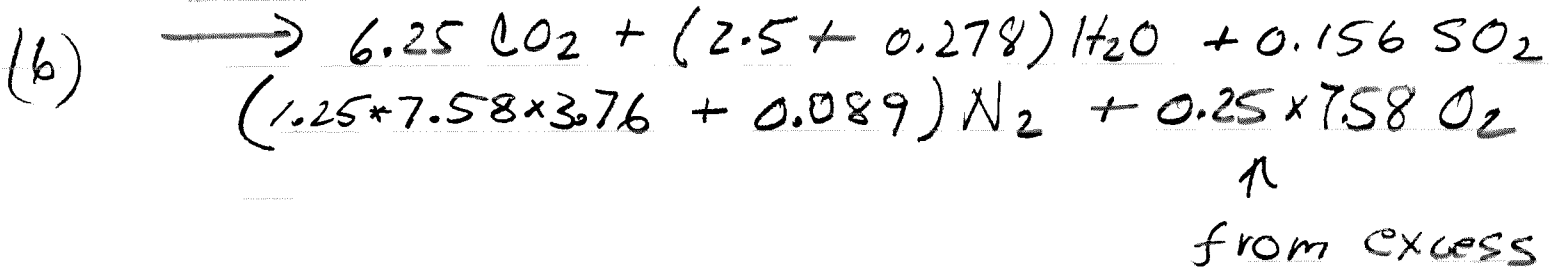
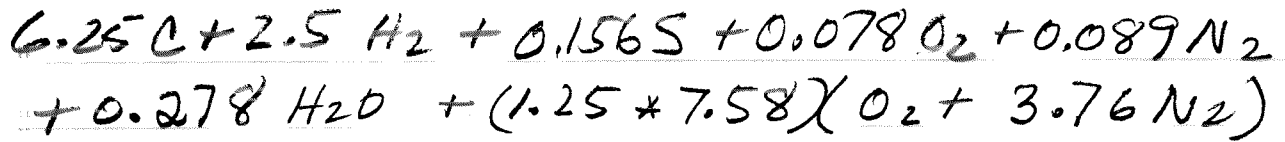


writing equation with 25% excess air



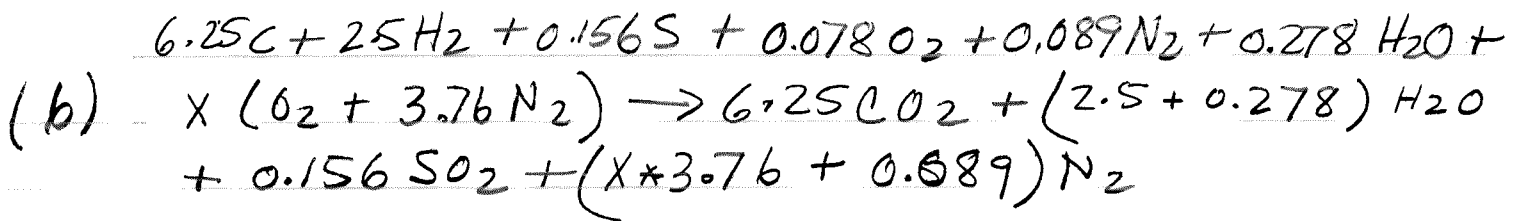
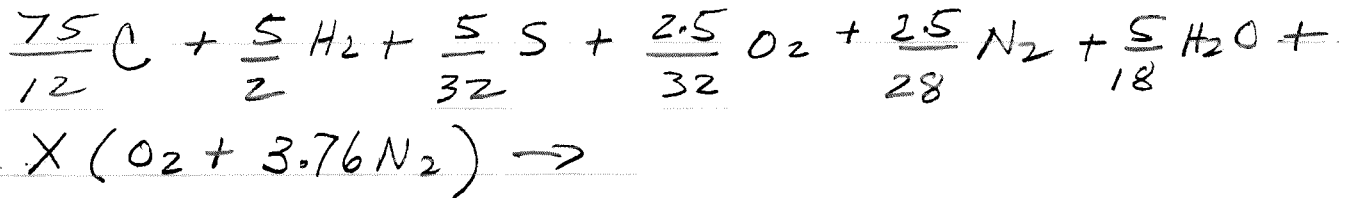
Composition $x = \frac{n}{n_{total}}$

Component	n_{wet}	X_{wet}	n_{dry}	X_{dry}
CO_2	6.25	0.134	6.25	0.142
H_2O	2.78	0.059	0	—
SO_2	0.156	333 ppm	0.156	354 ppm
N_2	35.7	0.763	35.7	0.811
O_2	1.90	0.040	1.90	0.043
total	46.8		44.8	

(2) $P_{H_2O} = P_a \times X_{H_2O} = 101 \times 0.059 = 6 \text{ kPa}$

(2) check steam tables $T_{sat} = T_{dew} = 36^\circ C$

① Convert mass to moles and write balanced equation for chemically correct complete combustion.



O₂ balance

(4) $0.078 + X = 6.25 + \frac{2.5}{2} + 0.156$
 to burn C H₂ S

Note the 0.278 H₂O appears on both sides and doesn't change balance

$X = 7.58$ Note we have assumed 100 kg of fuel

(4) $AF_c = \frac{m_a}{m_f} = \frac{7.58(32 + 3.76 \cdot 28)}{100} = \underline{10.4}$

with 25% excess air

(4) $AF = 1.25 AF_c = 13.0$

(2) The relative amounts of heat transfer in the furnace, where most boiling takes place, and the superheating region changes with the load.

- (5) (5) Attemperation
- Gas recirculation
- Separately fired superheater
- Excess air
- Gas bypass
- Moveable burners

(3) For each stage

$$\eta_s = \frac{\Delta h}{\Delta h_u} = \frac{h_1 - h_2}{h_1 - h_{2u}} = 0.8$$

4x(3) The same for all stages $\eta_s = 0.8$

(5)
$$\eta_{overall} = \frac{\Delta h}{\Delta h_u} = \frac{h_1 - h_5}{h_1 - h_{5u}} = 0.829$$

For equal stage efficiencies

(5)
$$R = \frac{\eta}{\eta_{stage}} = 1.036$$

(36)

$\dot{Q} - \dot{W} + \sum \dot{m}_e (h_e + h_{e2} + \frac{V_e^2}{2}) = 0$
 from steady state steady flow energy balance

(10)

$$\dot{W} = \dot{m} \left(h_1 + \frac{V_1^2}{2} - \left(h_5 + \frac{V_5^2}{2} \right) \right) \quad (4)$$

$$250 \times 10^3 \text{ kW} = \dot{m} \left(3297.1 - 2761 - \frac{50^2}{2 \times 1000} \right)$$

(6) $\dot{m} = 467 \text{ kg/s}$

to convert from J to kJ

$$\dot{m} = \rho VA = \frac{VA}{v} = \frac{50 \text{ A}}{0.193 \text{ m}^3/\text{kg}}$$

(7) $A = \frac{0.193 \frac{\text{m}^3}{\text{kg}} \times 467 \text{ kg/s}}{50 \text{ m/s}} = 1.8 \text{ m}^2$