Todays Leading Technology for Tomorrows Future

Air, Noise and Pollution Control Specialists

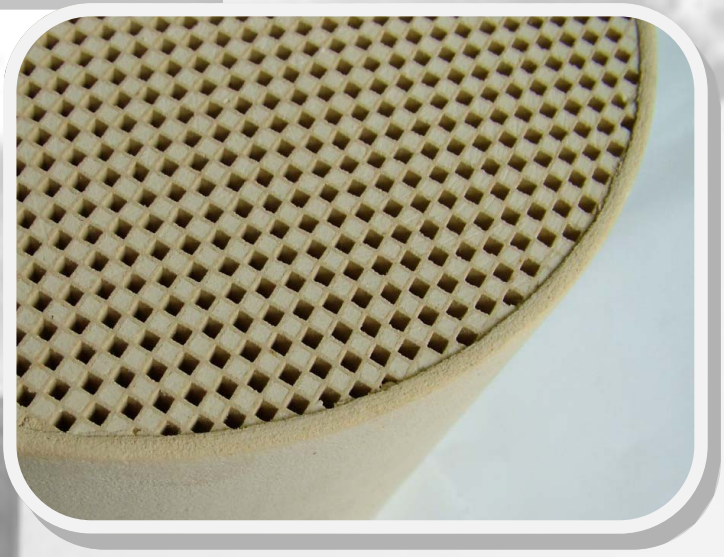
HUMEX

Emission Control

Emission of diesel engine soot has always been a publicly visible problem, the regulatory bodies worldwide are beginning to focus on the hidden health dangers of soot emissions as well.

Humex Pty Ltd as an advanced technology company, are always focusing on emission control product development. Orientated with fast technology development, the company have become a leading emission control product supplier.

These products includes Diesel oxidation catalyst (DOC), Catalyzed metallic filter (CMF) and Catalyzed diesel particulate filter (CDPF) for on-road and off-road emission removal emitted from the diesel engines, such as: buses, trucks, trains, off-highway vehicles, forklifts and gen-sets etc.



Diesel and Diesel Exhaust Catalytic Purifiers

Diesel is a petroleum product used as a fuel. As a hydrocarbon mixture, it is obtained in the fractional distillation of crude oil between 250°C and 350°C at atmospheric pressure. Diesel is used in diesel engines, a type of internal combustion engine invented by Rudolf Diesel. Diesel engines convert the chemical energy contained in the fuel into mechanical power. Diesel fuel is injected under pressure into the engine cylinder where it mixes with air and where the combustion occurs. The exhaust gases which are discharged from the engine contain several constituents that are harmful to human health and to the environment.

Carbon monoxide (CO), ***hydrocarbons*** (HC), and ***aldehydes*** are generated in the exhaust as the result of incomplete combustion of fuel. A significant portion of exhaust hydrocarbons is also derived from the engine lube oil.

Nitrogen oxides (NOx) are generated from nitrogen and oxygen under the high pressure and temperature conditions in the engine cylinder. NOx consist mostly of nitric oxide (NO) and a small fraction of nitrogen dioxide (NO2).

Sulfur dioxide (SO2) is generated from the sulfur present in diesel fuel. The concentration of SO2 in the exhaust gas depends on the sulfur content of the fuel. Low sulfur fuels of less than 0.05% sulfur are being introduced for most diesel engine applications throughout the USA, Canada and Europe.

Diesel particulate matter (DPM), as defined by the EPA regulations and sampling procedures, is a complex aggregate of solid and liquid material. Its origin is carbonaceous particles generated in the engine cylinder during combustion. The primary carbon particles form larger agglomerates and combine with several other, both organic and inorganic components of diesel exhaust. Generally, DPM is divided into three basic fractions

Solids - dry carbon particles, commonly known as soot.

SOF - heavy hydrocarbons adsorbed and condensed on the carbon particles, called Soluble Organic Fraction.

SO4 - sulfate fraction, hydrated sulfuric acid.

The actual composition of DPM will depend on the particular engine and its load and speed conditions. "Wet" particulates can contain up to 60% of the hydrocarbon fraction (SOF), while "dry" particulates are comprised mostly of dry carbon. The amount of sulfates is directly related to the sulfur contents of the diesel fuel.

