Proposal, how to assess the financial attractiveness of switching to a variable speed drive.

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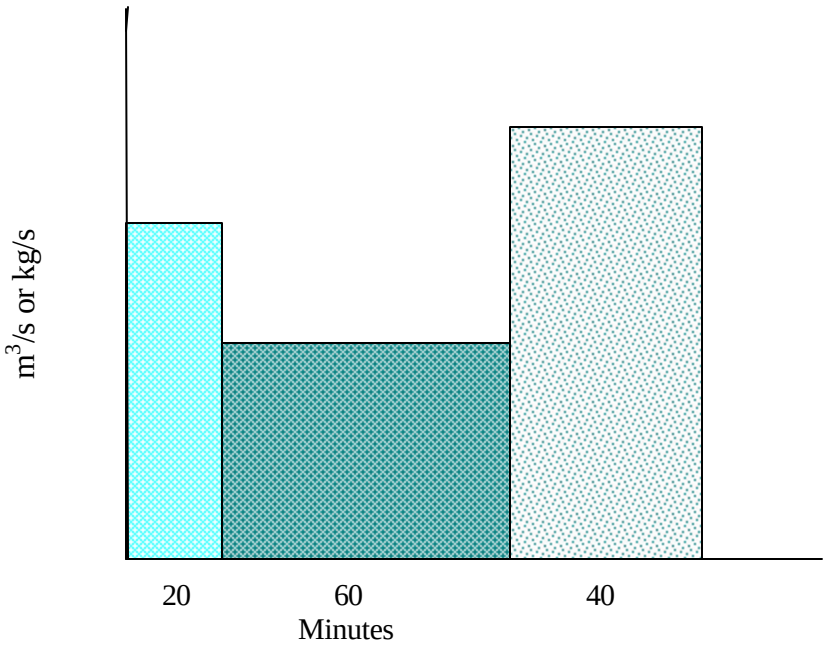
Step 1. Establish duty cycle chart. Express, if possible, the load in units of a flow rate (m^3/s or kg/s) because your system is in most cases pumping a fluid (i.e. air, water, stack gas).



Step 2. Use the following equation for each segment of the cycle to calculate the required demand in Watt on the system depending on the flow rate

$$\text{Watt} = \frac{\Delta P * \dot{v}}{h_{motor} * h_{Fan\,/\,pump}}$$

Where ΔP = Pressure drop in Pascal.
100,000 Pascal = 1 bar
100 Pascal = 1 cm water column.

$\dot{v}$ = Fluid flow rate in m^3/s

h_{motor} = The efficiency of the motor, subtract 2% - 6% loss of transmission if not direct coupled to the pump/fan.

$h_{Fan\,/\,pump}$ = The efficiency of the fan or pump at the given flow rate and pressure drop.

Note: It is important that an energy manager when buying a motor or fan insists on getting the so called performance curves of the equipment as shown in picture 1 and picture 2. Without these curves supplied by reputed equipment manufacturers, one cannot continue the assessment.

Step 3. Construct table to calculate annual kWh consumption and Rs costs for the proposed system

Segment	h_{motor}	$h_{Fan/ Blower}$	Watt	hours/ year	kWh/ year	Rs/ year
1						
2						
3						
Sum						

Step 4. Compare the existing system with the proposed system in terms of costs and calculate anticipated annual savings.

Annual savings are S = Present Costs - Sum of step 3

Step 5. Calculate financial attractiveness by the equation

$$S = \frac{q^n(q-1)}{q^n - 1} * I$$

Where n = the technical life of the proposed system

q = 1 + i, where i = interest rate fraction

I = Investment, i.e. cost of VSD and other costs.

Use a calculator and solve by trial and error for i. Observe that S was calculated in step 4 and I is the investment for retrofitting the system with a variable speed drive.

Step 6. Present the calculated interest rate "i" to your management and tell them this is the internal rate of return before taxes, if the measure is implemented. Management will tell you if "i" is acceptable.

