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NEW IDEAS AT A GLANCE

The engineer's choice

ebmpapst

Editorial

"ebm-papst stands for energy-efficient products."

Dear customers, partners and friends of ebm-papst,

Both the global economy and domestic demand for innovative and energy-efficient products have taken us all by surprise in 2010. After a modest start in the spring, the "economic wise men" now forecasting economic growth of about 3 % this year. Many companies – and we are no exception – have had to struggle with problems in procuring electronic components to satisfy booming demand on the market.

ebm-papst is on the right track. Together with our reference customers, we have developed and launched innovative products in recent years, and today these represent the world market standard. Gone are the days when a distinction was made between motors or fans for refrigeration systems, refrigerated counters, beverage dispensers, household appliances or for server cooling. What are required are intelligent, energy-efficient products that ebm-papst has tailored precisely to the needs of the market.

At this point, we would like to thank you, our customers, and also the institutes and research institutions for your partnership in innovation. It was this that made it possible for us to develop products that even today exceed the minimum efficiency standards required by the ErP directive for fans.

We are delighted with market demand for the entire ebm-papst product range. Here, we think above all about industrial engineering, mechanical engineering and power engineering, which have regained their old strength after a poor year in 2009, and which have conquered new markets with us. For this sector, we have developed a new series of centrifugal fans that we can offer as high-performance and low-noise modules, either with tried and tested AC or with GreenTech EC technology. Here, we expect these products to be used in industrial engineering, heat pumps and across the whole field of renewable energies over the months and years ahead.

Together with our customers and suppliers, we have succeeded in achieving raw material savings, e.g. with HyBlade® technology for axial fans. In accordance with our GreenTech philosophy, we have developed new products that will be used in a wide range of different applications.

Against the backdrop of booming markets, our task in the coming weeks and months will again be to implement projects purposefully, timely and with great flexibility. In this respect, we trust in the rules of the market and in the spirit of good cooperation between our customers, our production facilities and our suppliers. We must succeed in expanding and securing our technological lead so that we can conquer and expand our markets together with our customers.

With this in mind, we wish to continue our innovative partnership and look forward to a lasting good cooperation.

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Increased efficiency due to new geometry of the impeller

The often-used term "efficiency" describes the ratio between the quantity of output attained and the amount of effort required for this output. If the effort decreases, efficiency increases. This effect is becoming increasingly important in a wide variety of areas. For example, the efficiency of the fans used is a central topic in ventilation and air-conditioning technology. In light of these facts, it is no surprise that energy-saving EC technology is increasingly replacing conventional AC fans in this area in order to attain an additional increase in efficiency. New centrifugal fans can now provide even more added energy efficiency. Optimised geometry in the impellers improve efficiency while simultaneously reducing the noise level. In addition, the compact designs make it easy to replace conventional AC technology with the new GreenTech EC generation without any design changes on the ventilation or air-conditioning end device.

"Energy-saving EC technology is increasingly replacing AC fans"

Based on its core competencies in aerodynamics, motor technology and electronics, ebm-papst developed the new "RadiCal" centrifugal fan series for use in air-conditioning and ventilation technology systems. By means of powerful development tools and the implementation of manufacturing technology, a new generation of centrifugal fans was thus created that is not only particularly energy-saving in operation, but also very quiet (Figure 1). The basis for this is provided by the harmonious interaction of the fan impellers with the motor and electronics.

Figure 1: New "RadiCal" centrifugal fan series for applications in ventilation and air-conditioning technology. The impellers of the fans are matched perfectly to the motor and electronics to attain a high-efficiency total solution.

Revolutionary styling

The name "RadiCal" set the tone for the development. Compared to earlier variants, the geometry of the impellers has indeed changed radically, thanks to the latest insights in aerodynamics (Figure 2). The innovative styling of the entire flow channel provides a continuous flow of air through the impeller, which increases the aerodynamic efficiency of the fan significantly. This is ensured by the rounded inlet contours on the cover plate and base plate of the impellers. In addition, the interaction between the inlet nozzle and impeller inlet was improved significantly. The selection of materials used played a critical role here:
The impeller consists of a hybrid design. This provides a good combination of stability and design freedom. Unlike the otherwise

Figure 2: The innovative styling of the entire flow channel provides a continuous flow of air through the impeller, which increases the aerodynamic efficiency of the fan significantly.

“The RadiCal fans exceed by far the legal ErP Directives regarding efficiency”

common sheet metal impellers, the new impeller can be given a relatively simple design, as while sheet metal parts can only be bent or stamped, plastic can be shaped into three-dimensional profiles without any problems. The optimisation of the impeller geometry was carried out with CFD (Computational Fluid Dynamics), a numerical flow simulation. The tools for manufacturing were also developed using state-of-the-art means. One example of this is what is known as moldflow analysis. The moldflow analysis provides important results such as the optimal injection point, the filling behaviour and the optimum arrangement of the mould cooling to minimise warping.

Far exceeds the requirements of directives

However, the increased efficiency is due not only to the aerodynamic improvements implemented in this manner. The EC motors used in the fans feature state-of-the-art technology. Despite the integrated electronics, they are highly compact and feature outstanding motor thermal management. The stator is encapsulated in plastic for a high degree of IP protection (IP54); air inlets in the rotor ensure optimum cooling, which increases the efficiency of the motors.

