Halifax Fan

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News, views and applications

Green considerations take priority over first cost on asphalt batch heater plant

By adding inverter speed control to the exhaust fan on one of two new 3 ton asphalt batch plants undergoing trials at Local Asphalt, Leeds (Cemex), Mixlance (Technical Services) Ltd of Measham will achieve substantial energy savings and reduce greenhouse gas emissions sufficiently to attract EU LIFE funding for the project. The plant is described as 'Europe's most technologically advanced batch heater plant'.

Delivering 80 tons of coated material per hour, the new plant design is more compact, faster, quieter, cleaner and more economical than previous plants. Previously, the exhaust fans would run continuously at full power although it is a batch process. Now, fan speed is matched to process needs and at times of low demand, turned right down, delivering substantial energy savings and significantly reduced primary combustion gas fuel consumption and greenhouse gas emissions.

The exhaust gases contain a mix of particulates from the process, necessitating a self-cleaning impeller design. 45kW extra heavy construction Beaufort fans with backward inclined impellers have been supplied. With gas temperatures up to 200°C, each fan is fitted with a cooling disc around the main shaft to 'sink' heat from the casing to protect the bearing and deep-groove ball and roller bearings are employed to withstand the end thrust. Bearing life in excess of 100,000 hours can be achieved with proper periodic maintenance and inspection. Sizing the motor for 'closed damper' and 'low frequency start' controlled by the VSD has enabled a 45kW motor to be used in place of a motor nearly twice as large as on previous plants, significantly offsetting the inverter cost ●

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Halifax Fan reaps the rewards of its R&D for power station BOFA fans

Celebrating its 40th anniversary this year, Halifax Fan is currently enjoying a record year, due in part to orders arising from recent increases in environmental legislation.

Now the forthcoming EU Large Combustion Plant Directive (LCPD), due to take effect from 2008, has created a market for low NO_x combustion systems which will simultaneously limit levels of unburned carbon.

For existing coal-fired power stations, one technique which can be readily adapted is Boosted Over-Fire Air (BOFA). BOFA uses large fans to re-circulate the flue gases back through the furnace at high velocity, through over-fire air ports. BOFA improves furnace mixing and reduces levels of unburned carbon while dramatically reducing NO_x levels.

For the fan manufacturer, the major technical difficulty is dealing with the high temperature of the flue gases, up to 305°C, which have a major effect on bearing and shaft design. Working with one of the largest manufacturers of low NO_x systems, Halifax has invested heavily in R&D to design fans and bearings suitable for this arduous application and has been rewarded by a substantial contract for 8 off 650kW 11kV BOFA fans for two UK power stations. These large fans are up to 96 inches in diameter, handling up to 370,000 m^3/hr at a pressure of 4400 Pa.

Halifax has also been awarded a valuable contract by Scottish and Southern Energy for 16 fans from 55 to 400kW for biomass projects at two of the UK's largest coal fired power stations. The fans will form a critical part of what will become the first dedicated biomass co-firing plant in the UK when the units become operational during the first quarter of 2006 ●

Benefits and pitfalls in the application of

In the past, when the output of a fan system had to be governed, it was most commonly done by inlet or outlet damper systems. Initially this was done for first-cost reasons, despite the bulk and maintenance requirements of damper systems. More recently, ac drive systems, offering all the simplicity, availability, reliability and predictability of the standard induction cage motor, have become highly cost effective. However, despite the glib assurances of many drives promoters, the application of inverter drives to fans is not always as straightforward as it might seem.

Very often, 'drive experts' will quote the familiar fan affinity laws when arguing to apply VSDs to fans, i.e.

Volume $\propto$ speed

Pressure $\propto$ speed^2

Power $\propto$ speed^3

Noise $\propto$ speed^5

In practice this is rarely the case. The above laws apply to a fan only when operating on a fixed system. It is unusual however that a fan is left running at excess capacity; more often the flow is adjusted by the user to suit his requirements. Traditionally this was done by partly closing a damper and this is represented graphically in fig 1.

In this example a 2960 rpm fan has been used to operate at a duty of 22,000 m^3/h at 65mbar. The fan is actually capable of 90mbar at this flow and the excess 25mbar has been dissipated over a damper. At this flow rate the fan absorbed power is 80kW.

$$80 \times \frac{25}{(25+65)} = 22\text{kW}$$

Of these 80kW, approximately 22kW are wasted across the damper.

