Chapter 16, Problem 2

Return to Questions (/admin/questions/0?sfield=magento_id&stext=0000087567&sdka=&stype=&sdiff=)

Test Bank Question preview

Question

A turbine receives steam at a rate of 12 kg/s. At the outlet, the steam is at 200°C and 0.10 MPa (enthalpy of 2875.5 kJ/kg). At the inlet, the steam is at 250°C and 0.20 MPa (enthalpy of 2971.3 kJ/kg). In addition, the steam experiences an increase in kinetic energy of 1.92 kJ/kg. Assume the turbine is adiabatic. The fluid power extracted by the turbine is most nearly

Answers

(A) 200 kW

(B) 350 kW

(C) 1200 kW

(D) 3500 kW

The answer is (C).

Solution

Determine the fluid power imparted by the turbine.

$$\begin{aligned}\dot{W}_{\text{turb}} &= \dot{m}\left(h_e - h_i + \frac{\text{v}_e^2 - \text{v}_i^2}{2}\right) = \dot{m}\,(h_e - h_i + \Delta\text{KE}) \\ &= \left(12\ \frac{\text{kg}}{\text{s}}\right)\left(2875.5\ \frac{\text{kJ}}{\text{kg}} - 2971.3\ \frac{\text{kJ}}{\text{kg}} + 1.92\ \frac{\text{kJ}}{\text{kg}}\right) \\ &= -1126.56\ \text{kJ/s} \quad (1200\ \text{kW})\end{aligned}$$

QUESTION DATA

Vendor
0000087567
Solving Time

Difficulty
easy
Quantitative?
No
Status
Active
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07/11/2018 09:28:09 PM
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01/03/2020 08:32:49 PM

OTHER VERSIONS

03/22/2016 08:52:45 PM (/admin/questions/preview/91

07/11/2018 09:28:09 PM (/admin/questions/preview/111

DISCIPLINES
KNOWLEDGE AREAS
PRODUCTS USED IN
FECHPPW
FEMEPPW

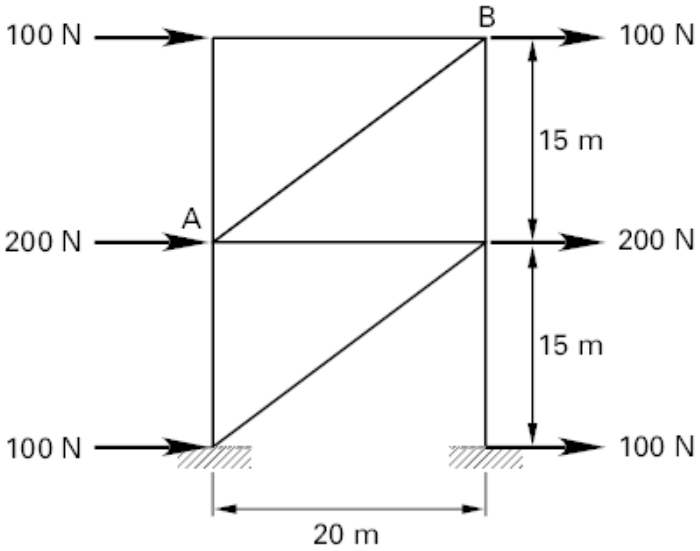
Chapter 29, Problem 4

Return to Questions (/admin/questions/0?sfield=magento_id&stext=87724&sdka=&stype=&sdiff=)

Test Bank Question preview

Question

The braced frame shown is constructed with pin-connected members and supports. All applied forces are horizontal.



Most nearly, what is the force in the diagonal member BA?

Answers

(A) 0 N

(B) 160 N

(C) 200 N

(D) 250 N

The answer is (D).

Solution

Determine the length of member BA by recognizing this configuration to be a 3-4-5 triangle.

$$L_{\mathrm{BA}} = 25\ \mathrm{m}$$

Use the method of sections. Cut the frame horizontally through member BA.

QUESTION DATA

Vendor
0000087724
Solving Time
2-4
Difficulty
medium
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Yes
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OTHER VERSIONS

05/31/2017 06:41:25 P (/admin/questions/prev

03/08/2018 07:35:49 P (/admin/questions/prev

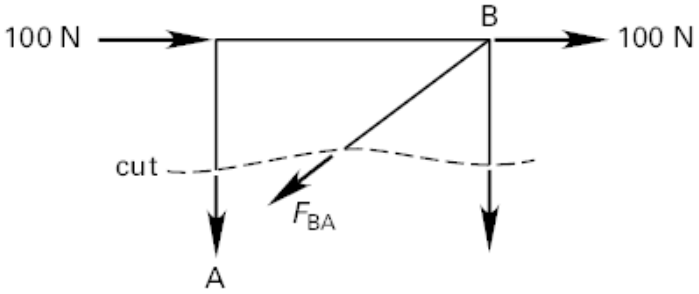
09/16/2019 07:14:57 P (/admin/questions/prev

