University of Nottingham

Department of Mechanical, Materials and Manufacturing Engineering

Thermofluids 3

Self Assessment Exercise Sheet - Exergy Analysis 1

Use Thermodynamic Tables for properties of air and steam.

a) Calculate the exergy of a flow of superheated steam. The mass flow rate is 25 kg/s. The temperature is 400 °C and the pressure is 40 bar. The environmental state is 15 °C and a pressure of 1 bar. (Assume that water is liquid at the environmental state) [31.65 MW]

b) Calculate the exergy of a flow of compressed air. The mass flow rate is 0.5 kg/s. The temperature is 25°C and pressure is 7 bar. The environmental state is 15°C and a pressure of 1 bar. [80.5 kW]

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1. Steam at 30 bar absolute and 350°C is supplied to a steam turbine which has an isentropic efficiency of 80%. The steam flow rate is 5 kg/s. The steam turbine exhaust is at a pressure of 2 bar absolute and the exhaust steam enters a heat exchanger where it is condensed. The condensate leaves the heat exchanger as saturated water at the steam turbine exhaust pressure. The heat is transferred to water which enters the heat exchanger at 60°C and leaves at 80°C. There are no heat losses from the heat exchanger. The environmental temperature is 20°C.

Calculate:

a) the power output from the steam turbine and the rate of heat transfer in the heat exchanger.

b) the rate of exergy loss in the steam turbine and the heat exchanger.

What are the reasons for the loss of exergy in the steam turbine and heat exchanger.

How would the loss of exergy in the heat exchanger be changed if the exhaust pressure of the steam turbine were reduced? What would be the effect on the power output from the turbine and the size of the heat exchanger.

[a) 2236 kW, 10810 kW, b) 425.2 kW, 1157.6 kW]