Gas Conditioning Systems for Fuel Cells and Future Applications

Rotera is currently also developing technologies for new applications in the automotive industry, the latest being air stream gas conditioning technology for fuel cell applications. The Rotera Aerosol Technology effectively removes gas contaminants such as S02 and NOx from the cathode air stream, and at the same time humidifies and cools the purified gas entering the fuel cell membrane.

Rotera Aerosol Technology is developed to remove harmful pollutants (such as microparticles and gases) in the air fuel stream, as these pollutants will otherwise affect the performance and durability of the fuel cell. Using scrubbing technology, contaminants are absorbed to water aerosols, which in turn is separated out from the air using our Disc Stack Technology. The ambient air from the compressor is conditioned by evaporative cooling and humidified for optimal operation of the fuel cell stack membrane.

R&D Centers

Rotera's R&D centers are located in Nacka Strand, Sweden, and Illertissen, Germany.
The German state-of-the-art laboratory in Illertissen is fully equipped with the latest testing equipment, including spectrometers to analyze particle distribution and separation efficiency, rotor dynamic test rigs, and special endurance testing equipment to simulate icing, soot sedimentation, and overall product lifespan. Our seasoned team of engineers has been working for over 25 years in the automotive industry, with extensive experience in crankcase ventilation and technical plastics. This has led to the development of a wide range of applications, which successfully transferred to series production.

Beside designing Active Crankcase Ventilation Solutions (ACCV), our R&D centers offer services for the automotive industry to develop systems and plastic components for powertrains, such as passive crankcase ventilation systems, oil pans, or cam covers with integrated air-oil separation as well as engineering services, validation, and testing.

Rotera develops and sells globally Active Crankcase Ventilation Solutions (ACCV) for separating liquid and solid particles from aerosols for the automotive industry. In addition to designing ACCV, Rotera offers services for the automotive sector to develop systems and plastic components for powertrains.

Rotera is part of the Swedish Grimaldi Development Group, which develops air cleaning solutions based on Disc Stack Technology.

Rotera means to rotate in Swedish, reflecting the movement of our Disc Stack Technology, which continuously seperates particles from air.

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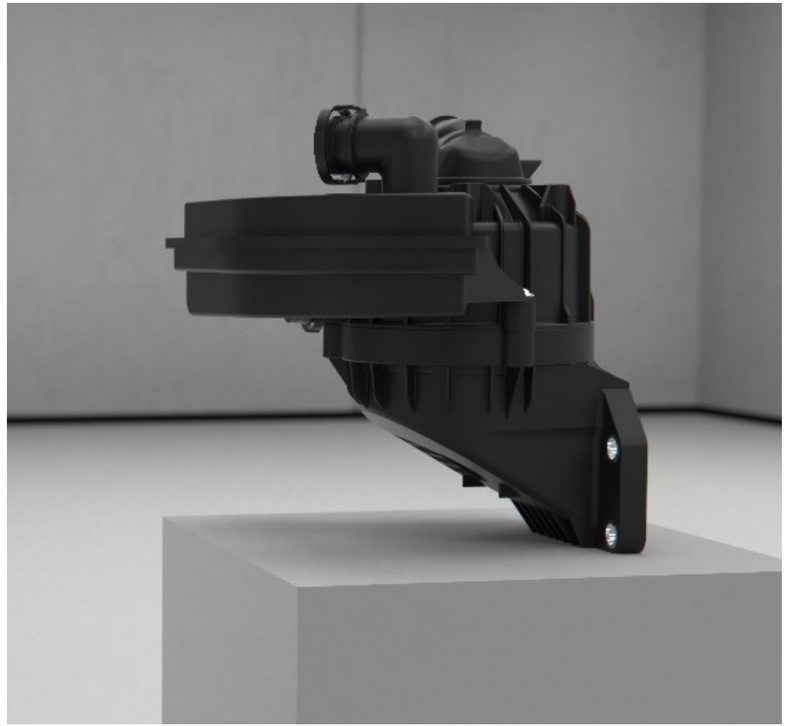

Disc Stack Separation Technology is in our DNA

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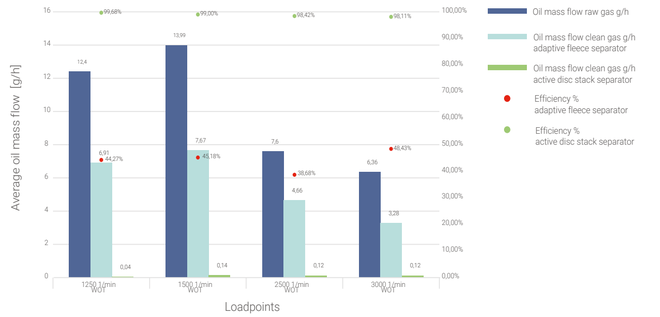
Swedish engineering firm Rotera (former 3nine Automotive) is a highly specialized industry innovator with its Active Crankcase Ventilation Solutions (ACCV) used in truck, car, and offroad combustion engines based on its patented Disc Stack Technology.

