure 3. Counter flow natural draft cooling tower

Types of Mechanical Draft Cooling towers

•Counter flow induced draft

•Counter flow forced draft

•Cross flow induced draft

Cross flow induced draft towers

Hot water enters at the top and passes over the fill.

•Air is introduced at the side, either on one side (single flow tower) OR opposite sides (double flow tower)

Inner scale deposit

For earlier supercritical boilers, the use of all volatile treatment (AVT) water chemistry had resulted in a significant increase in pressure drop through the furnace walls due to internal scaling, and hence increases in metal temperature and the necessity for frequent acid cleaning.

The oxygenated water treatment (OWT, or “CWT”) program was developed in Germany, and has been applied to supercritical boilers in operation for over 20 years.

The use of OWT after start-up can ensure the suppression of inner scale build-up on the furnace wall tubes.

Slagging and fouling

Severe slagging and/or fouling troubles that had occurred in early installed coal fired utility boilers are one of the main reasons that led to their low availability.

Furnace dimensions are determined based on the properties of coals to be burned. Most PRB coals and Eastern bituminous coals are classified as severe slagging fuels from their inherent properties. In addition to the degree of slagging, PRB coals are known to produce ash with specific characteristics, which is optically reflective and can significantly hinder the heat absorption.

Therefore an adequate furnace plan area and height must be provided to minimize the slagging of furnace walls and platen superheater sections.

The furnace for CBEC 4 was designed such that the exit gas temperature entering the convection pass tube coils would be sufficiently lower than the ash fusion temperatures of the fuel.

For furnace cleaning, wall blowers will be provided in a suitable arrangement. In some cases as deemed necessary, high-pressure water-cleaning devices can be installed.