

CONTOH - DESAIN IMPELLER BLOWER ⑦

Blower 2 tingkat, beroperasi pd 3600 rpm dengan
debit 16000 ft³/menit. Tekanan udara luar 14,7 psia dan koef
isien pembuangan 8,5 pig.

Jawab

Perbandingan tekanan overall : $E_p = \frac{14,7 + 8,5}{14,7} = 1,578$.

Tekanan pada sisi masuk $p_0 = 14,7 \times 144 = 2117 \frac{\text{lb}}{\text{ft}^2}$ absolut

Temperatur luar $60 + 460 = 520^\circ \text{R}$.

Volume spesifik $v = \frac{RT_0}{p_0} = \frac{53,34 \cdot 520}{2117} = 13,1 \frac{\text{ft}^3}{\text{lb}}$.

Massa aliran $w = \frac{Q p_0}{60} = \frac{16000 \cdot 0,0763}{60} = 20,35 \frac{\text{lb}}{\text{s}}$.

Ugri tekanan pada kondisi pendesainan:

$$H_{ad} \frac{\frac{p_0 v_0}{k-1}}{\frac{k-1}{k}} (E_p^{\frac{k-1}{k}} - 1) = \frac{RT_0}{k} (E_p^{\frac{k-1}{k}} - 1)$$
$$= \frac{2117 \cdot 13,1}{0,283} (1,578^{0,283} - 1) = \frac{53,34 \cdot 520}{0,283} (1,578^{0,283} - 1)$$
$$= 13500 \text{ ft}.$$

Ugri tekanan adiabatik per tingkat : $H_{ad} = \frac{13500}{2} = 6750 \text{ ft}$.

Berat spesifik udara : $\rho_a = \frac{p_a}{RT_a} = \frac{144 \cdot 14,7}{53,34 \cdot 520} = 0,0763 \frac{\text{lb}}{\text{ft}^3}$

Taya kuda adiabatik : $H_{ad} = \frac{w \cdot H_{ad}}{550} = \frac{20,35 \cdot 6750}{550} = 249,7 \frac{\text{HP}}{\text{tingkat}}$

Taya kuda total = $2 \cdot 249,7 = 499,4 \text{ HP}$.

KURAN² PISIR MASUK IMPELLER :

Ugri beraturan balok kecepatan melalui mata
impeller $v_0 = 175 \text{ ft/s}$, maka:

Ugri tekanan akibat kecepatan : $\frac{v_0^2}{2g} = \frac{175^2}{2 \cdot 32,2} = 476 \text{ ft}$

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$$= \frac{RT_a}{\frac{h-1}{h}} \left(E_p^{\frac{h-1}{h}} - 1 \right)$$

$$= \frac{RT_a}{0,283} \left(E_p^{0,283} - 1 \right)$$

$$E_p^{0,283} - 1 = \frac{0,283 \cdot H}{R \cdot T_0}$$

$$E_p^{0,283} - 1 = \frac{0,283 \cdot 476}{53,34 \cdot 520}$$

$$E_p^{0,283} - 1 = 0,00486$$

$$E_p^{0,283} = 1,00486 \rightarrow E_p = \underline{1,0173}$$

$$P_0 = \frac{14,7}{1,0173} = 14,45 \text{ psia}$$

$$T_0 = \frac{T_a}{E_p^{0,283}} = \frac{520}{1,00486} = 517,5^\circ \text{F absolut}$$

Bobot spesifik udara didalam mata impeller:

$$\rho_0 = \frac{P_0}{R T_0} = \frac{144 \cdot 14,45}{53,34 \cdot 517,5} = 0,0754 \text{ lb/ft}^3$$

Laju aliran melalui mata impeller:

$$Q_0 = \frac{W}{\rho_0} = \frac{20,35}{0,0754} = 270 \text{ ft}^3/\text{s}$$

Diameter poros (D_s) berdasarkan kecepatan kritis yaitu tabel dari Austin hal 284 yang besarnya adalah 8 inchi sly diameter hub = 9 inchi.

Diameter mata impeller:

$$D_0 = \sqrt{\frac{4}{\pi} \frac{144 Q_0}{V_0} + D_H^2} = \sqrt{\frac{4 \cdot 144 \cdot 270}{175} + 9^2} = \underline{19 \text{ inchi}}$$

Diameter sisi masuk sudu D_1 dapat dibuat sedikit lebih besar yaitu $19 \frac{1}{2}$ inchi.

Kecepatan ujung sudu sisi masuk:

$$U_1 = \frac{\pi D_1 n}{60} = \frac{\pi \cdot 19,5 \cdot 3600}{60} = 3673,8 \frac{\text{inchi}}{\text{s}} = 306 \frac{\text{ft}}{\text{s}}$$