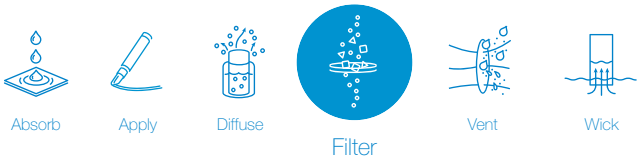
technical brief



Crankcase ventilation (CCV) systems:
Are your materials limiting your safety and sustainability performance?

Challenge

Inability to meet tightening global standards on emissions due to ineffective filtration of blowby gases in the crankcase, which can also lead to compromised engine performance and premature degradation of components.

At Stake

Failure to meet global standards will have far-reaching negative effects on the environment, while compromised vehicle performance has the potential to deliver a negative experience to the end user and damage automobile brand reputation.

Solution

By effectively filtering blowby gases within CCV systems, porous bonded fiber filtration solutions enable vehicles to meet emissions standards and also improve engine performance and lifespan.

The automotive industry and its direct effect on the environment have long been under scrutiny. As the engine goes through the combustion process to operate and power the car, it produces gases that - if not properly contained or filtered - threaten to pollute ambient air.

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In the EU, cars and light commercial vehicles are responsible for a respective 12% and 2.5% of total EU CO2 emissions[1], and trucks and public transportation account for another 6%. Official figures for China – consistently the largest market for vehicles since 2009 – show that in Beijing alone, emissions from some 6.2 million vehicles are responsible for roughly 45% of the city's concentration of small, breathable particles.

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In light of this sizeable impact, legislators are enforcing tighter restrictions to reduce global pollution levels, leading automotive manufacturers to seek innovative solutions that minimize the carbon footprint of vehicles using Diesel, CNG, LNG and hydrogen engines. Where those innovations can also help to enhance engine efficiency and lifespan, manufacturers stand to reap the most significant benefits.

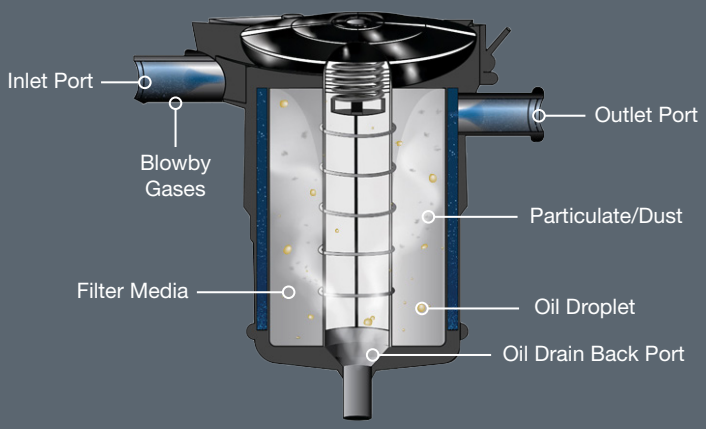
One innovation that provides this dual functionality is Closed Crankcase Ventilation (CCV), a system that helps enhance vehicle safety, sustainability and performance through effectively addressing what are known as 'blowby' gases. Blowby gases consist of combustion gases, aerosolized oils, air or pressure that have leaked into an engine's crankcase. When present, these gases cause greater pressure in the oil pan; introduce unburned fuel, dust and particulate matter and oxides of nitrogen emissions; and create condensation due to the temperature differential of combustion gases and the crankcase.

A functional CCV system works to relieve the pressure in the crankcase that is caused by hot blowby gases, removing airborne dust, particles, hydrocarbons and problematic gases so they are not released into the atmosphere - and also salvaging usable gas and aerosolized oil to be reused within the combustion process. This recirculation keeps the gases produced in the crankcase within the closed system. The effect is two-fold: First, the vehicle exhaust emits far less harmful gas into the environment, helping manufacturers to conform to legislation such as Euro VI, China VI, US Tier 4 Final and BS VI for reduced NOx, particulate matter, and hydrocarbon emissions. Second, the engine is protected from harmful substances and can reuse resources quickly, helping to maintain its health, efficiency and performance.