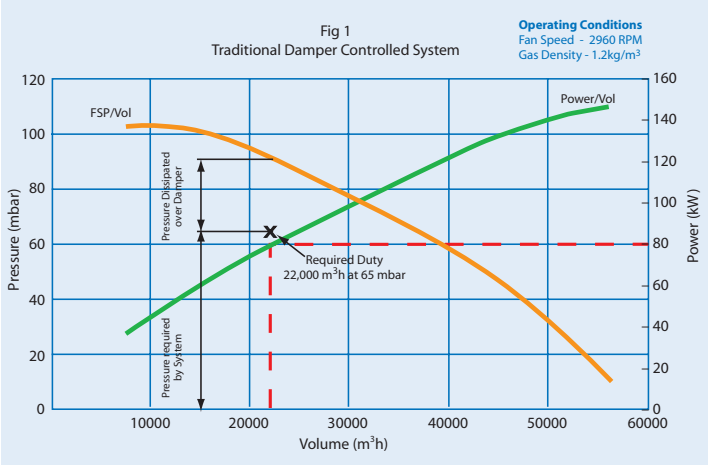
Fig 2 shows the same fan, inverter controlled to match the required duty exactly, and now running at a reduced speed of 2559 rpm. The absorbed power has been reduced to 57kW with no losses over the damper, now fully open. Note that in reducing the speed we have not followed the fan laws, since we have opened the damper and modified the system characteristic and it is no longer fixed.

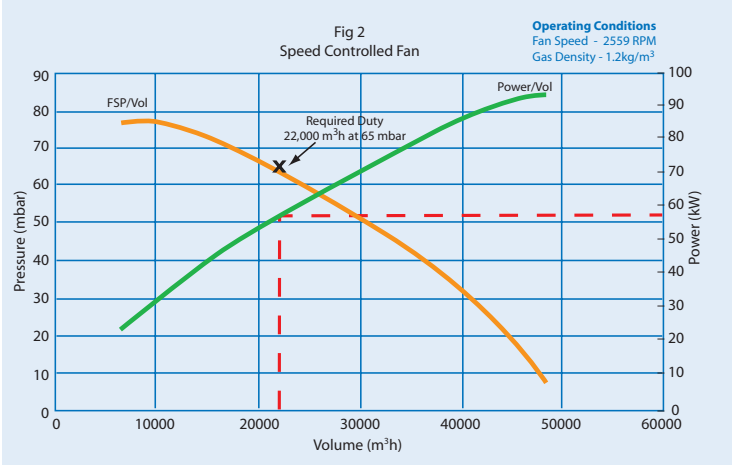
Maintaining constant volume, speed has decreased by 13.5%.

Pressure has fallen by 28%, compared with 25% calculated from the affinity laws.

Power has fallen by 29%, compared with 35% calculated from the affinity laws.

The reduction in absorbed power is significant in that running costs will be substantially reduced with an attendant saving in carbon emissions, an environmentally critical consideration today. It should also be noted that the speed reduction from 2960rpm to 2559rpm, brought about a power reduction from 80kW to 57kW.





Halifax Fan move quietly into acoustic control field

Halifax Fan Ltd has responded to looming changes in the 1989 Noise at Work regulations, by establishing an Industrial Noise Control Department.

In February 2006, new lower limits of noise, demanding action on the part of employers will come into force as part of the Noise at Work Regulations 2005. These new regulations will reduce by 5dB(A) the levels at which employers must take action to ensure the risk to employees is either eliminated at source or reduced to a minimum where elimination is not practical.

variable speed drives to centrifugal fans

Correspondingly, the torque requirement has dropped to 82.2% of original, but not to the theoretical 74.8% expected based upon the square torque characteristics associated with the affinity laws of centrifugal fans.

From this simple example we can explode two commonly held misconceptions about the application of inverter drives to fans:-

1) That the basic affinity laws can be relied upon to predict energy savings accurately. More usually it is more complex than that, and often with savings lower than the basic laws would predict.

2) That fans have a true square torque demand characteristic. This is important to note when selecting a drive for fan applications. The drive's torque rating at reduced speed should be carefully considered and adequate torque provision made for reduced speed operation. In some instances a constant torque drive may be the most suitable choice.

There are other points of consideration when selecting drives for fan duty.

A) Fans handling high temperature gases. The power required varies not only with speed but also with gas density. Even at constant speed, power can vary considerably. At 313ºC the power requirement will be half that at 20ºC.

B) Combustion air fans. When these fans are used to provide a constant mass to a burner over a wide range of ambient temperatures, the power varies by the square of the speed and the torque demand varies linearly.

C) ID Fans. When used to maintain a constant negative pressure upstream of a boiler over variable operating conditions, the torque demand in some conditions can be constant.

The foregoing clearly demonstrates, particularly for larger drives, that very careful consideration, in conjunction with the fan manufacturer, must be given to the projected operating range of the fan and its power/torque demands when selecting the fan/motor/drive package. So called HVAC drives, depending upon their control philosophy, may or may not offer adequate torque right through the operating range and should be selected with some care.