Even today, the RadiCal fans exceed by far the legal ErP Directives regarding efficiency which are soon to come into force.

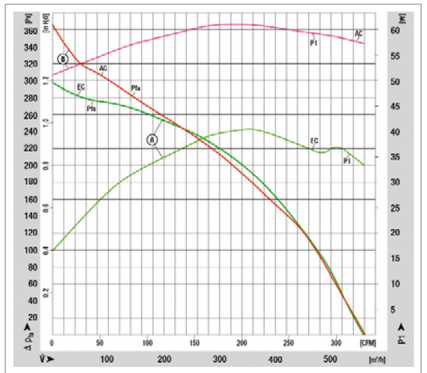

Figure 3: Even today, the new RadiCals exceed by far the legal ErP Directives regarding efficiency which are soon to come into force (green curve: “RadiCal” in GreenTech EC technology; red curve: conventional centrifugal fan in AC technology; P1=input capacity, Pfa=air performance curve)

Compared to conventional AC fans, they consume up to 50 % less energy with one-half the noise level (Figure 3). The good dampening behaviour of the plastic also helps to reduce noise emissions. Even without special varnish, the impellers are highly corrosion-resistant, for example if exposed to salt water or salty air. Direct solar radiation has no damaging effects on the UV-resistant material.

The good controllability of the EC motors used also contributes to the conservation of primary energy. With the continuous closed-loop speed control typical of EC motors, for example, the output of the fans can be adapted exactly to the specific application requirements or individual needs. EC technology not only provides savings when operated under full load; even in partial-load operation, EC motors lose much less of their efficiency, and thus energy savings are particularly noticeable here. If desired, however, they can also be set to a fixed speed, as is familiar from conventional AC solutions.

RadiCal sets new benchmarks in ventilation and air-conditioning technology:
Increased efficiency due to new geometry of the impeller

Figure 4: Existing AC centrifugal fans can be replaced easily with the new technology; the connection dimensions are nearly identical (left: AC, right: EC).

Figure 5: To reduce the already low installation effort even further, the new fans (left) can be purchased on request as ready-to-install modules.

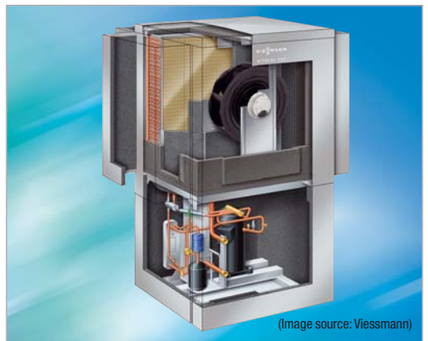

Figure 6: Application example of the new RadiCal fans in heat pumps.

Retrofitting made easy

The compact design allows the new centrifugal fans to replace the existing AC variants without any problem (Figure 4). They require the same amount of installation space and are downward compatible in terms of mounting and electrical connection options. Switching to energy-saving and quiet EC technology does not require any design changes on the end device. To reduce the already low installation effort even further, the new fans can be purchased on request as ready-to-install modules (Figure 5). The new centrifugal fans are currently available in sizes 133 to 250 with drive outputs between 35 and 170 W and in size 500 with three different EC motors with drive outputs of 500 W, 1 kW and 3 kW. This opens up possible applications in many areas of ventilation and air-conditioning technology, such as in control cabinet cooling, in-line duct fans, home ventilation units or heat pumps (Figure 6). In all of these applications, it is pays off to switch to high-efficiency RadiCal fans or to take advantage of this state-of-the-art, energy-saving technology from the start.

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Intelligent tangential blowers for ventilation technology

Image source: Kampmann

"New EC technology: Better results in terms of energy efficiency and smooth running"

Added up over the years, operating costs in buildings are a substantial cost factor and almost always higher than the initial investment. Many of the components used are in operation round the clock for years. As a result, even small improvements in the efficiency of the heating and cooling systems pay off quickly. If the purchase price of the improvement is cost-neutral to existing solutions, the savings start immediately. A new drive technology for tangential blowers in floor ducts combines two advantages: lower energy consumption with almost unchanged investment costs and expanded control options.

Targeted air conduction is important for an optimal room climate. In order to create the necessary prerequisites for this, the air is moved by smooth-running tangential blowers, especially in installations with floor ducts (underfloor heating and cooling systems). Kampmann, a company based in Lingen, Germany that specialises in building air-conditioning, has worked with this tried-and-tested system for years. However, to attain even better results in terms of energy efficiency and smooth running, the developers from Kampmann and ebm-papst are using a new drive in state-of-the-art GreenTech EC technology. This combines energy-saving operation with a long service life, easy installation and simple control.

