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In Boiling Tank, the Energy Is Resulted from Combustion Change into thermal energy

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Abstract
The mentioned thermal may be provided by natural gas combustion (mazut or gasoline), solid coal, and uranium. Thermal transferring in boiling tank is done by 3 main methods, but the methods effectiveness percentage is different in various boiling tanks according to different performances. each factor leads to reduce each thermal efficiency or boiling tank reduction. the increase in sediment in boiling tank tubes espacially in water tube has a great role in reduction of thermal flux from tube wall to fluid that leads to certain reduction of boiling tank efficiency. the operational and practical aspects of this research was done by maple software. Finally, boiling tank efficiency is calculated in different width of sediment in boiling tank. In addition, the role of different widths of sediments in reduction of thermal efficiency of boiling tank is studied and resisting ways are suggested.
Keyword: *Boiler efficiency, water tube, maple, heat flux, sediment*

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Introduction

Sediment accumulation in plants usually unwanted material on the surface of said equipment [1]. The calcium carbonate and magnesium are generally undesirable substances in water and sediments, also known as lime. Fouling of the equipment is determined as follows:

1. Lower the heat transfer capability of different sediment layers. This layer increases the resistance to heat transfer and reduces the effects of heat exchangers.
2. The cross section of the sediment flow and pressure drop can be reduced.

Although sedimentation and deposition in the heating and cooling installations into a huge cost to the industry, but research in this field is very limited. According to studies, 15% of the cost of maintaining the facility for boiler and heat exchanger is that it costs half the cost of the facilities is Deposition aids. The sedimentary layers are thicker wall pipe is hotter than the risk of serious damages. Impacts and problems caused by deposits in the boiler tubes is very high [2]. Fire eater deposit formation on surfaces in contact with impurities in the water boiler heat transfer surfaces [3]. In places where the sediment thickness is formed substantially, steps should be taken to remove them when the pot is clean and appropriate steps should be taken to prevent scale formation [4]. In 1970, applying the method of phosphates in the water used in the boiler, and the results were more significant in relation to enhance the quality of water used in boiler on the other. Before this, many reports concerning the use of the departments of corrosion caused by insufficient income, it was observed However, when the correct way to and control of the was to any failure relevance of boiler was observed [5]. Ypyng Zhang and Yang Yang in 2012. The impact of sediment thickness and temperature on the tube quickly became entitled Effects of the Fouling and laws governing the flow) continuity and momentum and energy (Dadnd.ayn article by Elsevier in its journal Energy Procedia was published [6]. Most of the articles published in this journal entitled Fouling is the second in chemical engineering. In this article published by Elsevier in 2012 by Vicente Lister presented a greater impact of different thicknesses deposited on the tube boiler heat flux transition is discussed in [7].

Geometry of the problem and derive the equations

The basic program of research and operational evaluation of different thicknesses deposited on the thermal efficiency of the boiler in the form of charts and offers ways to deal with it, and reduce fuel consumption is a. The water tube boiler into a pipe, and out of the hot combustion gas there. As in Figure 1 is shown in the inner tube, a layer of sediment and water from the outer layer of sediment resulting from the combustion of gas there. In practice, the problem in Figure 1, but in the proposal, all homogeneous thickness is assumed to be present during the formation of the experimental geometry [8].

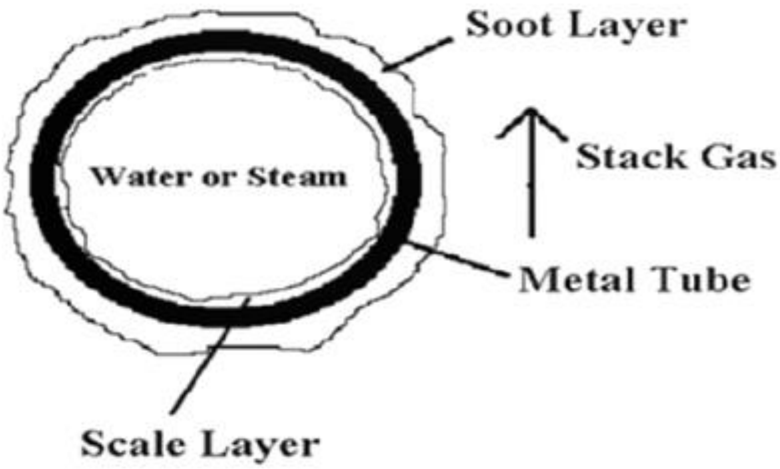

Figure 1: Geometry practical boiler tubes

To express the assumption that the shape of the current experimental data is shown below:

1. The inside of the tube boiler with water flow with radius r1
2. The thickness of the deposited mineral water with radius r2
3. The thickness of the boiler tube with radius r3
4. Sediment thickness from the hot combustion gas with a radius r4
5. Outer tube boiler with hot combustion gas stream with a radius r5

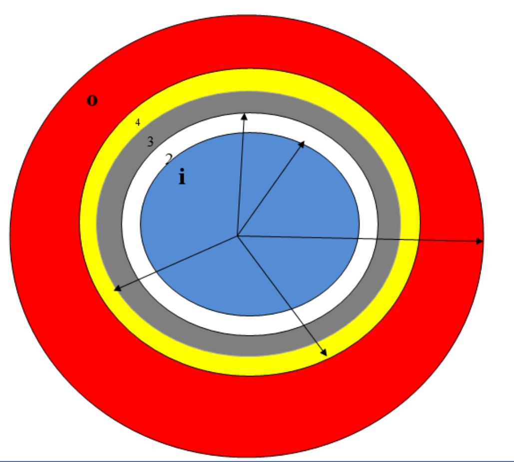

Figure 2: Schematic of the precipitate formed in the tube and pipe

Red: hot flue gas YELLOW precipitated from hot flue gas
Gray, white metal, mineral water and sediment from water: water flow
In Figure 1, respectively,

$$, h_i , h_o , T_{fluegas[1]} , T_{fluegas[2]} , T_{steam[1]} , T_{steam[2]} ,$$

Flows into and out of the tube - the tube Nmvdarsh interaction is assumed and is presented as follows:

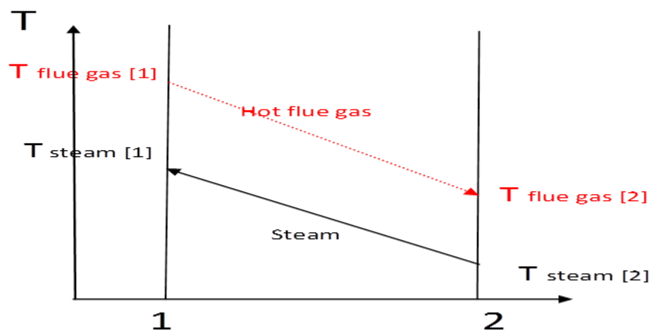

Figure 3: Flows into and out of the tube

Heat transfer coefficient of the fluid inside the tube, the heat transfer coefficient of fluid displacement outside of the tube, hot gas temperature, exhaust gas temperature, the temperature of the steam inlet pipe, boiler pipe outlet steam temperature is considered. With regard to the form (2) is intended for the following assumptions:

1. Water flow is considered incompressible.
2. The water flow is steady and the next one will be considered.
3. The temperature field is considered to be one-dimensional and steady.
4. The fluid viscosity is constant and does not change at different temperatures.
5. Newtonian fluid is assumed.

In this first of a boiler without any deposits in pipes that have been investigated and the amount of steam and hot gas outlet temperature and the output from the last stage of the boiler is different from the thickness of the sediments on the tube It is checked to determine the different thicknesses of sediment, much of the heat transfer and ultimately affect the amount of vapor and returns it. The flux of heat transfer between the hot and cold fluid to flow both in equation (1) is provided.

$$dq = -\dot{m}_h c_h dT_h = \dot{m}_c c_c dT_c \quad (1)$$

Since relation (2) holds:

$$dq = U(T_h - T_c)dA \quad (2)$$

$$dT_h = \frac{-dq}{\dot{m}_h c_h}$$
$$dT_c = \frac{dq}{\dot{m}_c c_c}$$

1 and 2 are related to the merger.

$$dT_h - dT_c = d(T_h - T_c) = -dq\left(\frac{1}{\dot{m}_h c_h} + \frac{1}{\dot{m}_c c_c}\right) \quad (3)$$