As part of Grimaldi Development Group (former 3nine Group), we offer a unique competence in Disc Stack Separation and Centrifugal Separation Technologies. For decades, we have extensively researched and developed air cleaning solutions based on Disc Stack Separation Technology. With over 120 patents, Grimaldi Development is focused on bringing the technology to new business areas. Together with the Royal Institute of Technology in Sweden (KTH), the Grimaldi Development team is now developing highly efficient Carbon Capture and Storage (CCS) technology, using an innovative aerosol approach for separating gases. Another use case involves blood separation to rapidly identify pathogenic bacteria in blood samples, which speeds up diagnostics for improved patient care. Yet another field concerns air cleaning systems to purify air by extracting dangerous viral and bacterial loads.

Are you ready for EURO7/VII? Our technology is

The new Euro 7/VII emissions standard is expected to be finalized in 2022, and similar directives are anticipated in the US and China. That is why optimizing crankcase ventilation is one important factor in complying with future emission limit values. This is done by minimizing the amount of residual oil in the blow-by gas and reducing crankcase pressure to a level below atmospheric pressure. However, existing passive systems can only use the flow energy from the blow-by gas to separate the oil mist, the separation will not be on a continuous level, this leads to higher oil consumption, engine malfunctions, and potential long-term motor damage. Our Active Disc Stack Separation Technology offers a continuous high degree of separation, making it one of the most reliable and truly rugged options for closed systems.

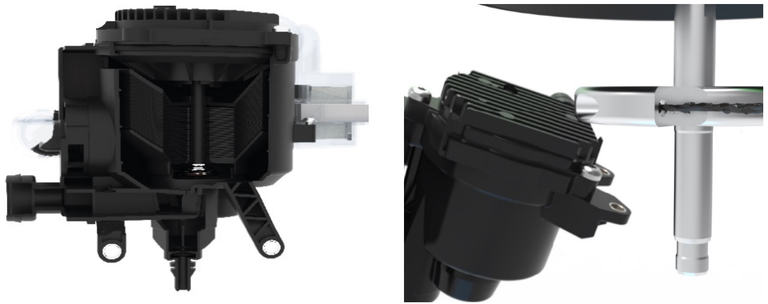


Efficiency of passive/active oil mist separator systems

Rotera's Active Crank Case Ventilation Systems

Rotera's Active Crank Case Ventilation (ACCV) Systems are based on our patented Disc Stack Technology that continuously separates oil particles from the blow-by gas. This technology consists of rotating conical discs stacked onto each other, which are electrically or hydraulically driven. Due to the rotation, blow-by gas is sucked into the rotor and forced through the disc stack where particles are captured and separated from clean air. Due to centrifugal force, captured particles then move towards the edge of the rotating disc and fuse with each other. The larger this fused mass becomes, the faster it moves towards the edge, where it is thrown onto the inner wall of the rotor chamber and trickles down thanks to our patented guiding ribs. Once it reaches the bottom of the housing, the oil is being fed back to the oil recirculation system. In closed systems, the clean gas is then vented back into the engine intake manifold; in open systems, the clean gas is emitted into the atmosphere. For closed systems, an integrated pressure regulation valve keeps the crankcase pressure to a level between atmospheric pressure and maximum calculated and allowed under pressure.

Engines and vehicle models have varying requirements for integrated crankcase ventilation systems. We therefore offer custom-developed products and solutions for passenger car, truck, and off-road engines. Our systems can also easily be adapted to hybrid applications and engines running with bio, flex, or e-fuel. Rotera's ACCV can either be driven electrically by a BLDC-motor, or hydraulically through our innovative HERON system.



Hydraulic and electric drive concept for disc stack separators & Hydraulic and electric drive concept for disc stack separators

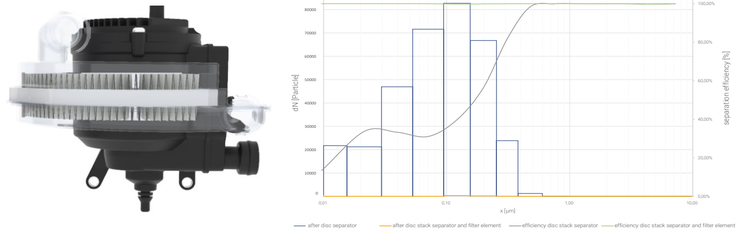
Rotera's Next Generation Active Crank Case Ventilation Systems

Although our Disc Stack Technology provides one of the highest separation rates on the market, a small amount of finest particles cannot be separated. To ensure close to particle-free gas, Rotera has developed a new Active Crank Case Ventilation (ACCV) System, combining Disc Stack Technology with a highly-efficient downstream filter element (patent pending) to capture even the finest particles (<0.6µm) and achieve near-perfect separation rates close to 100%.

The innovative high-efficiency filter element can be designed as a lifetime or service component, depending on the size and filter material required by your custom application. Depending on the application, replacement may be completely unnecessary or only necessary after a specified number of oil changes. Filter load condition can also be determined by way of pressure (differential) sensors, so that the filter will only have to be replaced when necessary. The filter has regenerative properties and can discharge itself to some extent when the engine is off, thereby feeding the separated oil back into the oil circuit. This self-cleaning effect can be optimized with Teflon coating for the filter material.

The proprietary filter design is customer-specific and adapted to the installation space, composition of the blow-by gas, particle sizes, temperatures, and the desired service lifetime, among other custom requirements.

It is also worth considering the replacement of electrically-driven disc stack separators without filters with hydraulically driven disc stack separators equipped with downstream filters due to the higher separation rates at acquisition costs, which are 10-20% lower.



Oil separation efficiency – active system versus active system with filter at 195 l/min blow-by