Keeping total cost of ownership in view

The total costs over the service life of a ventilation system can be reduced significantly by the correct selection of a few components, such as fans. Therefore, the following primary criteria exist for the fans built into floor ducts: they must be cost-effective, maintenance-free, quiet in operation, save as much energy as possible and be easy to install. A tangential blower design fulfils exactly these requirements. The many blades of the fan roller enlarge the surface area that propels the air, enabling the rotation speed to be reduced and so allowing very quiet operation (see Fig. 1). The twin fan version circulates even greater volumes of air. In the past, these were often driven by shaded-pole motors as these are inexpensive at the time of purchase. However, a major drawback of this solution is its relatively low efficiency. To keep noise levels low, it only works at 1400 rpm, but at this speed it is especially ineffective as a two-pole drive on a 50 Hz power line. That means firstly, increased power costs for the many fans needed in the building, and secondly, in the summer the cooling system also has to conduct the residual heat of the motor away, which requires even more energy. In order to be efficient and keep up with state-of-the-art technology, the air-conditioning experts at Kampmann are now employing the innovative drive concept from fan experts ebm-papst. The intelligent incorporation of GreenTech EC technology in the new

Figure 1: New tangential fan with energy-saving drive system (Illustration: ebm-papst).

New tangential blower with low-voltage drive for building air-conditioning:
Intelligent tangential blowers for ventilation technology

"State-of-the-art drive engineering saves energy, installation time and thus real money"

KaControl building automation system even allows the cost-neutral implementation in underfloor applications (see Figs. 2 and 3).

Outstandingly versatile EC drives

The electronically commutated direct current motor concept is ideal for meeting the requirement for high efficiency with a long service life and robust design. In this design, electronics integrated into the drive carry out the commutation instead of carbon brushes. It always governs the motor current optimally depending on the required power and speed. For this reason, efficiency remains uniformly high over a very wide speed and load range. This saves energy and minimises waste heat. The integrated electronics enable convenient control of the drive and reduce the need for external control technology drastically. The low-voltage drives require a mere 24 V DC as supply voltage, providing optimal reliability, especially in floor ducts. Intelligent motor management ensures a constant speed, regardless of load, depending on control voltage. Moreover, it is possible to program special speed control "ramps" from the factory in dependence on the control voltage in the fan. This allows air circulation to be adjusted to the requirements of the installation directly in the fan, which simplifies the external control system.

With internal rotor motors, the larger separation between the bearings improves the stability and smooth running of the rotating parts. Not even the "rough handling" encountered on the construction site has any major effect on the function or reliability of the fans (see text box, page 12).

Figure 2: Katherm floor convector for heating or cooling operation.

Customised air flow

At present, there are two fan versions available. The QLK45/0030-2212 with an air outlet of 300 mm and the twin fan version QLK45/3030-2212 with 2x 300 mm air outlet. The total installation size is 395 x 79 x 70 mm (single fan) or 755 x 79 x 56 mm (twin fan). Both versions work with 24 (18...26.8) V DC and a control voltage of 0...10 V. An integrated Hall sensor (2 pulses per revolution) provides signals for the internal electronics, but these signals can also be picked up at the connector socket for external use. In the twin roller version, the fan displaces up to 72 l/s running at free air, with a maximum delivery pressure of 37 Pa. The power input in the characteristic diagram is just 6 to 10 W (Fig. 4).

State-of-the-art drive engineering saves energy and installation time and thus real money, even in common current fan concepts for building air-conditioning. Inherent energy consumption is reduced by efficient motors, integrated electronics make installation easier and savings in control components are attained. Intelligent integration into the building automation system is the finishing touch that provides a clearly measurable increase in efficiency of the system compared to the conventional

Figure 3: Katherm floor convector with integrated tangential blower in GreenTech EC technology for heating operation (Illustration: Kampmann).

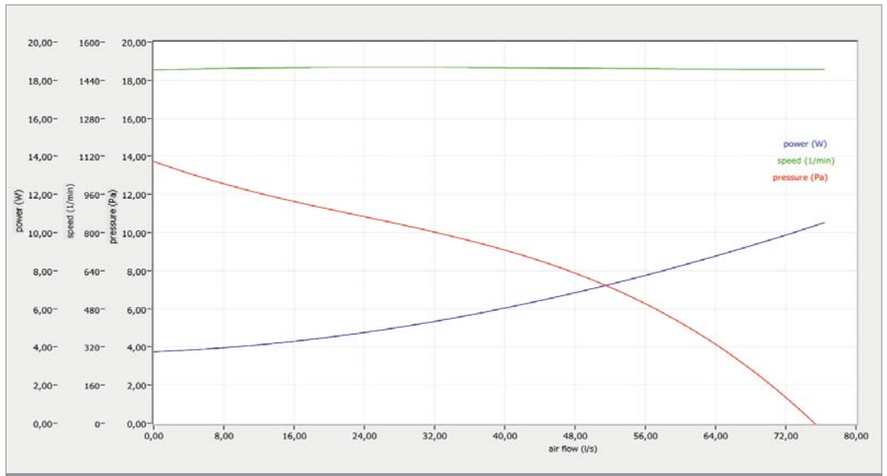

Figure 4: Air performance curves of the new tangential blowers (Illustration: ebm-papst).

design, for the same investment. The installation engineer saves labour hours; the owner/operator saves energy and thus costs, with a greater degree of comfort.

