Problem 15-15

Goal: Determine filter area and cost of a Rotary Vacuum Filter

Given: Time Value of money interest rate 0.053

		Original		New	
operating RPM	N_r	2	rpm	1.5	rpm
total filtering area	A_D	0.75	m^2	*find*	m^2
filtrate produced	$v_R N_r$	0.3	m^3/minute	3	m^3/minute
operating pressure drop	ΔP	140	kPa	100	kPa
fraction submerged	Ψ_f	0.2		0.2	
M&S Cost Index		1,102.5	Jan.2002	1431.7	current = 2nd quarter 2008

Approach: Volume of filtrate per minute is given by Eq. (15 - 101b)

volume filtrate/time = $v_R N_r = A_D [(2 \Psi_f N_r \Delta P)/(\alpha w \mu)]^{1/2}$

Since α, w, and μ remain constant in both filters, solve 15-101b original small filter for $\alpha w \mu$

$(\alpha w \mu) = [(2 \Psi_f N_r \Delta P)/] / (v_R N_r / A_D)^2$

Solve 15-101b for new larger filter area A_D

$A_D = v_R N_r / [(2 \Psi_f N_r \Delta P)/(\alpha w \mu)]^{1/2}$

Purchased cost of filter from Fig. 15-39 (in Jan. 2002 $'s)
update to current cost using M&S equipment cost index

Calculations:

$\alpha w \mu$ 700.0 =(2*E11*E7*E10)/((E9/E8)^2) = $(2 \Psi_f N_r \Delta P)/(v_R N_r/A_D)^2$ = $2(0.2)(2)(140)/(0.3/0.75)^2$

Answer (a) A_D **10.25** m^2 =G9/((2*G11*G7*G10/E29)^0.5) = $v_R N_r/(2 \Psi_f N_r \Delta P)^{1/2}$ = $3/[2(0.2)(1.5)(100)]^{1/2}$

read Fig. 15-39 $120,000

update to present $155,831

Answer (b) round off **$156,000**

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