MECHCAL'S BIG BREAKTHROUGH

Fans of the future

Significantly reducing energy consumption and carbon footprints is the key to long-term sustainability in the mining industry. One such company was founded and established to help address the issue, writes **Laura Cornish**.

Established in 2002 and officially registered in 2005, MechCaL's primary business purpose is to design, develop and manufacture high-efficiency, low noise industrial ventilation fans for underground operations. The company's core management team comprises former CSIR employees, who have over 120 years of combined experience in operations, aeronautical and mechanical engineering component manufacture and development.

"MechCaL excels in design and research and development (R&D) of customised fans, owing to our expertise in aerodynamics, and the use and incorporation of advanced materials, such as composites," says the MD, Gavin Ratner. "It has taken us years to design and redesign a fan that can deliver on its promise to achieve significant energy savings, reduce noise levels and deliver longer lifespans." MechCaL's fan product line includes axial flow fans, centrifugal fans, a fan monitoring system and a cooling system incorporating a novel centrifugal fan for Caterpillar (prototype in R&D).

From the beginning

MechCaL spent four years 'perfecting' its innovative fan designs and was fortunate to secure financial backing from the IDC (Industrial Development Corporation), which currently holds a 30% stake in the company. The product went through numerous pilot test stages across various mining sites, which saw structural and aerodynamic changes incorporated across all elements of the fan, including the rotor blades, the screen and barrel, coating material, motor and quality of steel used.

"The result is a unique product, completely different in appearance and design, which can save between 8 and 12 kW per 45 kW fan (or about 30%) depending on the existing fan," Ratner confirms. This means that an operation comprising 400 MechCaL fans would result in saved energy of about 4 MW.

MechCaLs' intellectual property

MechCaL already holds a full patent on its jet fan, which has a unique nozzle that determines how much air to inject into a working area.
The company has an additional five patents in the pipeline, including:
- an anti-vibration system for fans (increases system life)
- axial rotor assembly
- composite centrifugal fan assembly
- ventilation monitor

ABOVE The MechCaL manufacturing facility is 3 500 m²

Since putting its new steel rotor fan on the market, in late 2012, the company has already sold and delivered about 400 fans to Gold Fields, has another 500 on order, with pending sales for an additional 500 units. The company has also developed close working relationships with Anglo American and Gold Fields, which were intimately involved in the development and testing of the MechCaL fan and it is pursuing similar relationships with all of the major mining houses.

MechCaL's 3 500 m² floor space facility boasts an assortment of equipment including a computer controlled router, milling machines, lathes, unique press claves and jigging, as well as electronically controlled ovens. The ability to execute validated performance evaluations on fans to BS848/ISO5801 standards, along with two custom-built dynamic balancing machines, ensures the company is able to shorten the turnaround time for any prototype required prior to performance testing and eventual production development.

"We already have 53 people in our employment, all of who have undergone training to ensure they can deliver to our high standards in a working environment where accuracy, attention to detail and technological process know-how is essential.

"We are manufacturing about 100 fans every month, but have the capacity to scale up to 160 in the current facility. Our process, however, is extremely streamlined, which means scaling up is easy," Ratner notes. Every fan is test-run before delivery. MechCaL currently has designs and can manufacture the following typical axial flow fan sizes, including:
- 45 kW fan (740 mm – compatible with 762 mm ducting)
- 22 kW fan (740 mm – compatible with 762 mm ducting)

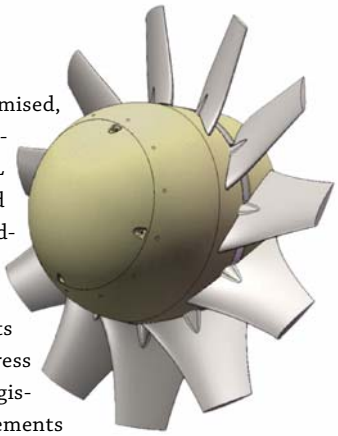
The following offerings are also in development:
- 75 kW fan (1 016 mm)
- 7.5 kW fan (406 mm)
- 15 kW fan (570 mm)

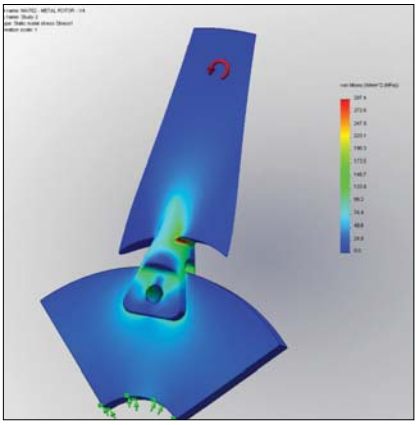
MechCaL does not only manufacture axial flow fans, but also produces a range of centrifugal fans, also designed and manufactured 'fit for purpose'. The company prides itself on its strategy and business model to design and build according to customer requirements.