The design of the EC drive

In the EC motor, the drive winding is housed in the motor jacket. The direct contact to the sheet jacket enables good heat dissipation. The low heat load, in turn, extends the service life of the motor bearings. The magnetic rotor consists of the gearbox output shaft and the rotor itself in the form of a permanent magnet with what is called the commutation track. Depending on the control solution used, speed (Hall) sensors provide the control electronics installed on the bearing shield with the necessary information about the position of the anchor. During this process, a simple control voltage between 0 and 10 V provides the electronics with the desired setpoint rpm. From the supply voltage, the control electronics generates a magnetic rotary field in the stator coils that depends on the speed and load. This always ensures the best possible efficiency at every speed.

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Energy-efficient fans for refrigeration technology

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"In refrigeration and air-conditioning technology, the change to modern EC technology is worthwhile"

From 2013 onwards, the ErP (eco-design) directive will enter into force for fans, This directive pursues in particular the objective of improving the energy efficiency of products and thus to realise European climate protection targets. For many electrically powered fans in use in refrigeration and air-conditioning technology, this means that they will have to satisfy the statutory limits stipulated in this directive. The result is a twin benefit: Impact on the environment is reduced and potential energy savings are felt in the pocket of the consumer. The sample calculations described below apply to refrigeration and air conditioning equipment typically found in supermarkets and they supply the necessary proof.

Since air-conditioning and refrigeration systems are operated with high duty cycles, energy savings are particularly noticeable in this area. However, there are considerable differences between applications. For example, the large condensers that are usually attached to the outsides of supermarkets have different requirements to the fans that are used in refrigeration counters and refrigerators. For each of these fields of application, "customised" energy-efficient EC fans now exist that feature outstanding reliability, maximum efficiency and low-noise performance.

Better than what is "required"

The broad product portfolio of the motor and fan specialist ebm-papst includes energy-efficient fans for practically every power range that could be used in refrigeration and air conditioning air-conditioning technology. Even today they already exceed by far the efficiency values stipulated in the ErP (eco-design) directive. Thanks to the successful interaction of motor technology, electronics and aerodynamics, EC fans do not just convince with respect to their energy efficiency. They also work extremely quietly thanks to their optimised commutation techniques and the aerodynamic configuration of the impellers. And on top of everything, they also convince with their durability and reliability.

In refrigeration and air-conditioning technology, the change to modern EC technology is worthwhile on many accounts, especially as the stipulations of the directive are not only ecologically rational, they are also economically highly interesting for the user. Even on comparatively small refrigeration units, the low energy consumption can bring about substantial savings compared to conventional fans that usually work with shaded-pole motors. One example is the so-called bottle coolers that can be found everywhere where chilled drinks or snacks are sold, from kiosks or filling stations to supermarkets.

Energy-saving motors for refrigeration units and counters

If, for example, there are two fans fitted in a refrigeration unit that are powered by conventional 30 W shaded-pole motors, and if these are in operation 12 hours a day, they will consume around 262 kWh in a year. However, if the fans were to be operated with energy-efficient 10 W EC motors from the energy-efficient ESM motor line from the ebm-papst product range, which boast the same air performance, this consumption would fall to about 88 kWh. There are two reasons for this: Firstly, the efficiency of the EC motor is vastly superior. At the operating point with a typical speed of 1300 rpm, the energy-saving motor has a maximum efficiency of more than 65%, allowing power input to be reduced by around 1/3 compared to a conventional shaded-pole motor (see Fig. 1). Secondly, less energy needs to be consumed from the very outset

Protecting the environment and saving money:
Energy-efficient fans for refrigeration technology

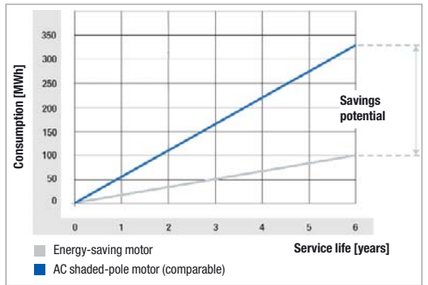

Figure 1: Comparison of ESM/shaded-pole motor curves.

for the cooling process because less heat is lost to the environment during operation.

From the resulting difference in energy consumption of 174 kWh and assuming a price for electrical power of 11.69 euro cent/kWh (average electricity price for industry in Germany, status January 2010 / Source: VEA, BDEW), there is an immediate annual saving of about 20 euro for each refrigeration unit. The energy-saving solution thus enables payback periods of less than 12 months. That makes this investment worthwhile not just for the environment, but also for the wallet of the user, especially when the comparably long service life of the EC fans (approx. 40,000 operating hours) is taken into account.

Savings potential by the metre and straightforward conversion

The more fans there are in operation, the greater the savings potential. Refrigeration counters are a good example. There are usually two fans for every metre in length. In a typical supermarket, there are some 100 m of refrigeration counters, making 200 EC energy-saving fans of size 200. The energy saving compared to conventional shaded-pole motors is 70%, equating to 38 MWh per year. For the environment, this means more than 22 tonnes less CO_2 being produced on the basis of today's energy mix. At the same time, the user will save more than 4,400 euro at an electricity price of 11.69 euro cent/kWh.