Advantages of this approach

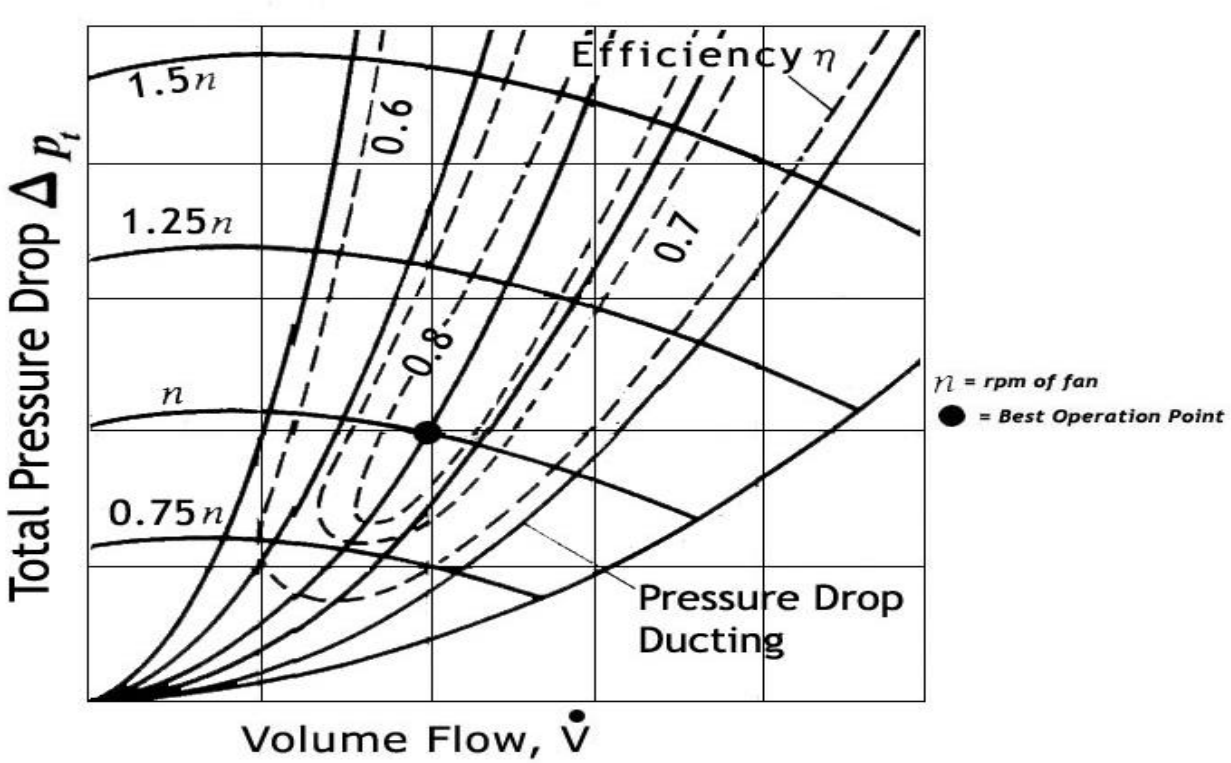
- Very focused and precise method.

Disadvantages

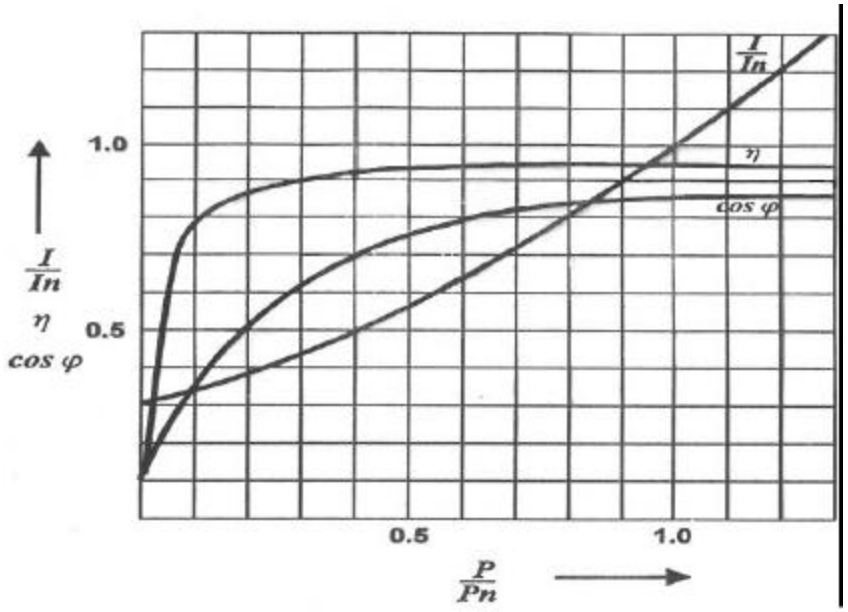
- Requires performance charts from equipment suppliers. Energy managers should have such charts anyway.

- If future repair and maintenance costs for the VSD are high, than step 5 will overestimate the internal rate of return. In this case it is best to superficially increase I for the R+M costs, over the technical life. This will certainly underestimate the internal rate of return. The truth is somewhere in between.

Picture 1: Performance chart of radial fan.



Picture 2: Performance chart of electric motor



In = nominal current in Amp
I = actual current in Amp
Pn = nominal power capacity in kW
P = actual power in kW
cos *j* = power factor
h = efficiency of motor