Since the development over the past decades, catalytic converter technology has been successfully employed to significantly reduce the harmful exhaust pollutants from gasoline-powered vehicles and diesel engines. Humex develops diesel exhaust purifiers on Diesel Oxidation Catalyst basis to improve the performance of diesel engine emission purification.

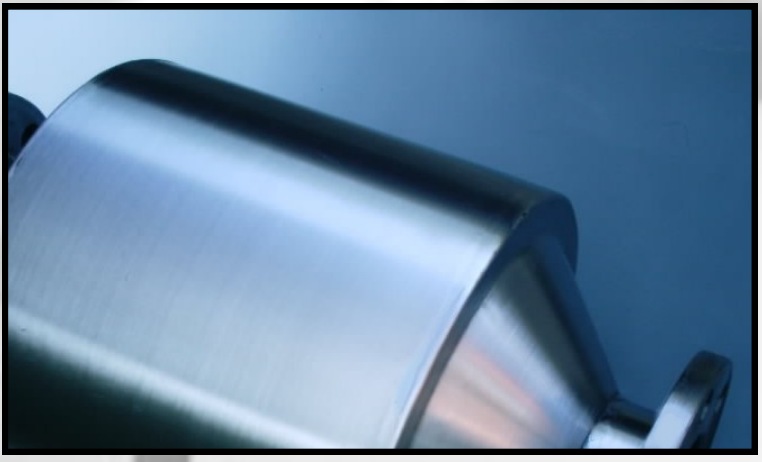
Humex Diesel Oxidation Catalyst (DOC)

Diesel Oxidation Catalyst

The standard Humex diesel engine emission purifiers utilize ceramic monolith catalyst substrates. The ceramic substrates are made of cordierite with very low thermal expansion coefficient. Moreover, cordierite substrates are more stable supports for catalyst coated on the monolith surface. Stability of coated catalyst is also an important factor for long life time expectation of Humex diesel exhaust purifiers. High cell density structure and large specific surface force exhaust gases into the turbulent flow regime resulting in better contact between exhaust gases and catalyst, enhanced mass-transfer conditions, and higher conversion efficiency.

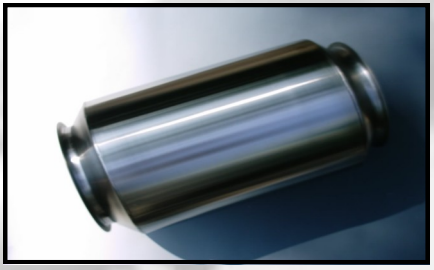
While exhaust gases contact the catalyst atoms deposited onto the monolith surface at a proper temperature, the catalysts oxidize carbon monoxide, gaseous and liquid hydrocarbons, including those adsorbed on the carbon particles, into carbon dioxide and water. The liquid hydrocarbons are known as the soluble organic fraction (SOF) and make up part of the total particulate matter. Due to insufficient reaction time, the carbon fraction of the PM remains mostly unaffected while flowing direct-through honeycomb monoliths. Typically it can achieve up to 80~95% CO & HC removal, and 30% soot reduction. (Ceramic and metallic monolith are optional)

Substrate: 300CPSI cordierite or metallic monolith



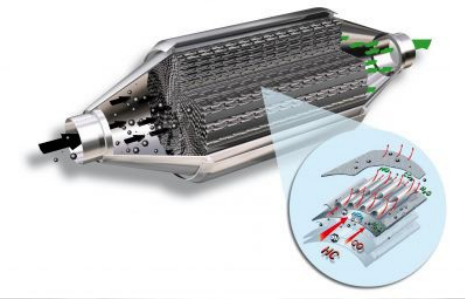
Catalyzed Diesel Particulate Filter (CDPF)

