Direct relation for Capacitor sizing:

$$KVAR \text{ rating} = kw[\tan\phi_1 - \tan\phi_2]$$

where, KVAR rating is the size of the capacitor needed, kw is the average power drawn, ~~tan φ~~

ϕ_1 = Existing PF angle $\qquad \phi_1 = \cos_1^{-1}(PF_1)$

ϕ_2 = Improved PF angle $\qquad \phi_2 = \cos_2^{-1}(PF_2)$

Example: The utility bill shows an average power factor of 0.62 with an average kw of 527. How much KVAr is required to improve the power factor to 0.85? , V = 415 volt

Soln

$\cos\phi_1 = 0.62 \qquad \tan\phi_1 = \tan(51.68) = 1.26$

$\cos\phi_2 = 0.85 \qquad \tan\phi_2 = \tan(31.78) = 0.61$

$\cos^{-1}(0.62) = \phi_1 = 51.68$

$\cos^{-1}(0.85) = \phi_2 = 31.78$

$$\begin{aligned} KVAr \text{ Required} &= P(\tan\phi_1 - \tan\phi_2) \\ &= 527 \times 10^3 (1.26 - 0.61) \\ &= 342 \text{ KVAR} \end{aligned}$$

Reduction in Current drawn ⇒

$PF = 0.62 \Rightarrow \qquad P = VI_1\cos\phi = 415 * I * 0.62 = 527 \times 10^3$

$$\boxed{I_1 = 2.048 \text{ kA}}$$

$PF = 0.85 \Rightarrow \qquad 527 \times 10^3 = 415 * I_2 * 0.85$

$$I_2 = 1493.97 \text{ A}$$

Reduction in Current $= I_2 - I_1 = 186$ A

Reduction in KVA

$\cos\phi_1 = \dfrac{kw}{KVA_1}$

$\cos\phi_2 = \dfrac{kw}{KVA_2} \qquad KVA_2 - KVA_1 = \_\_\_$