[1]https://ec.europa.eu/clima/policies/transport/vehicles/regulation_en
[2]http://www.xinhuanet.com/english/2019-07/02/c_138190039.htm

POREX Filtration Group®

The Secret to CCV Systems: Highly Effective Filtration



Filtration in a functional CCV system

The CCV system works to relieve any pressure from the engine's crankcase attributed to blow by gases by rerouting the gases back into the engine's intake manifold to be consumed by the engine.

The CCV filter media accepts the blowby gases from the engine through the inlet port and coalesces the aerosols formed by the engine oils in the exhaust gases while filtering out fine dust, particulate matter, nitrous oxides (NOx) and hydrocarbons before allowing the gases to exit the outlet port back to the intake manifold - and the oil to exit the oil drain back to the oil sump.

How does the CCV system deliver this functionality? A look inside a CCV setup reveals the critical role of filtration within the system's process.

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The filter is responsible for differentiating between what is usable and what is harmful, what should be recirculated and what is safe to be released. It is an important line of defense a CCV system holds for controlling how vehicles utilize and dispose of liquids and gases—making it not only a key component within the crankcase, but of the vehicle as a whole.

Effective, efficient CCV filters capture, clean, coalesce and return oil back to the engine sump to replenish the oil in the system. This is an important function, as oil is used in the engine to lubricate pistons and other working components. Oil that could previously escape the system is instead captured by superior aerosol filtration material, which separates oil mist and particulates while enabling necessary air flow.

Poor Filtration: The Culprit Behind A Wide Variety of Challenges

With new emissions standards, oil viscosity has been increased and the liquid particles that comprise the fluid are more condensed than ever before. As a result, more sophisticated filtration materials with optimized pore sizes are required in order to capture, filter and coalesce the finer particles and return them to the intake system and oil sump. Unfortunately, existing materials can present serious limitations in pore size and structure, resulting in poor filtration efficacy.

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Standard filters available on the market are often manufactured using fiberglass or a fiberglass blend that can shed and cause variability in the assembly of the finished filter. They are also invariably provided in sheets, which are then pleated and require cutting and gluing of the filter around the filter core. This adds significantly to the assembly time and, as a result, to the cost of production. Materials such as PVP and PET are also used for CCV filtration media, but along with pleated sheets, are considered unreliable for capturing all oil droplets at varied viscosities.

Effects of poor CCV system filtration

- Lower engine performance and life
- Costly maintenance repairs with more vehicle downtime
- Reduced engine efficiency and performance
- Pollution of air, water and soil
- Health problems such as asthma, lung cancer, cardiovascular issues and, in some cases, death

The effects of poor CCV system filtration can be severe. In terms of human impact, inhaling vehicle particulate matter and dangerous gases can lead to health problems such as asthma, lung cancer, cardiovascular issues and, in some cases, death. These emissions also contribute to pollution of air, water and soil and are detrimental to agriculture productivity.

From a vehicle perspective, proper CCV system filtration helps maintain oil levels that protect engine components, maintain high engine performance and promote engine life. Successful filtration also helps to preserve resources and conserve energy—ultimately making the vehicle more sustainable and efficient.

Future-Proofed Media: Introducing Porex® CCV Filter Technology

In order to ensure CCV systems are compatible with higher-viscosity fuels, Porex has created CCV filter technology with superior aerosol filtration capabilities. The innovative direct-formed, bonded fiber filters ensure optimal engine performance through effective removal of oil mist and particulates from crankcase blowby gases, meeting standards to reduce NOx and hydrocarbon emissions for EURO VI, China VI-a and VI-b, LEVIII, Tier 4 Final and BS VI. The unique bonded fiber technology also repels oil, preventing clogging and allowing for a lower pressure drop, which improves efficiency and prolongs filter life.