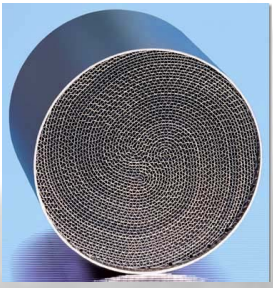
Working in a similar way to DOC, the CDPF catalysts show a significantly improved soot reduction performance at low exhaust temperatures due to the soot trapping filter. Since the soot loading capacity is always limited and the trapped filter have to be periodically regenerated by higher exhaust temperatures, this is also called “self-cleaning” function.
The exact emission performance of catalyst depends on the catalyst size, exhaust temperature, and raw exhaust composition. Kick-off temperature of about 180°C is required for carbon monoxide conversion. Best catalyst performance occurs at temperatures 350-400°C when the conversion of carbon monoxide and hydrocarbon exceeds 90%. Conversion of diesel particulate matter in the catalyst depends on the composition of the particulates and the sulfur content of the fuel. In application of CDPF’s equipped with porous ceramic particulate trap, achievable particulate matter reductions amount to over 95% in terms of mass. Low sulfur diesel fuel is recommended for best catalyst performance because the formation of sulfate fraction at high temperature reduces finally the performance of particulate matter reduction. Continuous automatic regeneration of Humex’s CDPF kicks off at temperature of about 280°C. Catalytic reaction on catalyst surface lowers the burning-off temperature of diesel particulate matter. Average temperature of 350-400°C is recommended for an ideal performance.

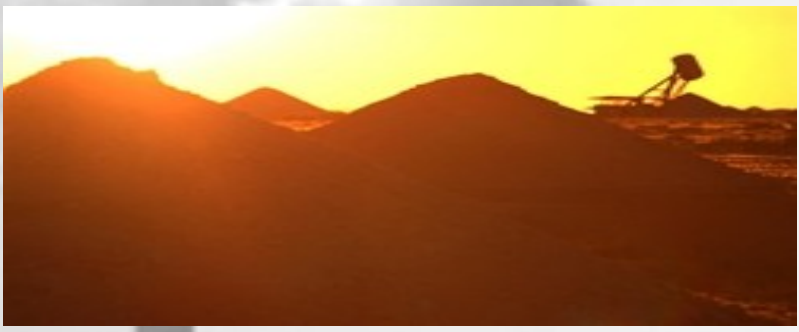


Catalyzed Metallic Filter (CMF)

To remove the DPM emitted from the diesel engine, one option is utilizing the wall-flow diesel particulate filters to achieve >95% soot removal; the other option is using flow-through metallic filter, normally 40~70% soot reduction can be achieved. Comparing to the complicated & expensive CDPF system, it is very obvious for CMF advantages, such as: simple system design, convenient operation, low back pressure, maintenance free, small size and easy installation.
Meanwhile, Humex's proprietary catalyst formulations and coating processes also result in 80~95% CO, HC and Odors reduction for each.
Humex's catalyzed metallic filters are suitable for either OEM and retrofit applications, with high sulfur resistance and long durability.
Humex will provides advice for the design and manufacture of diesel engine exhaust systems.



