

## **ABSTRACT**

*Water tube boiler was a main device on various industry. It was used to change water into steam through heat transfer mechanism at the high temperature. The boiler's components loses much it's strength at the high temperature. Therefore, it can lead to the failure. Failure of boiler's components must be fixed completely. Overheating was the main cause of failure in the boiler and frequently occurs in waterwall tubes. Tubes those especially subject to overheat cause by significant deposits containing.*

*The calculation of tube wall temperature and stress in waterwall tubes were applied to solve the problems that was caused by overheating. Theory of Tresca's failure was used to determine failure in waterwall tubes because of the over stress. Stress in waterwall tubes consist of thermal stress and maximum shear stress.*

*The results of calculations show that the waterwall tubes got overheating and over stress. The outside temperature of waterwall tubes was 373 °C. It was higher than the temperature design that only at 300 °C. Therefore, waterwall tubes got an overheating phenomena. The thermal stress in waterwall tubes was 367.25 MPa. It was higher than the yield strength that at 295 MPa. Thus, it can lead the thermal failure. Stress rupture was a form of overheating damage that usually produces a thick-lipped rupture. It was caused by the maximum shear stress at 179.23 MPa. Therefore, it was higher than the waterwall tubes shear strength that at 147.50 MPa.*

*Keywords: Water tube boiler, overheating, waterwall tubes, thermal failure, over stress*

## INTISARI

Ketel uap pipa air adalah peralatan utama dalam berbagai industri yang berfungsi untuk mengubah air menjadi uap melalui proses perpindahan panas pada temperatur tinggi. Komponen ketel uap kehilangan kekuatannya pada temperatur tinggi sehingga dapat menimbulkan kegagalan. Kegagalan pada komponen ketel uap harus ditangani secara tuntas. Panas berlebih adalah penyebab utama kegagalan pada ketel uap dan sering terjadi di *waterwall tubes*. Pipa yang mengalami panas berlebih sering terdapat kerak yang signifikan.

Perhitungan temperatur dinding pipa dan tegangan di *waterwall tubes* dilakukan untuk mengatasi yang disebabkan karena panas berlebih. Teori kegagalan *Tresca* digunakan untuk menentukan kegagalan pada *waterwall tubes* karena tegangan berlebih. Tegangan pada *waterwall tubes* terdiri dari tegangan thermal dan tegangan geser maksimum.

Hasil perhitungan menunjukkan bahwa *waterwall tubes* mengalami panas dan tegangan berlebih. Temperatur dinding luar *waterwall tubes* adalah 373 °C melebihi desain temperatur yaitu 300 °C, sehingga *waterwall tubes* mengalami *overheating*. Tegangan thermal pada *waterwall tubes* adalah 367,25 MPa melebihi kekuatan luluh *waterwall tubes* yaitu 295 MPa, sehingga menyebabkan kegagalan thermal. Kegagalan yang disebabkan oleh panas berlebih adalah robek yang lebar. Robek yang terjadi pada *waterwall tubes* disebabkan oleh tegangan geser maksimum adalah 179,23 MPa melebihi kekuatan geser *waterwall tubes* yaitu 147,50 MPa.

Kata kunci: Ketel uap pipa air, panas berlebih, *waterwall tubes*, kegagalan thermal, tegangan berlebih