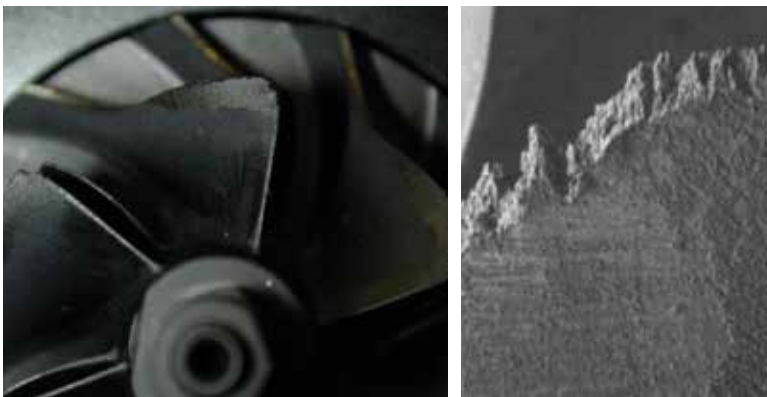


VOLUMETRIC MESH AND FILTER FOR THE AUTOMOTIVE INDUSTRY

LP EGR FILTER + PARTICULATE OXYDATION CATALYST (POC)



FILTER FOR EXHAUST GAS RECIRCULATION (EGR)



Damaged compressor wheel – no emergency filter used

Vehicle manufacturers and suppliers are working in close partnership to develop new solutions for reducing fuel consumption and thereby also CO₂ emissions. Low pressure exhaust gas recirculation (LP EGR) systems are one example of how they are attempting to increase the efficiency of diesel engines. These systems operate on the clean air side downstream of the particle filter with an emergency filter to protect the engine and turbocharger from soot and abrasive particles which might damage the compressor wheel.

REQUIREMENTS AND DESIGN QUESTIONS FOR LOW PRESSURE EGR (LP EGR) FILTER

> Basic and essential requirements for a LP EGR Filter:

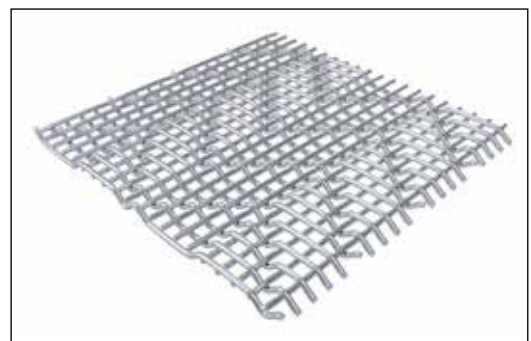
Filtering/ deposition of all particulates:	> 200 μm
Max. temperature:	300-850° C
Max. filter pressure loss:	3-20 mbar
Component cleanliness:	500 μm (hard particles)

Important for the selection of the LP EGR filter is the filter media and the design of the filter. The design and installation situations are usually determined by available space and specific requirements.

> Established on the market are two types of filters:

Radial filters: The component is installed in the main exhaust stream behind the DPF. The recirculated exhaust gas is filtered through a lateral outlet and fed to the cooler.

Cone filters: Located in the EGR line. The exhaust gas flows through the modified truncated cone filter in a longitudinal direction. The filter can be installed either directly behind the junction or directly in front of the cooler.



Volumetric mesh developed by GKD



EGR filter design using metal crimping developed by GKD

EMERGENCY FILTER FOR LOW PRESSURE EGR

When developing EGR's, a critical task is to avoid particles from the combustion cycle or the diesel particulate filter reentering the turbo charger or the engine. Woven wire meshes have some advantages compared to other filter media. E.g. they offer low pressure drop at defined pore sizes, depending on the construction of the mesh. Also they possess very narrow filtration efficiency.

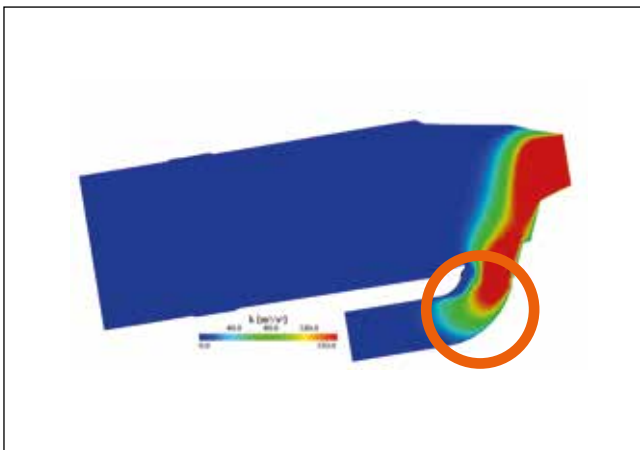
Our research focuses on single and multi-layered meshes as a control filter, also known as emergency filter, to prevent any particle from passing back into the engine and its components. Multi-layer meshes offer the same stability and durability as single layer-meshes, but can offer even better filtration efficiency and/or smaller pore sizes with low pressure drop. Especially GKD's new designed so-called Volumetric meshes have been qualified for LP EGR systems.