By no means are users only able to benefit with new installations. A conversion of existing installations is possible and straightforward. In this case, ebm-papst offers energy-efficient iQ motors, which are mechanically compatible with existing shaded-pole motors, and which have a high efficiency of up to 65% and the same installation dimensions, allowing a straightforward 1:1 exchange. Axial impellers with a diameter of 154 to 254 mm can be fitted in the same way on the iQ motor to create an energy-efficient solution. The intelligent electronics regulate voltage fluctuations so that the speed remains constant. Today, countless well-known supermarket chains are making use of this ecologically and economically rational 1:1 exchange option (see Figure 2).

Figure 2: Energy-efficient technology for refrigeration counters: energy-saving fans as a system solution for refrigeration counters (left), iQ motors allow a straightforward 1:1 exchange of the conventional shaded-pole motors for efficient cooling (right).

High-performance energy-saving fans for condensers and evaporators

Comparable energy savings can be achieved in many other applications. For example, ebm-papst has set standards with its

Protecting the environment and saving money:
Energy-efficient fans for refrigeration technology

Figure 3: Excerpt from the HyBlade® line for condensers.

Figure 5: Depending on the requirements of the individual supermarkets, between four and twelve fans are used in a condenser.

energy-efficient HyBlade® fans for condensers and evaporators (see Figure 3). Thanks to modern GreenTech EC technology and aerodynamically optimised vane geometry, the fans, which are available in sizes 172 to 990 mm diameter, convince with energy savings of up to 50% compared to AC fans. This applies not only in full-load operation, but also and especially in partial-load operation. In addition, the speed can be controlled for EC technology. In other words, it can be adjusted to the respective cooling requirements, which provides further potential savings. The result is substantially lower energy costs which are quickly felt in practical operation. The different curves shown in Figure 4 illustrate the power input of controlled AC/EC motors in comparison. In all speed ranges, energy costs are vastly lower with EC motors than with voltage-regulated or frequency-inverter-fed asynchronous motors.

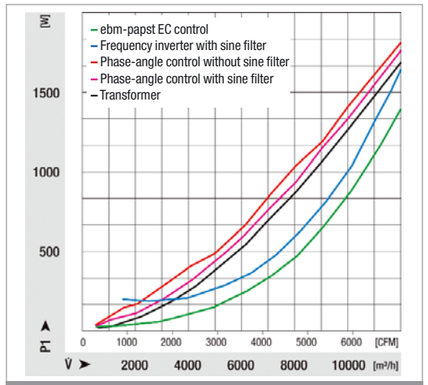

Figure 4: The individual curves illustrate the power input of controlled AC/EC motors in comparison.

Depending on requirements, between two and twelve of these fans are typically used in such condensers (see Fig. 5). If you take a condenser with six HyBlade® axial fans of size 800 with GreenTech EC technology and compare these with six AC axial fans in the same power category, each with an air performance of 11,000 m³/h at 85 Pa, the six AC fans will need a total of 5,400 W, while the GreenTech EC fans will have a power input of just 3,900 W. In this instance, the GreenTech EC fans consume a total of 1,500 W less energy, representing a saving of 28%. Further savings can be achieved by simply networking the GreenTech EC fans via a BUS system, linking them to the higher-order management systems (see Fig. 6). Low noise levels, durability and the low weight resulting from the robust plastics used are further benefits of these axial fans. In addition, the integrated power electronics are configured for country-specific mains voltages, allowing worldwide use, regardless of whether the power frequency is 50 or 60 Hz.

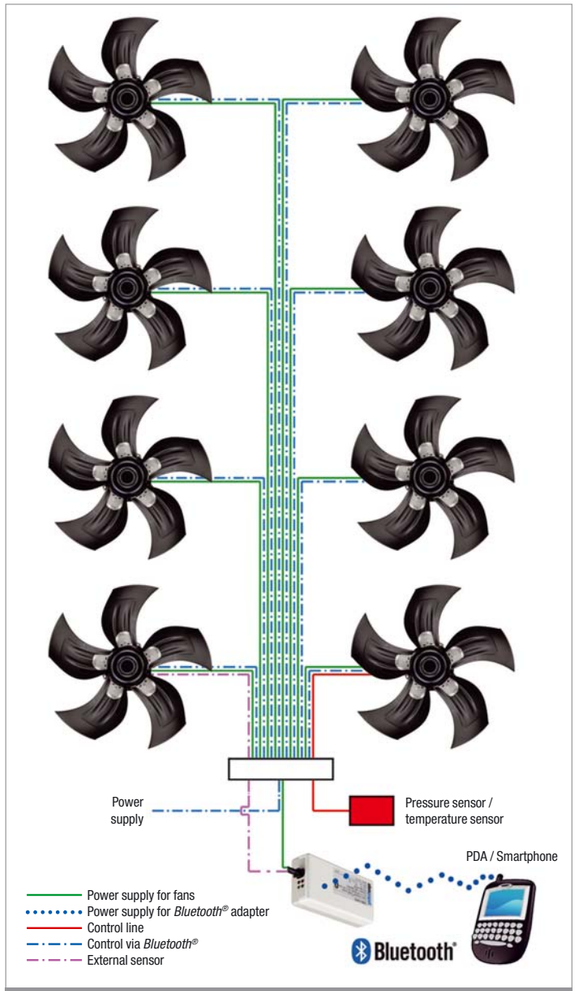

Figure 6: Example of a schematic illustration of components on a condenser.

