Varmefræði - Dæmablað 4

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*Q5

$P_1 = 8 MPa$, $T_1 = 300°C$, $P_2 = 25 kPa$, $x = 0,85$

$W_{out} = 11 MW$

Enthalpy of steam when going in:

$$h_1 = h_{@8MPa,\,300°C} = 2786,5 \frac{kJ}{kg}$$

Now we find h_2 with

$$h_{f@25\,kPa} = 271,96 \frac{kJ}{kg}$$

$$h_{fg@25kPa} = 2345,5 \frac{kJ}{kg}$$

and we have

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

$$= 271,96 \frac{kJ}{kg} + 0,85 \cdot 2345,5 \frac{kJ}{kg}$$

$$= 2265,64 \frac{kJ}{kg}$$

And we get

$$\dot{m}(h_1 + c) = \dot{m}(h_2 + c) + W_{out}$$

$$\Rightarrow \dot{m} = \frac{W_{out}}{h_1 - h_2} = \frac{11\,MW \cdot \frac{1000\,kW}{MW}}{(2786,5 - 2265,64)\,kJ/kg}$$

$$= \underline{21,12\ kg/s}$$

BRUNNEN

*Q6] $P_1 = 7\ MPa$, $P_2 = 0{,}6\ MPa$

At input we have:

$$h_1 = h_{g@7MPa} = 2772{,}6\ \frac{kJ}{kg}$$

Throttling valves, we have energy balance so

$$h_1 \simeq h_2$$

At output we have:

$$h_2 = 2772{,}6\ \frac{kJ}{kg}$$

$$h_{g@0{,}6MPa} = 2756{,}2\ \frac{kJ}{kg}$$

Since $h_2 > h_g$ we have superheated steam

From table A6 we get:

$$h = 2756{,}2\ \frac{kJ}{kg} \rightarrow T = 158{,}83^\circ C$$

$$h = 2850{,}6\ \frac{kJ}{kg} \rightarrow T = 200^\circ C$$

Now using interpolation:

$$T_2 = 158{,}83 + \frac{(200 - 158{,}83)}{2850{,}6 - 2756{,}2} \cdot (2772{,}6 - 2756{,}2)$$

$$\simeq 166^\circ C$$

*Q10 $P_1 = 1{,}4\ MPa$, $T_1 = 500°C$ $\dot{m} = 31\ \frac{kg}{s}$

$T_2 = 60°C$ $W = 2450\ kW$

From table A6 we get

$$h_1 = h_{@500°C,\ 1{,}4MPa} = 3474{,}8\ \frac{kJ}{kg}$$

From table A4 we get

$$h_2 = h_{g@60°C} = 2608{,}8\ \frac{kJ}{kg}$$

Since the energy in and out are balanced:

$$E_{in} = E_{out}$$

$$\Rightarrow \dot{m} \cdot h_1 = \dot{m} \cdot h_2 + W_{out} + Q_{out}$$

$$\Rightarrow Q_{out} = \dot{m} \cdot h_1 - \dot{m} \cdot h_2 - W_{out} = 2346\ kW$$