GOOD PRACTICES IN SME

Installing frequency converters in fan motors

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Ministry of Climate and Environment

European Union

KAPE
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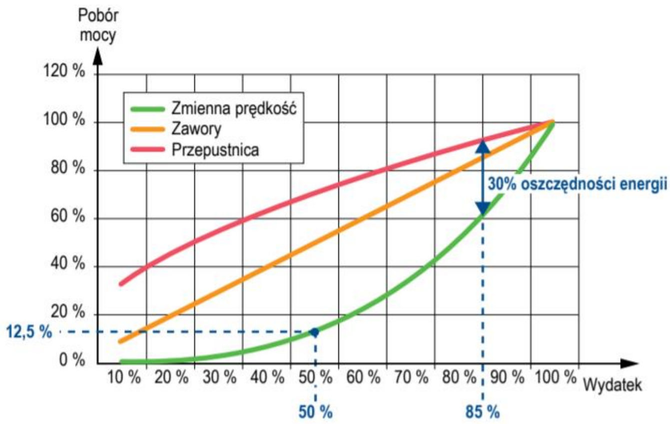
When to use frequency converters in fan motors?

Regulating rotational speed is used in cases requiring the constant adjustment of parameters during use. Whenever the range of the regulated parameters is wide, the commonly used throttle regulation is not very economical, similarly for bleed control. Controlling the motor's rotational speed using variable speed drives could lead to significantly improved energy savings connected to enhanced process control, lower equipment wear, and lower noise. When demand is lower, variable speed drives can lower energy consumption particularly in impeller pumps, compressors, and ventilators – usually by between 4% and 50%.

In the case of variable speed ventilators, pumps, or other centrifugal equipment, energy consumption changes proportionally to the speed cubed. In other words, by an energy expenditure of 50%, energy consumption is only 12,5% of the motor's nominal power. Lowering the speed by just 15% allows for 30% of energy savings in comparison to regulation using a bleed control system.



Graph: y-axis: Power used, x-axis: cost,
Legend: green: variable speed, yellow: bleed, red: throttle,
Text: 30% energy savings

Over a narrow regulation range, it is often cost-effective to use bleed control, because using variable speed regulation is necessarily linked to additional energy loss (loss in drive). It can be estimated, that if the level of bleed control required by the pump does not exceed 8%, then bleed control will probably appear the most cost-effective, although this significantly depends on the magnitude of the flow.

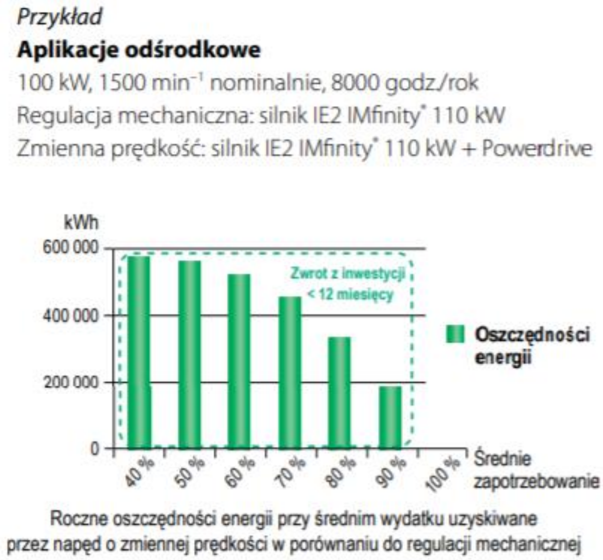
Source: cited from: European Commission „ Reference Document on Best Available Techniques for Energy Efficiency", 2009; Nidecautomation „Rozwiązania o wysokiej efektywności", 2019; Andrzej Misiewicz, Wojciech Misiewicz „Napędy regulowane w układach pompowych źródeł ciepła", 2008

Pic. 1 Ventilators: Radial fan

Pic. 2 Ventilator: axial fan

Average return of investment for frequency converters

In recent decades, the relative cost of variable speed drives fell, while the price of energy increased. As a result, using variable speed drives became more cost-effective in almost all rotational appliances. Over the entire lifetime of the drive, the price of energy is the dominating factor. Replacing mechanical regulation with a solution adjusting the motor's speed leads to significantly lower energy consumption and lowers the cost of mechanical maintenance. Taking this into account, the ROI often takes place within a year.