One of MechCaL's core products is a 423 mm centrifugal full carbon composite fan that is used on current Kumatso haul trucks at Exxaro and Sishen mines. This impeller replaced the metal fans being used with a mass reduction of over 50%, decreasing overall maintenance costs and increasing performance levels at the same time. The same product is also used in the main blower system supplied to Siemens for the Hitachi EH5000 haul trucks.

A grand design

An entirely new design does not mean that traditional fan operating requirements have been compromised, but rather enhanced. MechCaL fans are developed using the most advanced CAE tools. With the use of CFD and FEA, its auxiliary fans address the stringent legislated noise requirements





ABOVE Structural analysis of the cast steel rotor blades to ensure greater fatigue life and low stresses in the final assembly

while exceeding performance expectations (unsilenced at 90 dBA, silencing results in levels below the required utopian level of 85 dBA). Advanced materials (steel alloys and composites) and design aspects mean that wear characteristics have also been improved. Mechanical component maintenance is also reduced and aerodynamic efficiencies improved.

"Despite the significant advancements we have already achieved on our fans, we will continue to allocate between 5 and 10% of the cash we generate on R&D. Our long-term objective is to further improve the robust nature of our fans, which will have a positive impact on their life cycle.

"We also want to do further computational optimisation design, improve aerodynamics further and reduce noise levels below industry accepted levels. Our fans will be more robust in the long term, meaning their life will extend beyond the typical period."

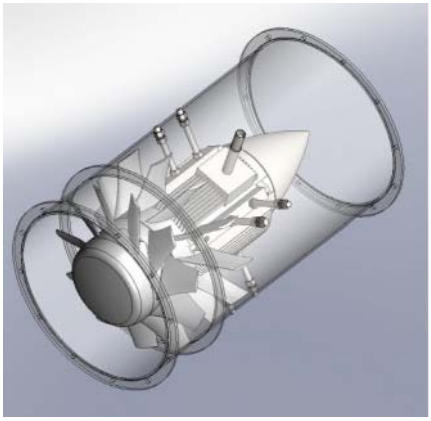
MechCaL is already establishing the benchmark for reduced fan noise levels and is one of a very few that have reached the required 85 dBa level. "Our scrubber fan noise levels are already below target

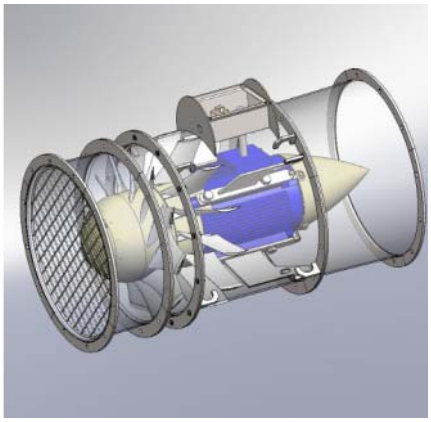
MechCaL's client base

- Sibanye Gold (formerly Gold Fields' Kloof, Beatrix and Driefontein shafts) Anglo American (auxiliary cooling)
- Transnet (traction cooling)
- Lonmin (auxiliary ventilation fans)
- Caterpillar (cooling systems)
- Siemens (grid cooling and main blower)
- Hitachi (axial box and grid cooling)
- Exarro (axial box and grid cooling)
- Kumba Iron Ore (axial box and grid cooling)
- Assmang (auxiliary ventilation fans)
- Colliery Dust Control (coal scrubbers)
- AngloGold Ashanti (auxiliary ventilation fans)
- CSIR

and working well for Colliery Dust Control. Its dust suppression 'Inline Wet Fan Scrubber' system is designed to ensure high dust-capture efficiency.

Ratner says the company has further developed a monitoring system for installed fans. "We have designed and patented a system to monitor a fan's health from a single point." The system is fully automated and operates in real time online.





ABOVE 3D illustrations showing the internal components of the MechCaL fan.

LEFT The traditional (old) support methods and barrel designs

RIGHT MechCaL design showing the 4 barrel sections and the patented motor barrel support which reduces vibration levels and improves blockage and generated noise

Further opportunities

Ratner explains that the company's in-house experience and capabilities afford it with numerous opportunities going forward, particularly for the design and production of customised fan solutions for original equipment manufacturers (OEMs).

"We are already far advanced in the design and development of a fan for Caterpillar for one of its large-scale haul trucks. The security of a contract from this project alone is already sufficient workflow in addition to our base load to consider expanding our premises and production capacity," he points out. 3S