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Quickly installed and easily set up for operation as needed using sensor technology:
High-performance inline duct fan with additional functions

High-performance inline duct fan with additional functions

Buildings are being equipped with ever better damping technology, while at the same time the natural air exchange decreases. Less cold fresh air saves heat energy, but in the event of incorrect ventilation it brings the danger of mould formation in the building. This is corrected as needed by a well-thought-out ventilation concept with air ducts. With this, the saved energy will not be reused by inefficient ventilation technology. A new, easy-to-install inline duct fan now enables universal operation for 100-mm ducts. Optionally, a variety of sensor functions and the integrated control allow for optimum co-ordination of the fan with the conditions on-site. Thanks to EC technology, the internal power consumption in operation is very low and saves additional operating costs.

"Thanks to EC technology, the internal power consumption is very low and saves operating costs"

Whether useful living space such as a bath, sauna and WC or primarily unused and little-heated storage rooms in attics, formation of condensation water must be reliably prevented in all of these cases. Humidity always means the danger of mould formation with corresponding health hazards and correspondingly high renovation costs. Likewise, in the industrial field, targeted air exhaust, e.g. at brazing and welding stations, is literally a matter of life and death. On the other hand, inefficient ventilation year in and year out can cause substantial and unnecessary heating costs. The remedy for this is exhaust ducts with inline duct fans for targeted ventilation or suctioning as needed. The fan specialists from ebm-papst St. Georgen in Germany's Black Forest region have studied the existing standard concept in this area and developed a new fan that can be used universally (Figure 1). The new generation of exhaust air fans features impressive high output at low energy consumption and built-in intelligence. Thus the fan can easily be adapted to its intended task in the building or also assume additional functions at a later point in time.

Figure 1: In-line duct fan of type AC100 – a permanently excited synchronous motor with electronic commutation for an AC voltage terminal.

State of the art of technology

Even today, the classic inline duct fan still operates in many cases with simple but robust AC shaded-pole motors. The efficiency, however, is very low at only 12 to 15%. If EC drives are used, the efficiency of the fan drastically increases to a value of over 65%. Unfortunately conventional fans seldom operate optimally. For the most part, all they are capable of is being switched on and off and, in rare cases, also speed-controlled operation. As a result, the classic design to date consists of the fan, the external control and the exhaust air duct. Only in rare cases do all three components match each other optimally and fulfil their task truly efficiently. Even the apparently minor differences in energy demand of the drive motor add up over the run-time of a house fan (usually over 10 years) to considerable amounts of money, which far surpass the initial costs. In addition to all cost factors,

therefore, an all-round optimisation must also take into account the factor of energy consumption over time.

New approach

Everyone knows the problem that arises when a construction plan starts out looking good, but subsequent changes to it cause numerous problems with the originally planned technology. Ordering new parts costs time and money, so it is better to simply adapt existing technology to the new conditions. With their new product, the fan experts from the Black Forest have developed this approach until it was ready for practical application. The actual drive motor is mounted vibration-free in the housing via a special soft suspension (Figure 2). This way the transmission of vibration and structure-borne noise is nearly eliminated. The electrical connection is housed in a separate housing segment (alternatively under a separate housing cover) so that it is easily accessible and permits easy wiring of supply lines and sensor cables.

The electronics integrated in the drive enable autonomous control without any other components. Additionally, they allow connection of various sensors that control the "on-demand operation". This way temperature and humidity sensors as well as motion detectors are connected just as quickly as the supply line (Figure 3). Depending on the configured profile, the fan then operates only

Figure 2: The soft suspension of the motor in the fan housing prevents the transmission of engine running noise.

when a corresponding response is received via the sensor. That saves energy without impairing safety or comfort. Continuous closed-loop speed control and external data output are also available as options. Another innovation is the optionally available constant air flow control. Where extensive adaptation measures were previously necessary to co-ordinate the fan operation with a corresponding air exchange rate, this step is now omitted entirely. Even slight differences in the pipeline's counterpressure, e.g. from different routing or other air exhaust grilles etc., no longer impair the configured air flow. The fan assumes the automatic adjustment. That saves valuable installation time and largely

Figure 3: Easy option for installation with an electrical connection of the fan to any AC voltage supplies from 85 volts to 265 volts with 50 Hertz or 60 Hertz.

Quickly installed and easily set up for operation as needed using sensor technology:
High-performance inline duct fan with additional functions

„High-performance inline duct fan sets new benchmarks!"

prevents the need to keep fans with different performance levels in stock.

High-performance

The technical data prove that these fans set new benchmarks. The dimensions of the fan are a 98-mm diameter with a 130-mm length of the Venturi tube. With (85 to 265 VAC, 50/60 Hz) the current supply covers all power systems used worldwide. Upon request, a special low-voltage design with 48 VDC is also available. The maximum power consumed is 10 watts, and the specific fan power value lies at an outstanding level of 0.3 W/m³/h. The standard design of the fans has two fixed speeds which the user can change via the connection terminal or a switch installed by customer. All electrical components are equipped with moisture protection and fulfil the IP 44 requirements for wet rooms.

