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HW 6 Solution

Given: Mass In = 1.5 kg
Mass In Pressure = 10 kPa and Saturated Vapor
Process 1 is reversible and adiabatic

1. Find: ΔS for the left box in figure 1

Solution:

$$\Delta S = \int \frac{\delta Q}{T} + \sum m_{in} s_{in} - \sum m_{out} s_{out} + S_{gen}$$

From Given - $\int \frac{\delta Q}{T}$ and S_{gen} are zero

$$\Delta S = \sum m_{in} s_{in} - \sum m_{out} s_{out}$$

From Diagram - No m_{out}

$$\Delta S = m_{in} s_{in}$$

Given $P = 10$ kPa and $\dot{m} = 1.5$ kg/s
for a total of 2 seconds
and it's a saturated vapor

$s_{in} = 8.15$ kJ/kgK
$m_{in} = 3$ kg

$$\Delta S = 3\text{ kg} \cdot 8.15\text{ kJ/kg K} = \boxed{24.45 \frac{\text{kJ}}{\text{K}} = \Delta S}$$

2. Find S_{gen} for Process 2:

System: Entire Figure 2.

Given: • ΔS for whole Figure 2 does not change.

• Equilibrium implies half of mass travels to the second box in vacuum

Solution:

$$\Delta S = \int \frac{\delta Q}{T} + \sum m_{in} s_{in} - m_{out} s_{out} + S_{gen}$$

Because we look at the entire system, which is the hard decision for this problem, $m_{in} = m_{out}$ and $s_{in} = s_{out}$. ΔS also is zero.

So,

$$-\int \frac{\delta Q}{T} = S_{gen}$$

Only one flow into the system and S_{gen} can not be zero!

$$\frac{-15\,KJ}{293\,K} \rightarrow S_{gen} \text{ can not be negative.}$$

Not Possible