But the type of mesh is not the only important issue when dealing with low pressure EGR. The design of the filter element is as important as the mesh itself.

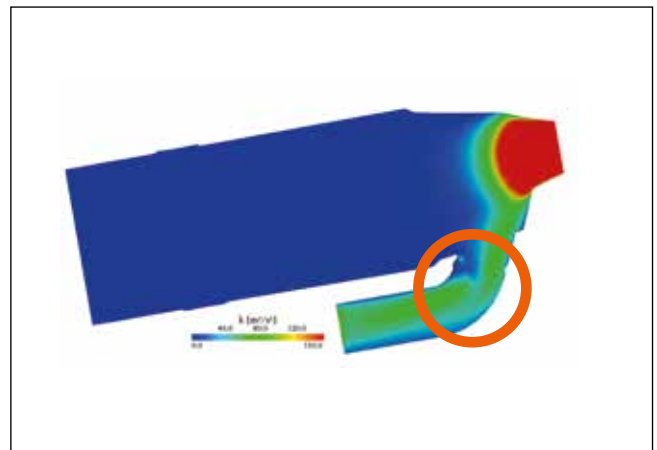
Shown below on the left is an EGR construction using a filter bag design. The position of the filter element is highlighted by the circle. The colors represent the kinetic energy of the turbulences developing in the flow. Turbulences on the other hand remove energy from the flow which will cause higher pressure drop or slower flow. Reducing turbulences is one way to increase the efficiency of the EGR. Together with an industrial partner, GKD develops various filter media and new designs for filter elements.

Shown below on the right is the result of one of the optimizations we managed to develop. Again the position of the filter is highlighted.

Research and development in our company is based on CFD simulation and laboratory tests to the limit of our technical capabilities. Large scale tests are usually done by our industrial partner. Supported by CFD tools, we design customer-specific woven wire meshes and various filter designs especially for EGR application to identify the optimum filter solution.



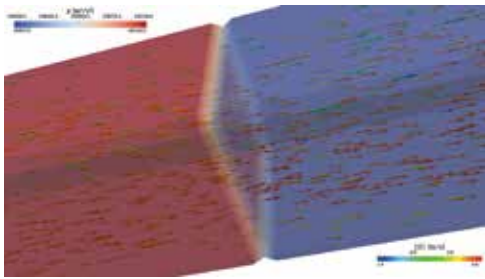
CFD analysis showing the kinetic turbulence inside an EGR filter



CFD analysis showing the kinetic turbulence inside an **optimized** EGR filter

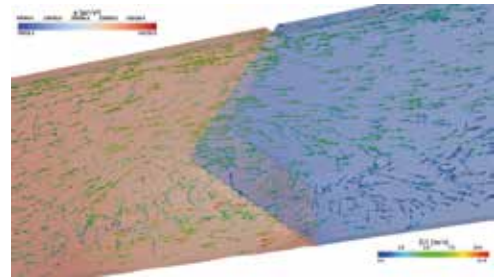
EFFICIENCY OF THE FILTER DESIGNS:

FILTER PAD

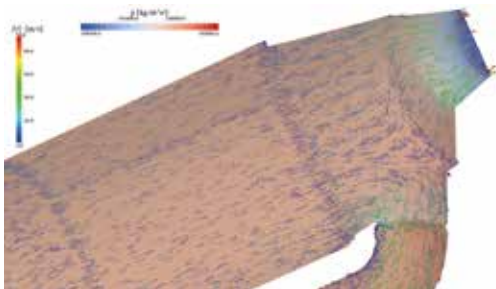


CFD simulation of a flat porous filter

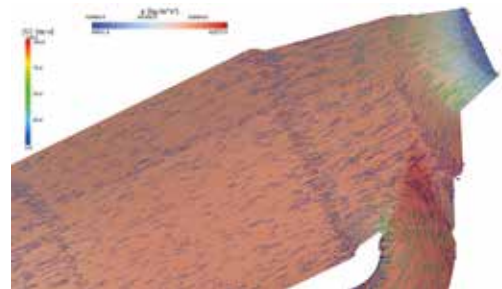
FILTER POCKET



CFD simulation of a pointed porous filter



CFD simulation of an EGR system using a filter pad



CFD simulation of an EGR system using a filter pocket

WIRE MESH FOR PARTICULATE OXIDATION CATALYST (POC)