In comparison to fans of competitors with similar blower output, the operating noise level is consistently 2 to 6 dB(A) lower. The maximum flow rate lies at 140 m³/h, the maximum delivery pressure is 143 Pa (Figure 4). With 70,000 hours at an operating temperature of 40 °C, the service life corresponds to long-time use in building systems.

The new AC-100 inline duct fans are versatile and allow for use in many areas of building systems and industry. They can easily

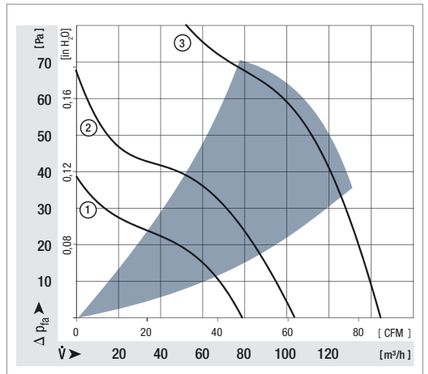

Figure 4: Fan curve with optimum operating range of the inline duct fan of type AC100 for three different speed steps.

be adapted to the conditions on-site, tolerate a wide range of supply voltage and thus make the stockkeeping of different fans obsolete. As a result, the new fan concept saves you time and money for stockkeeping and installation alike.

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Keeping an eye on the environment during product development

The overall costs for fans are not only influenced purely by the procurement price, but also essentially by energy costs during operation. For this reason, energy-efficient EC technology is increasingly becoming the prevailing drive system, relieving both the environment and the user's wallet to an equal extent. That is an encouraging development to which the aerodynamically optimised geometry of the impeller wheel contributes just as much as the motors do. Innovations in the materials used also allow the energy input during the production of the fans to be substantially reduced. An important environmental aspect that demands a good deal of know-how from the design engineers.

"EC technology relieves the environment and the user's wallet"

Until recently, axial fans mainly employed aluminium blades. Other fan blades made of sheet steel or aluminium were restricted by the specific material properties. Monolithic blades with a uniform sheet thickness restricted the design possibilities. Innovative design principles and new combinations of materials are now opening the door to interesting possibilities.

Over the last two years, the motor and fan specialist ebm-papst has developed a complete line of HyBlade® axial fans in and these have already become successfully established on the market (see Fig. 1). With the HyBlade® fans, the blades are made of an aluminium inlet with a fiberglass-reinforced plastic coating sprayed around them (see Fig. 2). The blade thus marries the mechanical stability of aluminium with the versatility of plastic. Here, the aluminium and the plastic are positively joined without needing glue or any other bonding agent. The new material combination has made blade geometries possible that improve the aerodynamic efficiency of the fan, reduce the weight and at the same time optimise noise output (cf. text in box, page 26). A study conducted within the framework of the MENZEL material efficiency network has now demonstrated that compared to past aluminium constructions, this material combination offers substantial benefits in the environmental balance even during the production process.

Figure 1: Extract from the range: HyBlade® axial fans in EC technology.

Figure 2: In contrast to die-cast aluminium blades (left), the HyBlade® blade (right) has an aluminium core that is spray-coated with plastic. The blade thus marries the mechanical stability of aluminium with the design versatility of plastic.

“HyBlade® blades: impressive energy savings during the manufacturing process”

Manufacturing processes in comparison

The studies identified and assessed the environmental impact of both construction principles during the complete manufacturing process, from the original production of the bauxite to the manufacturing plant at ebm-papst Mulfingen (see Fig. 3). The key values were the pure energy input needed for manufacturing, the generation of greenhouse gases (primarily CO_2) and the impact on the environment of acidifying air pollutants, e.g. sulphur dioxide. To compare and assess the production, the entire production process for both construction versions was first described from a process engineering perspective.

The conventional aluminium blade is manufactured using the die-casting method. Here, a casting mould is made from high-strength steel. This has a limited guaranteed service life. The raw aluminium is produced in the form of ingots at the aluminium mill. This involves very high energy consumption. At the die-casting plant, the aluminium has to be melted down again to enable it to be processed in the casting machine. The hardened and cooled cast part is then press-trimmed.

For the HyBlade® blades, the aluminium inlet is first produced from rolled strip material in a progressive die. The inlet then has a high-performance plastic coating sprayed onto it with a plastic spraying machine. For both processes, stamping and spraying, tools with a very long service life are needed.

Environmental balance during manufacturing

In order to identify and assess the environmental impact, the data for the production of the aluminium raw materials needed to manufacture the two blade types plus (for the HyBlade® blades) the plastic were taken from the GEMIS database (Global Emissions Model for Integrated Systems). The process data for stamping and spraying the HyBlade® blades were measured directly in the manufacturing process. The process data for the die-cast aluminium and plastic spray-coating process were largely taken from statistics and from existing databases.

The result is unequivocal and speaks for the HyBlade® option. For practically all environmentally relevant parameters investigated, it boasts a lower environmental impact than the aluminium blade. In most cases, the data for the HyBlade® blade was lower by a factor of two (see Fig. 4a and b). Especially noteworthy on the HyBlade® blades are the impressive energy savings during the manufacturing process. The energy consumption is illustrated by the CEC summation parameter (cumulative energy consumption).