That said, when correctly selected and applied, variable speed drives offer a wide variety of benefits when applied to centrifugal fans, beyond the more commonly quoted, and frequently substantial, financial benefits.

Benefits of VSD operation

- Energy efficient
- Soft-starting
- Reduced noise levels
- Finer process control
- Reduced maintenance
- Improved power factor
- Reduced max demand

Summary

It is common that the specified fan duty exceeds the needs of the actual operating conditions by a generous margin and thus requires some form of flow control. Equally, the operational condition of the fan may require frequent output variation for production or seasonal reasons. In such cases, variable speed drives have a highly beneficial role to play in controlling centrifugal fans and this is confirmed by the upswing in their adoption over the last 10 years or so, particularly for energy saving reasons, which with care, can be reasonably accurately quantified at the time of selection.

Where a new fan is being selected, then there are clear advantages to working with the fan manufacturer, who is fully familiar with the fan and system characteristics and is best placed to advise on the selection of the right drive to meet the fan characteristics. Halifax is able to conduct in-house testing of the complete drive-motor-fan assembly as part of the overall project, rather than deal with split responsibility once the equipment is installed on site ●

Halifax has years of experience in noise control techniques and under Gary Woodward, who has 15 years experience in the design and manufacture of industrial noise control equipment, the new Acoustic Control Team will bring the selection and design of acoustic noise control equipment in-house and offer their services to a broader spectrum of industry. Gary's team will offer a full pre-sale consultancy service including on-site noise assessment. It will provide quotations on a wide range of acoustic solutions including rectangular and circular silencers, marine specification inlet and discharge silencers, filter units and replacement filters, acoustic enclosures, acoustic doors, screens, louvers and lagging materials, in a wide range of construction materials and finishes.

According to Gary "Halifax has invested heavily in new plant and design technology, and is very well positioned to offer a wider acoustic control service to a much broader customer base. In future we will design and manufacture our own acoustic enclosures for our fans in-house and will offer this service for other manufacturing plant too ●

Zone 2 ID fans boost efficiency at Hong Kong Gas

Hong Kong and China Gas Co Ltd is carrying out a major refurbishment of its gas plant to increase production to 115% of current levels. Halifax Fan has supplied 4 off each 200kW and 75kW ID fan systems for the reformer furnace, complete with speed control and soft-start back-up to operate in a Zone 2 environment.

Halifax's experience in hazardous areas was critical in winning the contract. Beaufort models, constructed to the old ICI Arduous Duty specification with increased service factors for improved life and reliability and with self-cleaning, backward inclined impellers, will ensure fan efficiency is maintained despite particulates in the air stream and reduce periodic maintenance and downtime..

Critically, Halifax has supplied the complete fan power string including motors, 12 pulse inverter drives and soft-start back-ups. Inlet guide damper control has also been provided to facilitate controlled operation should an inverter fail and the motors soft-started and run up to full speed. Continuous plant operation is required even in the event of mains electrical supply failure and low frequency or electronic soft-start of the fans allows low current starting on their UPS system.

Paul Fan, Mechanical Manager at the plant, said, "The use of VSDs on the fans will ease starting on our limited mains supply or on our UPS, and as gas demand drops to 40% at night, reduced fan speed gives us substantial energy savings.

Rigorous in-house testing of the complete power strings, including over-speed testing, was carried out prior to despatch ●

New project focused strategy

Halifax Fan has appointed Ian Crum to the position of Projects Manager, to offer their customers a broader project based service. Ian started with Halifax as an apprentice over thirteen years ago and has spent seven of those years in the design department. In his new role, Ian will take responsibility for managing larger projects from initial specification right through to delivery and commissioning and will have a highly experienced team of designers and commercial engineers working with him.

This shift to project based activity is part of an ongoing evolution within Halifax which has seen substantial investment in new CAD/CAM design and production equipment along with greatly enhanced in-house test facilities. This realignment represents a substantial change in business strategy and enables Halifax to offer a wider service to its customer base, focusing the responsibility for an ever larger portion of the fan system content of any plant project onto a single supplier, simplifying procurement and ensuring quality and performance for the fan system as a whole.

In the recent past Halifax has built, tested and supplied substantial fan projects for the power generation, petrochemical, steel and marine industries, comprising not only the fans themselves but also damper systems, inverter drives, acoustic equipment etc.

By setting up this new project team, Halifax has become more forward looking and customer focussed, offering an expanded project based service to its industrial customer base and meeting the need for ever more demanding performance, safety and noise specifications ●

For further information on the articles published in this issue or any other subject of interest please contact us at Halifax Fan or visit our website.

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