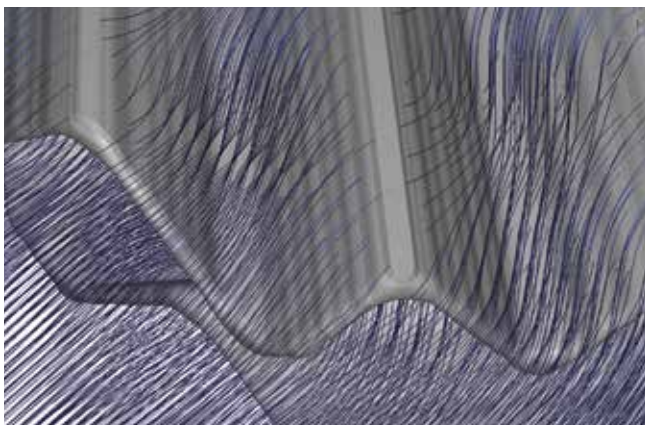
GKD has developed new metal wire meshes for the diesel Particulate Oxidation Catalyst (POC). The POC is an open filter structure, developed to trap Particulate Matter in LD and HD diesel vehicles. The POC with screens out of wire mesh can increase the turbulent flow of the unit. The 3D design is produced with several corrugated wire mesh screen layers. The gas flows through the tortuous paths and uses the wire mesh to enable the gas to flow through the walls into the neighboring cells. A complete 3D flow is possible inside the substrate. The gas has the possibility to flow either through the straight channels or through the POC walls. Compared to conventional filter designs, the flow through a POC based on woven screens is very turbulent which improves the filtration efficiency.



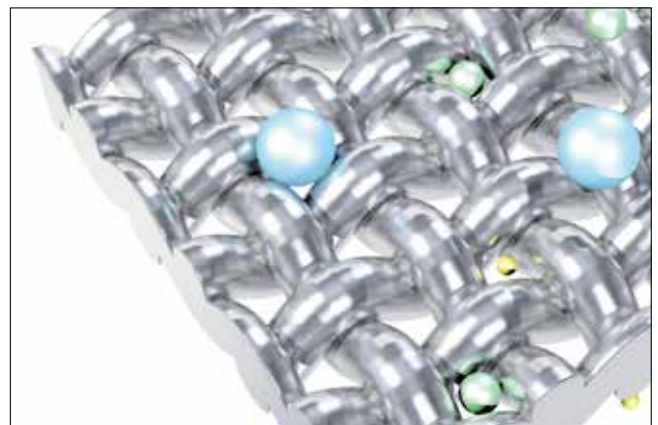
Pleated and corrugated woven wire mesh for POC

THE BENEFITS OF METAL WIRE MESH FOR POC:

- _ DEFINED PORE SIZES
- _ SIZE BENEFIT
- _ FLEXIBILITY IN SHAPE
- _ LOW WEIGHT
- _ EXTREMELY LOW PRESSURE DROP
- _ HIGH-TEMPERATURE MATERIALS
- _ IMMEDIATE CATALYTIC PERFORMANCE
- _ COATABLE
- _ HIGH RESISTANCE AGAINST THERMAL AND MECHANICAL SHOCKS



CFD calculation of a POC section



Wire mesh for POC

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GKD - GEBR. KUFFERATH AG

As a privately owned technical weaver, GKD-Gebr. Kufferath AG is the world market leader in metal, synthetic and spiral mesh solutions. Four independent business divisions bundle their expertise under one roof: **INDUSTRIAL MESH** (woven metal mesh and filter solutions), **PROCESS BELTS** (belts made of woven mesh and spirals), **METALFABRICS** (façades, safety and interior design made of metal fabrics) and **MEDIAMESH®** (transparent media façades). GKD continuously develops new fields of application through its manufacturing technology and process expertise. We use GKD meshes to create efficient systems, equipment and components that are perfectly integrated into our customers' processes across all industrial sectors. GKD is active on the international stage from its headquarters in Germany, five further production sites in the US, South Africa, China, India and Chile, as well as branches in France, Spain, Dubai and representatives all over the world.

BUSINESS UNIT: INDUSTRIAL MESH

State-of-the-art mesh and filter solutions made of metal and plastic wires, as well as technical fibers – for use in all industrial sectors. With innovative web technologies and the latest simulation methods, we develop and produce efficient technical weaves, semi-finished products, components and filter equipment – optimally matched to the most diverse mechanical process engineering requirements. We use our high-level laboratory expertise to continually refine and further optimize our products. Leading manufacturing standards, certified processes and comprehensive testing procedures secure end-to-end high quality in all GKD filter media. This approach allows us to produce some of the most reliable, high-performance filter media in the world. Our innovative capacity, many years of experience with application processes and customer proximity, coupled with our cost-focused and user-centered approach, have made GKD the first choice international partner for industrial mesh.

CLOSE TO THE MARKET AROUND THE GLOBE.

- ① GKD GERMANY, Düren (headquarters)
- ② GKD FRANCE, La Roque d'Anthéron, Croisilles
- ③ GKD SPAIN, Barcelona
- ④ GKD USA, Cambridge, MD
- ⑤ GKD LATIN AMERICA, Santiago de Chile
- ⑥ GKD SOUTH AFRICA, Randfontein
- ⑦ GKD INDIA, Jaipur
- ⑧ GKD CHINA, Beijing, Qufu
- ⑨ GKD MIDDLE EAST, Dubai