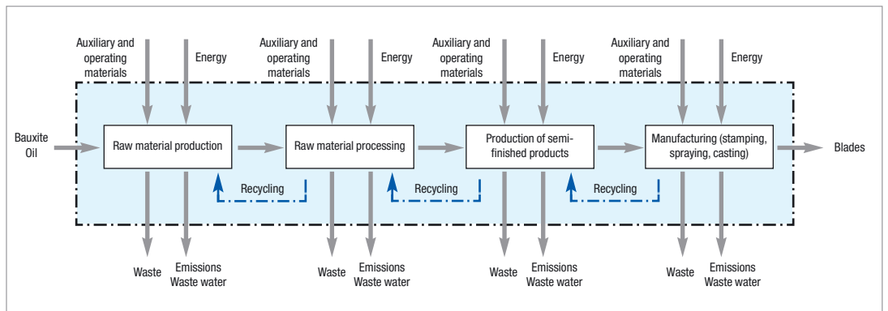

Figure 3: Illustration of the limits of the system examined.

Study confirms positive ecological aspects in fan development:
Keeping an eye on the environment during product development

In total, this verifies the benefits of the HyBlade® blades with 15 kWh to 33 kWh per blade, which equates to a halving of energy input (see Fig. 4c). This value includes all activities involved in the production of the aluminium and of the plastics up to the finished blade (secondary aluminium proportion in the HyBlade® blade: 30%, in the aluminium blade: 70%).

Lower energy consumption and lower carbon dioxide emissions

What this energy saving means specifically for the environment, can be seen from two examples: For the production of 100,000 fans with HyBlade® fittings (five blades per fan) the energy saving compared to fans with aluminium blades is about 9,000 MWh. In Germany, the average two-person household consumes about 2,800 kWh per year. In other words, the saving approximately equates to the electricity consumption of around 3,000 households, or put another way, the electricity consumption of a small town is saved by the employment of HyBlade® technology.

Interesting findings are also provided by looking at greenhouse gases, which are reduced by 50%, by comparing the carbon dioxide figures with the emissions from a passenger car. Typical figures here are CO_2 emissions of 120 g/km and a mileage of 15,000 km per year. By employing HyBlade® technology, manufacturing 100,000 fans will reduce

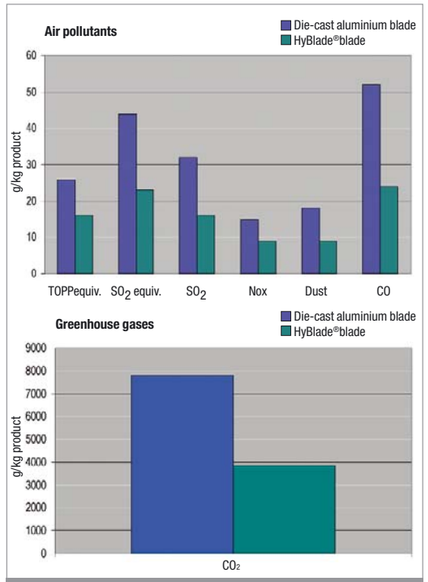

Figure 4a + b: Environmental impact in comparison: HyBlade® has the edge in air pollutants (a), greenhouse gases (b) and cumulative energy consumption.

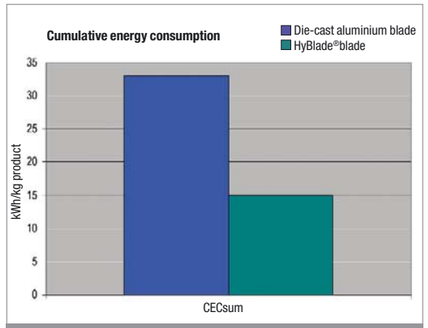

Figure 4c: Energy consumption can be reduced by half with the use of HyBlade® fans.

Study confirms positive ecological aspects in fan development:
Keeping an eye on the environment during product development

CO_2 emissions by 2,300 tonnes per year. This reduction approximately equates to the emissions from nearly 1,300 vehicles. The HyBlade® design is clearly the ecologically superior alternative, not only in operation but also during the manufacturing process.

Dipl.-Ing. (FH) Gunter Streng
Development Manager for Product Area A
ebm-papst Mulfingen GmbH & Co. KG

HyBlade® – Lower noise development with greater efficiency:

On large axial fans, HyBlade® blades substantially improve both noise behaviour and efficiency. Extensive test series have verified the benefits of combining different materials to create a symbiosis. The aluminium inlet can withstand the mechanical forces during operation and ensures a durable connection to the rotor, while the plastic encapsulates the carrier structure, giving the blade its optimised aerodynamic shape. At the same time, the plastic jacket also has a positive effect on the total weight of the fan. This reduces fuel consumption during transport of the fans to their site of actual operation. HyBlades® have even proven their reliability in temperature fluctuation tests, shock tests and long-term tests under real-life operating conditions. They withstand extreme summer sunlight just as well as they do sand, salt water and salty air. They are resistant to corrosion even without (environmentally harmful) painting.

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