ANNOUNCED QUIZ #7 – ME 2030 –SECTION 001 – Fall 2024

NAME: SOLUTION

This is an open book quiz. You may use a four-function calculator. An unsigned honors pledge will result in a zero. Show all work.

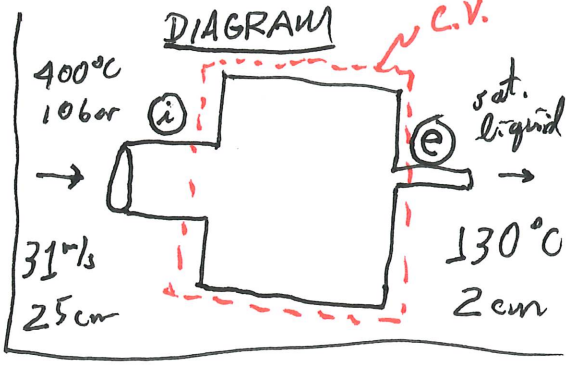
1. Consider a tank with a single inlet and a single exit. At the inlet, water enters at a temperature of 400°C, a pressure of 10 bar, and a velocity of 31 m/s. At the exit water leaves as a saturated liquid at a temperature of 130°C. If the inlet diameter is 25 cm and the exit diameter is 2 cm, determine the flow velocity at the exit. The tank is in steady-state. Report your answer in m/s.

GIVEN: P_i, T_i, V_i; exit saturated, T_e; d_i, d_e, H_2O; S.S.

FIND: V_e

ASSUME: v, p, T, V are uniform at inlet and exit (i.e., one-dimensional flow)

DIAGRAM



ANALYSIS: From eqn (4.5) for 1-D flow

$$\frac{dm_{C.V.}}{dt} = \sum_i \frac{A_i V_i}{v_i} - \sum_e \frac{A_e V_e}{v_e} \Rightarrow \sum_i \frac{A_i V_i}{v_i} = \sum_e \frac{A_e V_e}{v_e}$$

b/c S.S.

For single inlet/exit → $\boxed{\frac{A_i V_i}{v_i} = \frac{A_e V_e}{v_e}}$

From tables inlet is superheated and $v_i = 0.3066\ m^3/kg$

exit is saturated liquid → $v_e = v_f = 1.0697 \times 10^{-3}\ m^3/kg$

$$\frac{\pi d_i^2}{4}\frac{V_i}{v_i} = \frac{\pi d_e^2}{4}\frac{V_e}{v_e} \Rightarrow \frac{(0.25m)^2\, 31\, m/s}{0.3066\ m^3/kg} = \frac{(0.02m)^2\, V_e}{1.0697 \times 10^{-3}\ m^3/kg}$$

$$\boxed{V_e = 16.90\ m/s} \leftarrow \text{ANS.}$$

I HAVE NEITHER PROVIDED OR RECEIVED HELP DURING THIS QUIZ.

SIGNATURE