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2006/06

Constant pressure central extract systems

EC Motors and backward curved fans come together to save a tonne of CO^2

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Central extract systems are becoming a popular method of ventilating multiple rooms such as a housing complex. The system pioneered in Scandinavia provides a quiet, flexible and efficient solution. The efficiency has now been further advanced by improving the fan technology and using high efficient EC fans. This case study demonstrates that an extra tonne of carbon dioxide can be saved with EC fans in a typical extract system servicing 12 apartments.

Traditionally kitchens, bathrooms and toilets have been ventilated by individual ventilators. These are easy to install, especially as a later improvement. However this requires these rooms to be on the outside of the building so that wall or window ventilators can be used. Where a room is within a building then a duct is required to attach to the fan to exhaust to the outside of the building. Ducts on small single room ventilators add considerable power consumption. Furthermore the local extract fans are noisy close to the habitants.

Central Extract systems solve the need for kitchen, bathrooms and toilets to be located on the outside of the building. Figure 1 shows how one extract unit is mounted on the roof of the building and a duct is connected to a number of rooms. These rooms can be located anywhere within the building. The one single extract unit only uses one large fan instead of the multiple small fans. Large fans are more efficient than small ones and the larger one is designed to operate with the higher pressure of the duct efficiently.

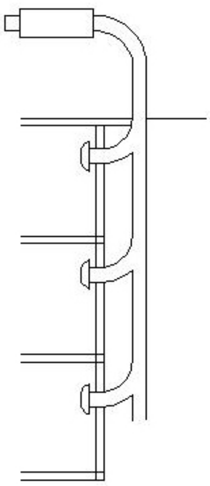

Figure 1 sketch of a central extract system

Control of the ventilation flow is relatively simple. A pressure sensor measures the pressure within the central duct and is connected to a fan control unit set to run the fans at variable speed to maintain a constant pressure within the duct. Located within the individual rooms are dampers that can be opened and closed to regulate the ventilation extract rate. As the damper is opened, the pressure in the duct drops; the fans increase speed to recover the pressure and in doing so increases the volume flow to extract from the room. Conversely when the damper is closed to reduce the ventilation the pressure in the duct rises, the fans regulate slower to reduce the pressure back to the desired value also reducing the volume flow.

The latest technique of occupancy sensors means that the control of the extract rate occurs without the intervention of the habitants. Indeed they often will not know that there is constant and variable ventilation as they can no longer hear the fans. The large single fan located away from the dwelling is quieter than the small local fan.

EC fans have now pushed the boundaries of this efficient system to save even more energy and Carbon emissions. EC motors are DC motors with integral AC to DC conversion providing the high efficiency and controllability of DC motors with the flexibility of connection to EC mains supply. This case study compares a typical double inlet forward curved blower of 250 mm diameter with an AC motor, figure 2, to that of a backward curved 400 mm diameter plug fan with EC motor, figure 3.

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Figure 2 double inlet forward curve blower with AC induction motor

Figure 3 backward curved plug fan with EC motor

In this case study the EC fan provides a number of improvements;

- The EC motor is more efficient than the AC motor. The forward curved blower uses a 1.1 kW induction motor of <80% efficiency and the backward curved plug fan uses a 0.4 kW EC motor of >85% efficiency.
- The AC motor efficiency reduces considerably with variable voltage speed control. Variable voltage control increase motor losses to effect a reduction in motor speed. Conversely the EC motor does not and so maintains the efficiency at reduced motor speed. In this application the fan speed is constantly changing and is run at reduced speed for long periods of time.
- The EC fan is a backward curved fan and is more efficient. The double inlet forward curved blower is in the order of 50% and the backward curve 70%. The efficiency varies with the duty point.
- The EC fan is also simple to control with a simple 0-10V analogue speed control input. In some instances an additional control unit is not required as the sensor can be connected to the EC fan and its internal PID control can be set to accordingly, see figure 4.

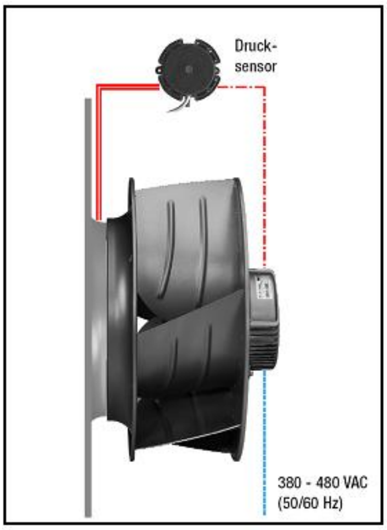

Figure 4 pressure sensor connected directly to the EC fan

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The energy saving of the EC fan is demonstrated with the following table. The data compares power inputs at different volume flow conditions with a constant 150 Pa pressure within the duct. There is a significant energy saving from 156 W to 524 W. With 24 hours per day operation and an average duty of 2000 m³/h there is one tonne of Carbon Dioxide emission to be saved.

Volume flow (m³/h)	Forward curved fan with single phase AC induction motor - power input (W)	Specific fan power of FC AC fan (W/l/s)	EC backward curved plug fan with EC motor - power input (W)	Specific fan power of BC EC fan (W/l/s)	Energy saving (W)	Carbon dioxide saving based on 24 hour per day operation (kg)
3000	796	0.95	272	0.33	524	1968
2500	662	0.95	260	0.37	402	1510
2000	484	0.87	192	0.35	292	1097
1500	354	0.85	143	0.34	211	793
1000	257	0.92	101	0.36	156	586

EC fans are more efficient than AC fans and maintain their efficiency at reduced speeds. When adding that EC fans are simple to control it is easy to understand why EC fans are made for this application.

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