By solving the equation proposed, LMTD in equation (4) is calculated [24]:

$$\Delta T_m = \frac{(T_{h2} - T_{c2}) - (T_{h1} - T_{c1})}{\ln[(T_{h2} - T_{c2})/(T_{h1} - T_{c1})]} \quad (4)$$

According to the chart:

$$LMTD = \Delta T_m = \frac{(T_{fluegas[2]} - T_{steam[2]}) - (T_{fluegas[1]} - T_{steam[1]})}{\ln \frac{T_{fluegas[2]} - T_{steam[2]}}{T_{fluegas[1]} - T_{steam[1]}}}$$

The temperature profile along the tube and Nusselt number are presented to solve the energy equation. Water tube boiler tubes to the equation (5) can be considered.

$$Nu = 0.021.\mathrm{Re}^{0.8}.pr^{0.43}.[\frac{pr}{pr_w}]^{0.25}.\varepsilon_1$$
$$\varepsilon_1 = \frac{l}{d} \quad (5)$$

$10^4 \langle \mathrm{Re} \langle 5.10^5$

$0.6 \langle pr \langle 2500$

To flow out of the tube boiler flue gas exhaust gas hot water pipe (the pipe as a direct network) into equation (6) will be provided:

$$Nu = 0.23.\mathrm{Re}^{0.65}.pr^{0.33}.[\frac{pr}{pr_w}]^{0.25}.\varepsilon_\psi \quad (6)$$

$2.10^2 \langle \mathrm{Re} \langle 2.10^5$

Figure (2), the thermal flux formula wrote as follows:

$$0.9 * M_g.c_{pg}.(T_{fluegas[1]} - T_{fluegas[2]}) = U.A.\frac{(T_{fluegas[2]} - T_{steam[2]}) - (T_{fluegas[1]} - T_{steam[1]})}{\ln\frac{T_{fluegas[2]} - T_{steam[2]}}{T_{fluegas[1]} - T_{steam[1]}}} =$$

$$U.A.\frac{(T_{fluegas[2]} - T_{fluegas[1]}) - (T_{steam[2]} - T_{steam[1]})}{\ln\frac{T_{fluegas[2]} - T_{steam[2]}}{T_{fluegas[1]} - T_{steam[1]}}} \quad (7)$$

$$Q = \frac{2\pi L * \text{LMTD}}{\left(\frac{1}{r_i h_i} + \frac{\ln r_1/r_0}{k_1} + \frac{\ln r_2/r_1}{k_2} + \frac{\ln r_3/r_2}{k_3} + \frac{1}{r_o h_o}\right)}$$

U_c C_{pg} The overall heat transfer coefficient below the pipe without precipitation, The mean specific heat capacity of the hot gas (Flvgs) will be considered. The overall heat transfer coefficient can be obtained as follows [20]:

$$U = \frac{0.90 * M_g.c_{pg}.(T_{fluegas[1]} - T_{fluegas[2]}).\ln\frac{T_{fluegas[2]} - T_{steam[2]}}{T_{fluegas[1]} - T_{steam[1]}}}{A.[(T_{fluegas[2]} - T_{fluegas[1]}) - (T_{steam[2]} - T_{steam[1]})]} \quad (8)$$

To check the operation of the boiler, in different thicknesses deposited inside and outside tube boiler efficiency calculation it is necessary, therefore, the efficiency of the boiler will be shown as follows [19]:

M_{steam} The steam produced in mass quantities, Q_c, Q_f the amount of heat required to produce steam

$$M_{steam} * (h_2 - h_1) = Q_f$$

$$\eta_f = \frac{Q_f}{Q_c}$$

Pierre clean condition and is clean. η_f Efficiency in clean condition η_c with the deposition efficiency is in clean condition

$$Q_c = M_g.c_{pg}.(T_{fluugas[1]} - T_{fluegas[2]})$$

U_d The overall coefficient of heat transfer in a clean condition and sediment thickness t, and k is the heat transfer coefficient sediment.

fouling resistance = fouling factor (fr or ff)= t/k

The overall coefficient of heat transfer tubes with a thickness of sediment in the boiler (clean conditions), defined as follows.