The material's ability to separate even the smallest particulates and oil mist allows it to effectively recapture oil and release clean air, both of which can be repurposed within the combustion process. The media virtually eliminates oil drip, preventing the fluid from escaping through the vehicle exhaust and into the surrounding environment. It also separates oil from oil mist, protecting the health and lifespan of the engine, and maintains vehicle oil levels, extending the life of existing

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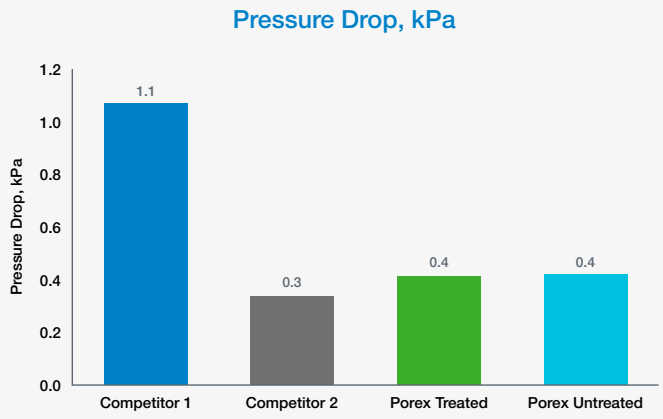
Also unique to this design is a very low differential pressure drop (deltaP), which enables consistent filtration efficiency and extended filter life. Oil filter differential pressure is used to indicate the operating condition of the filters and the overall oil system. Lower differential pressure (average should be 20 psi) on the filter is an indication of reduced oil flow, while high differential pressure is an indication of high oil flow or a plugged filter.

With a filter that promotes an even oil pressure in the lower ranges of 20 psi, manufacturers receive reassurance that vehicle engines will receive adequate lubrication, promoting a longer life of both the CCV filter and engine. POREX® filtration media, which optimizes pressurization regardless of vehicle speed, helps to reduce the risk of increased blowby gas pressure within the CCV. This capability also mitigates risks of bearing leaks or compromised seal integrity.

Designed for efficient production and installation, these direct-formed, bonded fiber filters are designed without pleats or seams and eliminate the use of binders or adhesives. They are a finished filter media requiring no multilayer construction or post-manufacturing treatment. The simple, seamless design is glass-free, will not shed and can be fully customized to meet any automobile coalescing application.

