

## An engine renaissance

Achates Power, a US-based company engaged in the development of auto engines, is now ready with a new opposed-piston, two-stroke engine which, the company's president in this interview with Huned Contractor, claims will significantly reduce the costs through better fuel economy

During the Symposium on International Automotive Technology held at ARAI in Pune in January this year, one of the many interesting presentations was that of an opposed-piston (OP) engine, which has no cylinder head, and both the pistons are shape-optimised for combustion. Developed by the US-based Achates Power, it operates on a two-stroke cycle with variable speed superchargers that have an advantageous stroke/bore ratio. Now, nine months later, the engine has been put through several testing procedures and is ready for commercial production. In this interview, Mr David Johnson, President & CEO, Achates Power provides an update as also highlights the various challenges that the automotive industry faces in view of the increasing cost of fuel.

### What is the status of the Achates Power engine?

We have developed a radically improved internal combustion engine that enhances fuel economy, reduces greenhouse gas emissions and is of lower cost. Designed for commercial and passenger vehicles, the Achates Power opposed-piston, two-stroke engine has been through more than 2,500 hours of testing in our state-of-the-art facility. From this testing, we have demonstrated that when compared to the published performance data of one of the best clean diesel engines, the Achates Power engine has:

- 20 per cent lower cycle average brake-specific fuel consumption
- Similar engine-out emissions levels
- Less than 0.10 per cent fuel-specific oil consumption, and
- Reduced cost, weight and complexity.

The founder of Achates Power, Dr James Lemke, recognised that opposed-piston engines enjoy a combination of virtues – high efficiency and low emissions, cost and weight – that are in great demand today. Through the application of rigorous science and engineering methods, we have overcome the historical emissions and oil consumption challenges. Our team of more than 50 scientists and engineers has continued to perfect the engine design using computational fluid dynamics, our fuel lab (which rivals those of OEM fuel injector manufacturers) and our cluster super computer (which allows us to analyse a variety of complex multi-million cell models). The result has been the creation of numerous patented innovations that, in combination, deliver record-setting performance.

### When will Achates Power get into the commercial production of the engine?



We are currently working with a variety of customers worldwide to test and validate our opposed-piston technology for their requirements as well as to ensure overall market success. Our customers will announce commercial production plans and, based on current discussions, I would expect production of the Achates Power engine to begin in the second half of this decade.

### How would your engine compare with developments in hybrid and electric vehicles?

OEMs are investing a significant amount of time and money to improve the efficiency of their vehicles and electrification is a major area of focus. Batteries, though, are very expensive and heavy, limiting the appeal of all-electric vehicles. It is hard to find a bigger booster of vehicle electrification than the US Department of Energy. However, in their September 2011 'Quadrennial Technology Review', they report: "The performance, low cost and fuel flexibility of ICEs make it likely that they will continue to dominate the vehicle fleet for at least the next decades." This is our view too. Therefore, our more efficient and lower cost engine will play a big role in reducing petroleum consumption and carbon dioxide emissions.

### What are the challenges faced by the emerging economies in terms of reducing pollution and meeting emissions standards and how would your engine address them?

The main challenge is cost. Looking at conventional motor vehicle emissions, like oxides of nitrogen and particulate matter, tighter standards cause higher vehicle prices, lower vehicle fuel

economy and higher fuel prices. For a commercial vehicle, the estimated increase in price due to improvements in after-treatment technologies is between USD 5,000 and USD 10,000. Tighter emission regulations in the US reduced average truck fuel efficiency by about 10 per cent between 1999 and 2007. In addition to that, the ultra-low sulfur fuel required for the most advanced emission mitigation devices adds about five cents per gallon to US diesel fuel prices. Now that CO<sub>2</sub> emissions are being regulated around the world, there is an additional cost driver on engines and vehicles.

The National Research Council predicted an increase of USD 16,740 per truck to achieve a 10 per cent fuel efficiency gain (as well as reduction in CO<sub>2</sub>). Achates Power directly addresses these cost concerns and their impact on world economies by not only focusing on fuel efficiency and emissions of the engine itself, but also on production expenses and factory footprint. Our engine is 10-15 per cent less expensive to produce due to fewer parts (such as the elimination of the cylinder head and valvetrain) and manufacturing requirements.

Overall, the less complex engine design results in a decrease in plant tooling costs (17 per cent) and factory size (33 per cent). So, not only is the engine more fuel efficient, cleaner and less costly to operate than the best diesel engines in the world, it is also less expensive to produce.

### What about bio-fuels and new age fuels?

Liquid hydrocarbons are the best source of transportation fuel we have. They carry a lot of energy by both volume and weight, are easily transportable, are relatively safe and have a worldwide infrastructure in place. There is a great deal of research in developing renewable liquid hydrocarbons to take advantage of these features. Meanwhile, there is much research going on to make renewable fuel from algae and other sources that are both cost-effective and carbon neutral.

Once we figure out how to make the renewable fuel production processes scalable and cost-competitive with petroleum-based fuels, internal combustion engines, like ours, will serve as an even more sustainable mode of transport

### How will your engine benefit the Indian auto market?

Using the Achates Power engine, manufacturers can reduce fuel consumption while, at the same time, meet the most stringent emissions standards such as Euro 6, reduce upfront vehicle cost and ongoing operating costs. This, combined with other actions such as light-weighting, improved aerodynamics, enhanced traffic flows and more widespread mass transportation, will go far in addressing the problem of India's rising fuel costs.

### What are the opportunities and challenges in the case of two-stroke engines?

Historically, the opposed-piston, two-stroke diesel engine set combined records for fuel efficiency and power density that have yet to be met by any other engine type. In the latter half of the twentieth century, the advent of modern emissions regulations stopped the widespread development of the two-stroke engine for on-highway use. Since then, however, Achates Power has applied modern analytical tools, materials and engineering methods to the development process of an opposed-piston, two-stroke engine, resulting in a design that has demonstrated a 20 per cent fuel efficiency improvement compared to a state-of-the-art 2010 medium-duty diesel engine at similar engine-out emissions levels. Furthermore, oil consumption (which had been a challenge in historical opposed-piston engines) has been measured to be less than 0.10 per cent of fuel over the majority of the operating range.

### Wouldn't electric vehicles provide a better solution?

Power shortages represent a great challenge for electric vehicles. If you cannot be certain that you can obtain the fuel – electricity for electric vehicles – for your vehicle, it makes it very difficult to plan your day and your life.

*For more specifics on the company's testing methods and published results, you can review white papers on the Society of Automotive Engineering International website ([www.sae.org](http://www.sae.org)) or the Achates Power website ([www.achatespower.com](http://www.achatespower.com)).* ■

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SAIL, Topworth Steel and Power Pvt Ltd.**

and many other users of a large number of industrial products do when looking for new products and better substitutes?

They log on to [www.ipfonline.com](http://www.ipfonline.com) and post their exact requirements seeking further details from the manufacturers/suppliers of the respective product.

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