$$U_d = \frac{1}{\frac{1}{U_c} + fr}$$

$$\eta = \frac{M_{steam}.(h_2 - h_1)}{M_f.H} \qquad (9)$$

Simulation results:

Equations (7) - (9) boiler thermal efficiency and power consumption in terms of temperature and specific heat capacity shows. The following results were obtained by variation of parameters of the equations. Increasing the thickness of sediment flux and thermal efficiency of the boiler to the steam and heat flux decreases and the constant need to use more fuel when it comes to wasting energy. Figure 1 shows the energy loss by increasing the thickness of the sediment can be seen Dhd.hmantvr increasing the thickness of sediment, a lot of heat dissipation occurs in the system, so that the thickness of the sediments above the zero of the heat transferred into.

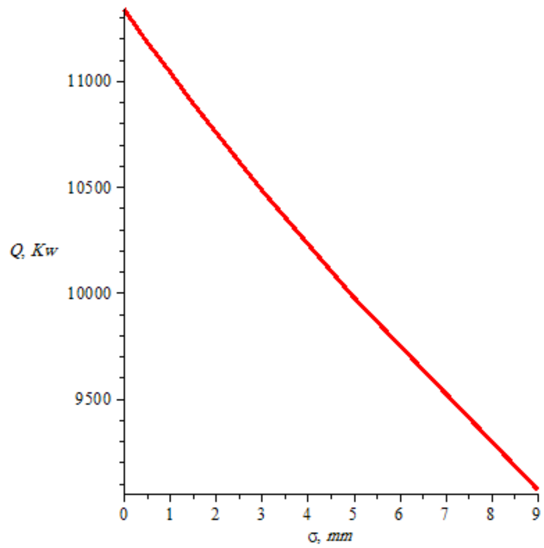

Figure 4: thermal power dissipation by increasing the thickness of the sediment

Figure 5 Diagram of energy consumption by increasing the thickness to maintain the quality and quantity of steam. Thus, if we increase the thickness of the sediment needs to produce more energy in the system.

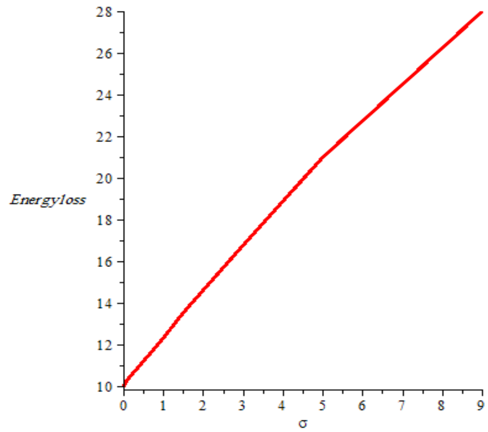

Figure 5: percent increase in power consumption by increasing the thickness of the sediment

Figure (6) reduce boiler efficiency by increasing the thickness of the inner pipe sediment shows the linear decrease in the thickness of the high efficiency of our system.

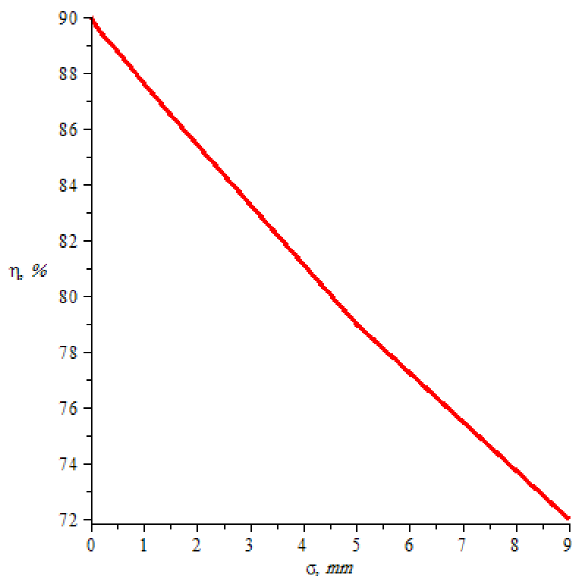

Figure 6: boiler efficiency by increasing the thickness of the sediment

In Figure 6 the inner fluid heat transfer coefficient in different thicknesses and deposition shown enormous reduction in heat transfer coefficient in the internal fluid displacement thicknesses are high.