12/18/2019 08:07:07 P (/admin/questions/prev

DISCIPLINES

FE Civil (/admin/questions/inde sfield=discipline&stext= Civil)

FE Mechanical (/admin/questions/inde



By inspection, the horizontal component of F_{BA} balances the two applied horizontal loads.

$$\mathrm{BA}_x = 100\ \mathrm{N} + 100\ \mathrm{N} = 200\ \mathrm{N}$$

By similar triangles,

$$\mathrm{BA} = \left(\frac{5}{4}\right)(200\ \mathrm{M}) = 250\ \mathrm{M}$$

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Mechanical)

FE Other Disciplines
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Other Disciplines)

KNOWLEDGE AREAS

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PRODUCTS USED IN
FEMEPPW
FECEPPW
FECHPPW

Chapter 44, Problem 3

Return to Questions (/admin/questions/0?sfield=magento_id&stext=0000088708&sdka=&stype=&sdiff=)

Test Bank Question preview

Question

Aeration of a 500 m^3 wastewater pond is required as part of a bioremediation plan. Ten spargers located 4.6 m below the surface bubble compressed air through the pond at a rate of 0.425 m^3/min each. The mass transfer provided by each sparger is given as a transfer factor (the overall liquid mass-transfer coefficient multiplied by the ratio of the average interfacial area of bubbles to volume of solution) equal to 0.0680 h^{-1}. Most nearly, how long will it take to increase the water's dissolved oxygen concentration from 3 mg/L to 6 mg/L?

Answers

(A) 6.7 min

(B) 40 min

(C) 150 min

(D) 390 min

The answer is (B).

Solution

Mass transfer can be expressed in terms of the overall liquid mass-transfer coefficient, K_L. In this case, K_L is per sparger (not per sparger area), and since there is no well-defined sparger area, the variable *A* is interpreted as the number of spargers.

$$\frac{N_{O_2}}{A} = K_L(C^*_{O_2} - C_{O_{2,L}})$$

Expressed in differential form, the equation becomes

$$\frac{dN_{O_2}}{dt} = K_L A(C^*_{O_2} - C_{O_{2,L}})$$

Separating variables and integrating yields

QUESTION DATA

Vendor
0000088708
Solving Time
2-4
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medium
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Status
Active
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OTHER VERSIONS

DISCIPLINES

FE Other Disciplines (/admin/questions/index?sfield=discipline&stext=FE Other Disciplines)

PE Mechanical: HVAC and Refrigeration (/admin/questions/index?sfield=discipline&stext=PE

$$\int_{C_{\mathrm{O}_2,L|0}}^{C_{\mathrm{O}_2,L|t}} \frac{dC_{\mathrm{O}_2,L}}{C^*_{\mathrm{O}_2} - C_{\mathrm{O}_2,L}} = K_L A \int_0^t dt$$

$$\ln \frac{C^*_{\mathrm{O}_2} - C_{\mathrm{O}_2,L|0}}{C^*_{\mathrm{O}_2} - C_{\mathrm{O}_2,L|t}} = K_L A t$$

$$\begin{aligned} t &= \ln \frac{C^*_{\mathrm{O}_2} - C_{\mathrm{O}_2,L|0}}{C^*_{\mathrm{O}_2} - C_{\mathrm{O}_2,L|t}} \left(\frac{1}{K_L A} \right) \\ &= \ln \frac{11.3\ \frac{\mathrm{mg}}{\mathrm{L}} - 3.0\ \frac{\mathrm{mg}}{\mathrm{L}}}{11.3\ \frac{\mathrm{mg}}{\mathrm{L}} - 6.0\ \frac{\mathrm{mg}}{\mathrm{L}}} \\ &\quad \times \left(\frac{1}{\left(\frac{0.0680}{\mathrm{h} \cdot \mathrm{sparger}} \right) \left(10\ \mathrm{spargers} \right)} \right) \left(60\ \frac{\mathrm{min}}{\mathrm{h}} \right) \\ &= 39.6\ \mathrm{min} \quad (40\ \mathrm{min}) \end{aligned}$$

Mechanical: HVAC and Refrigeration)

PE Mechanical: Thermal and Fluid Systems (/admin/questions/index?sfield=discipline&stext=PE Mechanical: Thermal and Fluid Systems)

KNOWLEDGE AREAS

Thermodynamics and Heat Transfer (/admin/questions/ind sfield=area&stext=Thermodyn and Heat Transfer)

Heat Transfer (/admin/questions/index?sfield=area&stext=Heat Transfer)

Heat Transfer Principles (/admin/questions/index?sfield=area&stext=Heat Transfer Principles)

