Boiler Efficiency

$P_{average} = 12$ bar Now 1.01325 bar = 0.101325 MN/m^2

12 bar = P

$P_{average} = 12 \times \frac{0.101325}{1.01325}$ MN/m^2

$P_{average} = 1.2\ MN/m^2 = 1.2\ MPa$

Determining h_2 (steam tables)

Pressure	h_F (KJ/Kg)	h_{fg} (KJ/Kg)	h_g
1.2 MPa	798.4	1984.3	2782.7

$h_2 = h_F + x\,h_{fg}$

$h_2 = 798.4 + (0.96) \times 1984.3$

$h_2 = 2703.33$ KJ/Kg

$h_1 = 659.94$ KJ/Kg

$h_1 = 113.1$ KJ/Kg

Boiler thermal Efficiency $= \frac{\text{energy to steam}}{\text{energy from fuel}} = \frac{\dot{m}_s (h_2 - h_1)}{(\dot{m} C_v)}$

energy to steam $= \dot{m}_s (h_2 - h_1) = 1.325475 (2703.33 - 113.10)$

$= 2708.46 = 3433.28$ KJ

energy from fuel $= \dot{m} C_v = 0.5427 \times 46 \times 10^6$

$= 24.964 \times 10^6$ J

Boiler thermal efficiency $\eta_{th} = \frac{3433.28 \text{ KJ}}{24\,964 \text{ KJ}} \times 100\% = 13.75\%$