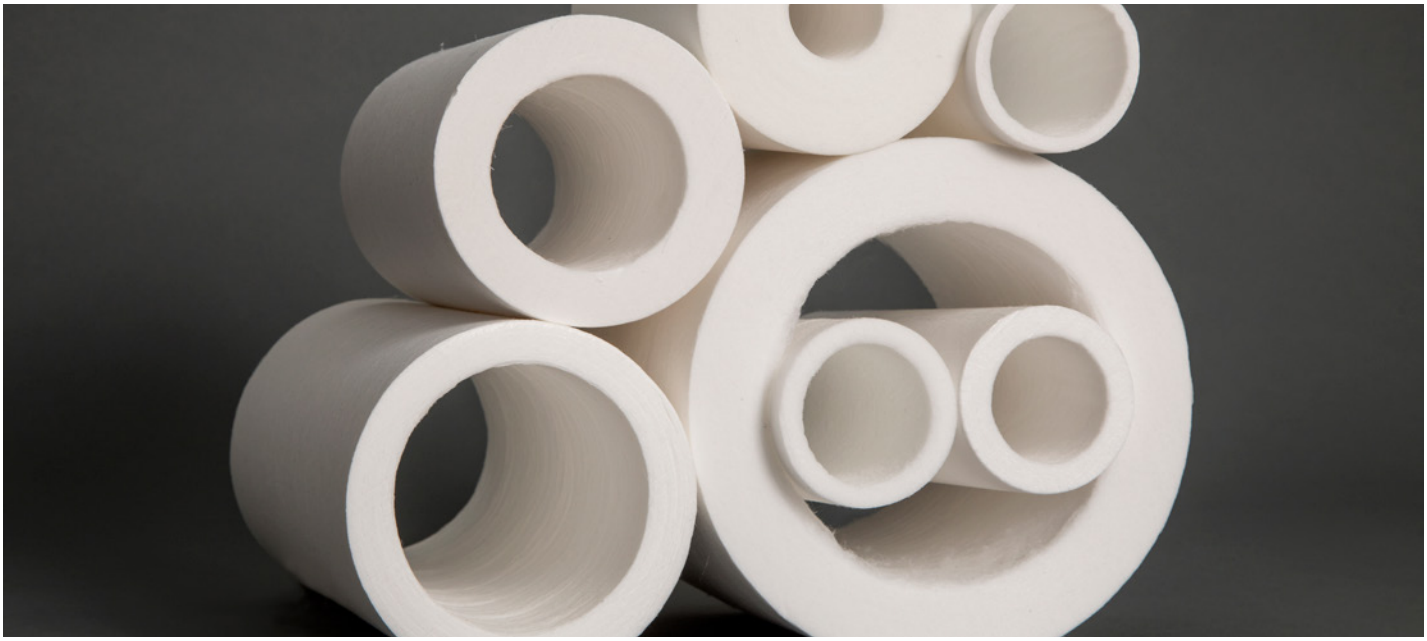


Porex CCV filter media provides better filtration stability than competitors in terms of fractional efficiency based on varying airflow rates with consistent performance over time.

Filtration Efficiency

Sample	ΔP, kPa	Filtration Efficiency per Micron Range			
		0.3 – 1.0	1.0 – 3.0	3.0 – 5.0	Avg.
Porex CCV Filter	0.4	89.9 %	99.4 %	100.0 %	96.4 %
Competitor 1	1.1	92.1 %	99.8 %	100.0 %	97.3 %
Competitor 2	0.3	86.3 %	98.1 %	100.0 %	94.8 %

ISO 17536 – 5, modified with Hot Oil (80*C), 200l/min
Approx. size: 90OD x 30ID x 200L mm



POREX CCV filters are pre-treated, delivered fully formed and require little preparation prior to fitting inside the CCV air filter housing.

Pleated filtration solutions often begin with a flat sheet roll, which must be treated with a water-repellent finish, pleated, formed, glued and then equipped with end caps. This can be seven stages in total, which equates to seven sources of variability, seven sources of waste and seven times the work in progress (WIP). POREX CCV filters, in contrast, are pre-treated, delivered fully formed and require very little, if any, additional preparation prior to fitting inside the CCV air filter housing. Assembly typically involves two to three steps, meaning this media creates fewer variables, less manufacturing waste and fewer WIPs.

Bonded Fiber versus Fiberglass

- Greater filtration efficiency
- Longer lifespan
- Reduced media migration
- Decreased weight and part-to-part variability
- Sustainable (can be incinerated)

In addition, the technology's consistently low pressure drop also enables the filter itself to be designed using a smaller footprint while still delivering high filtration efficiencies. Its small size relieves engine cavity space constraints, meets different engine density needs and supports higher loading capacity, allowing manufacturers greater design flexibility.

Change Your CCV Filtration Media, Change Your Brand Reputation

As global standards become more rigorous to reduce the impact of transportation on the environment, high-quality CCV filtration media will become increasingly critical. Crankcase emissions already contribute up to 25% of total emissions, and as higher-viscosity oils are implemented to minimize potential pollution, automobile manufacturers will be tasked with finding innovative means for improving CCV system efficacy.

> By utilizing state-of-the-art filtration media from Porex, automotive brands all over the world can ensure their CCV systems help minimize carbon footprint and maximize engine performance to extend vehicle life

By utilizing state-of-the-art filtration media from Porex, automotive brands all over the world can ensure their CCV systems help minimize carbon footprint and maximize engine performance to extend vehicle life, offering a complete vehicle that consumers are proud to operate and safe to drive.

To learn more about filtration media for CCV systems, visit us at porex.com.

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