PRODUCTS USED IN FECHPPW

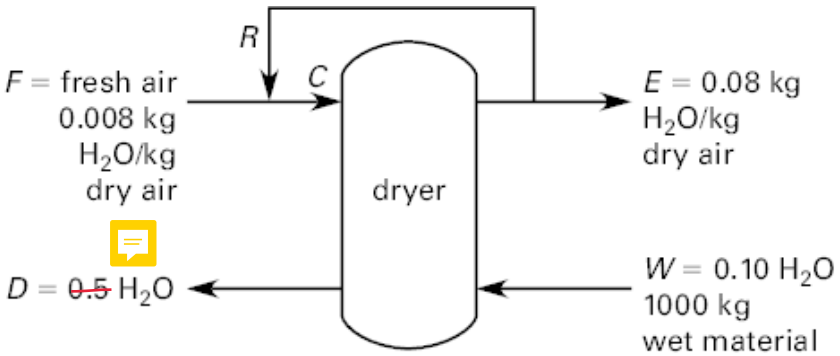
Chapter 46, Problem 1

Return to Questions (/admin/questions/0?sfield=magento_id&stext=0000088744&sdka=&stype=&sdiff=)

Test Bank Question preview

Question

A drying process with drying air recycle has a drying air inlet moisture mass fraction of 0.008 kg H_2O/kg dry air and an outlet moisture mass fraction of 0.08 kg H_2O/kg dry air. 1000 kg of moist material is introduced to the dryer. The material contains 10% (by mass) moisture and is to be dried to 5% (by mass) moisture. The mass fraction of moisture in stream *C* is 0.01 kg water/kg dry air. The dryer operates as shown. (*F*, *R*, *C*, *E*, *D*, and *W* represent individual streams.)



Most ~~nearly,~~ what is the total mass of stream *R*?

Answers

(A) 21 kg

(B) 38 kg

(C) 54 kg

(D) 78 kg

The answer is (A).

Solution

The overall mass balance of the system is

$$m_{\text{in}} = m_{\text{out}}$$

Complete a mass balance of the moist material, *W*. The mass of moist material out, *D*, is

QUESTION DATA

Vendor
0000088744
Solving Time

Difficulty
easy
Quantitative?
No
Status
Active
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OTHER VERSIONS

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DISCIPLINES
KNOWLEDGE AREAS
PRODUCTS USED IN
FECHPPW

$$\begin{aligned} y_W W &= y_D D \\ D &= \frac{y_W W}{y_D} \\ (1 - 0.10)(1000 \text{ kg}) &= (1 - 0.05)D \\ D &= 947.5 \text{ kg} \end{aligned}$$

The amount of water removed is

$$\begin{aligned} \text{water removed} &= W - D = 1000 \text{ kg} - 947.4 \text{ kg} \\ &= 52.6 \text{ kg} \end{aligned}$$

Perform an overall system total mass balance.

$$\begin{aligned} W + F &= D + E \\ 1000 \text{ kg} + F &= 947.37 \text{ kg} + E \\ F - E &= -52.63 \text{ kg} \end{aligned}$$

Complete a water balance around the system.

$$\begin{aligned} x_W W + w_F F &= x_D D + x_E E \\ (0.1)(1000 \text{ kg}) + \left(\frac{0.008}{1.008}\right) F &= (0.5)(947.4 \text{ kg}) + \left(\frac{0.08}{1.08}\right) E \\ 100 \text{ kg} + 0.0079F &= 47.37 \text{ kg} + 0.074E \\ 0.0079F - 0.074E &= -52.63 \text{ kg} \end{aligned}$$

Substitute the overall system balance equation.

$$\begin{aligned} 0.0079(E - 52.63) - 0.074E &= -52.63 \\ 0.0661E &= 52.214 \text{ kg} \\ E &= 789.9 \text{ kg} \\ F - E &= F - 789.9 \text{ kg} = -52.63 \text{ kg} \\ F &= 737.30 \text{ kg} \end{aligned}$$

The mass of the dry air in the feed air is

$$\begin{aligned} z_F &= F\left(\frac{1}{1.008}\right) = (737.30 \text{ kg})\left(\frac{1}{1.008}\right) \\ &= 731.45 \text{ kg} \end{aligned}$$

The mass balance around the point where the recycle loop joins the feed (i.e., where *C* is the flow into the dryer with the recycled and feed air) is

$$\begin{aligned} m_{W,F} + m_{W,R} &= m_{W,C} \\ x_F F + x_R R &= x_C C \end{aligned}$$

Perform a water balance to find the mass of recycled air.

$$
\begin{aligned}
(731.45\ \text{kg})\left(0.008\ \frac{\text{kg H}_2\text{O}}{\text{kg dry air}}\right) \\
+R\,(0.08) &= (731.45\ \text{kg} + R)(0.01) \\
5.85\ \text{kg} + \cancel{0.8}R &= 7.3145\ \text{kg} + 0.01R \\
0.07R &= 1.465\ \text{kg} \\
R &= 20.92\ \text{kg} \quad (21\ \text{kg})
\end{aligned}
$$