Text (top):
Example
Centrifugal applications
100 kW, 1500 min^{-1} nominally, 8000 h/annually
Mechanical regulation: IE2 IMfinity 110 kW motor*
Variable speed: IE2 IMfinity 110 kW motor + Powerdrive*
Graph (middle):
y-axis: kWh, X-axis: average consumption in %
ROI > 12 months, Green = Energy savings
Text (bottom):
Annual energy savings in average use case scenarios achieved by variable speed motors in comparison to mechanical regulation

Source: cited from: Nidecautomation „Rozwiązania o wysokiej efektywności", 2019; Danfoss Drives „Katalog doboru produktów 0,25 kW–2 MW", 2016

How to estimate savings resulting from installing a variable speed drive in a ventilator?

To estimate savings which could be achieved by a variable speed drive we can use the following formula:

$$\Delta k = (\Delta P_1 \times t_1 + \Delta P_2 \times t_2 + \cdots + \Delta P_n \times t_n) \times k$$

Δk – annual saving $[\frac{PLN}{year}]$

ΔP_1 – difference between energy consumed by the ventilator with a throttle control and a ventilator using a variable speed drive for power Q_1 [kW]

t_1 – time of use at power Q_1 [h/year]

k – price of electrical energy $[\frac{PLN}{kWh}]$

What savings could be achieved by installing a variable speed drive assuming the ventilator uses 90% of its power?

The estimated savings [PLN/year], which could be achieved by replacing throttle control with a variable speed drive in cases where the ventilator uses 90% of its power and an energy cost of 0,55 PLN/kWh:

	Electric power of the ventilator at optimal operation [kW]							
Time working at 90% [h/year]	10	20	30	40	50	60	75	90
500	413 PLN	825 PLN	1 238 PLN	1 650 PLN	2 063 PLN	2 475 PLN	3 094 PLN	3 713 PLN
1000	825 PLN	1 650 PLN	2 475 PLN	3 300 PLN	4 125 PLN	4 950 PLN	6 188 PLN	7 425 PLN
1500	1 238 PLN	2 475 PLN	3 713 PLN	4 950 PLN	6 188 PLN	7 425 PLN	9 281 PLN	11 138 PLN
2000	1 650 PLN	3 300 PLN	4 950 PLN	6 600 PLN	8 250 PLN	9 900 PLN	12 375 PLN	14 850 PLN
2500	2 063 PLN	4 125 PLN	6 188 PLN	8 250 PLN	10 313 PLN	12 375 PLN	15 469 PLN	18 563 PLN
3000	2 475 PLN	4 950 PLN	7 425 PLN	9 900 PLN	12 375 PLN	14 850 PLN	18 563 PLN	22 275 PLN
3500	2 888 PLN	5 775 PLN	8 663 PLN	11 550 PLN	14 438 PLN	17 325 PLN	21 656 PLN	25 988 PLN
4000	3 300 PLN	6 600 PLN	9 900 PLN	13 200 PLN	16 500 PLN	19 800 PLN	24 750 PLN	29 700 PLN
4500	3 713 PLN	7 425 PLN	11 138 PLN	14 850 PLN	18 563 PLN	22 275 PLN	27 844 PLN	33 413 PLN
5000	4 125 PLN	8 250 PLN	12 375 PLN	16 500 PLN	20 625 PLN	24 750 PLN	30 938 PLN	37 125 PLN

Source: KAPE