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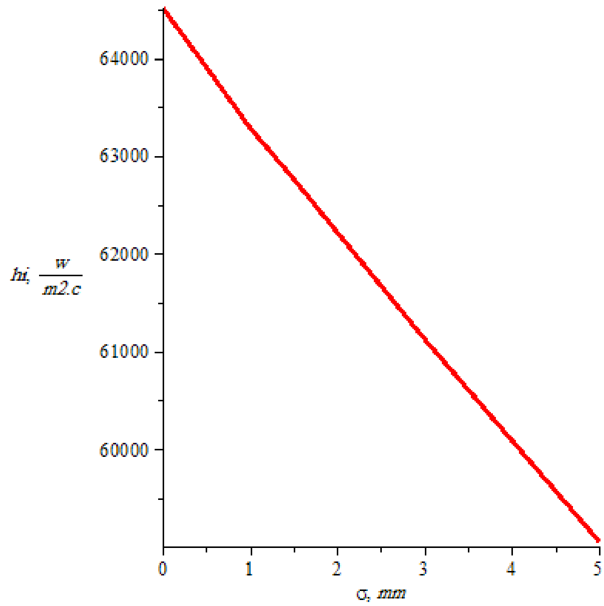

Figure 7: displacement of the inner fluid transfer coefficient with increasing thickness of the sediment

Sediment and increase its thickness, as well as reducing the speed of the internal fluid flow, which in turn reduces the amount of water used to produce steam will be included. This causes a waste heat boiler efficiency further reduce sedimentation and thickening Yabd.ps can see it directly affects the performance of the boiler efficiency. In order to sediment pore assumed Table 1 below is presented that reduce the amount of sediment thickness increases efficiency in front of the show:

Sediment thickness (mm)	Boiler efficiency(%)
0.1	0.30
0.50	1.20
1	2.40
1.50	3.50
3	6.70
5	11
9	18

Table 1: the percentage reduction in boiler efficiency by increasing the thickness of the sediment

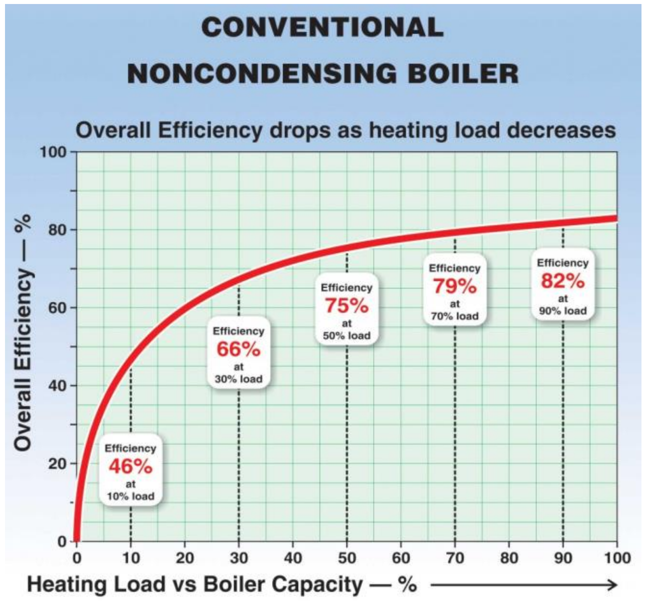

Figure 8: in different capacities steam boiler efficiency

Conclusion

Deposits and thickening of the heat flux can not just spend heat transfer tube wall with the sediment and therefore the temperature of the hot gas temperature of heat output of the increase in out decline. If the combustion chamber is not properly insulated, heat loss by radiation is negligible, at low and high production capacity due to the high temperature steam boiler combustion chamber, the heat dissipation and a fixed amount of attention, it is the efficiency of the boiler and it reduces the impact. This decrease is due to the amount fixed in different capacities, the low capacity of its steam makes more visible, so it is preferable to operate the boiler at high capacity, low efficiency is lower. The steam produced by the boiler process is preferred to work less at lower capacity. That's why most plants, capacity steam boiler with a capacity of up to several boiler allocated.

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