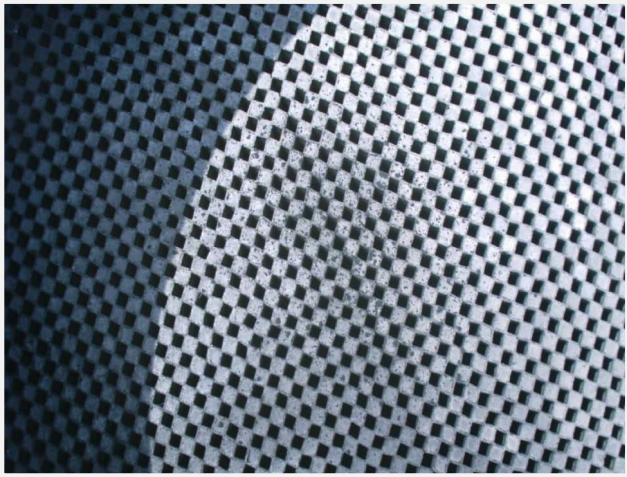


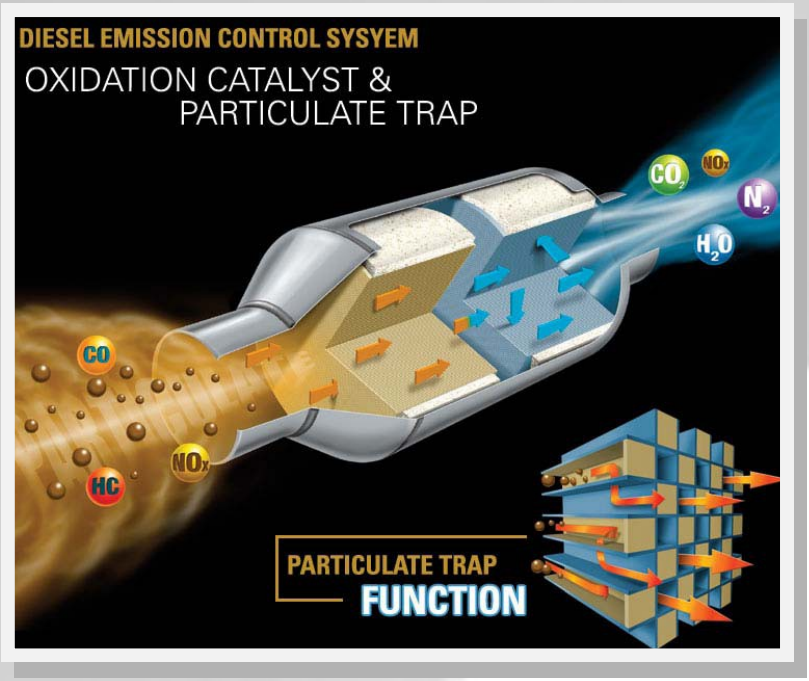


More on Diesel Particulate Filters (DPF)

Humex's diesel particulate filters utilize cordierite wall-flow monoliths to trap the soot emitted from diesel engines. DPF consists of parallel channels, separated by thin walls made of porous cordierite. The channels are open at one end, but plugged at the other. During operation the exhaust gases are forced to flow through the thin walls and leave particulates trapped in the filter walls.

Soot particulate trapped in Humex's CDPF ceramic walls will be oxidized into gaseous compounds, while other harmful exhaust gases converted into harmless compounds. This high oxidation rate of particulate matters helps the automatic regeneration. DPF's without catalyst filters can be manually regenerated after some periods of operation when back pressure increases.





Product Features

Longer lifetime and chemical stability.

Catalyst is a substance that accelerates the rate of a chemical reaction but remains unconsumed by the reaction. It participates in the chemical reaction but is neither a chemical reactant nor a chemical product. Humex's catalysts enable reactions to occur at lower temperatures because of changes that they induce in the reactants. Actually, catalysts provide an alternative pathway, one with a lower activation energy, for a reaction to proceed. Molecules that would not have had the energy to react or that have such low energies that it is likely that they would take a long time to do so are able to react in the presence of a catalyst.

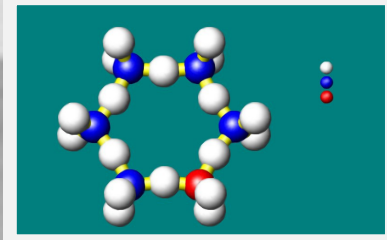
Catalysts inside of our catalytic purifiers have precious metals such as platinum, palladium and rhodium coated on the surface of ceramic honeycomb structures, a lifetime of more than 10,000 operation hours on vehicles or G-drive diesel engines can be achieved without regular maintenance. Chemical reactions take place converting the harmful exhaust gases into harmless compounds when exhaust molecules contact the catalysts. For series with particulate filter, particulate matter trapped in ceramic filter can be oxidized to carbon dioxide and water at lower temperatures because of lowered activation energy. In case of incorporation at continuous lower temperatures, filter direction is recommended to be changed after every 2,000 operation hours. For engine exhaust under the minimum start-up regeneration temperature, an extra heater may be needed.

Ceramic substrate with excellent properties

Our dominate material of ceramic substrate for catalytic converters is porous cordierite, which can be used at temperatures up to 1300°C. Because of its nature of crystallization, crystalloid-chemical formula, cordierite has extremely low thermal expansion coefficient. A large geometric surface to volume ratio is achieved through high cell density of 400 CPSI. Other features like low pressure drop, chemical inertness, fast heat up time, and structural stability at high temperatures make our ceramic honeycomb an ideal catalyst substrate media for both oxidation and reduction catalyst.

Cordierite with a chemical composition of 2MgO-Al2O3-5SiO2 is the most important ternary compound in a magnesium oxide-alumina-silica fume (MgO-Al2O3-SiO2) body and is also our dominate material of ceramic substrate for catalytic converters because of its extreme low thermal expansion coefficient. Cordierite is situated in the primary crystallization field of mullite and has a chemical composition in terms of weight of MgO = 13.8%, Al2O3 = 34.8% and SiO2 = 51.4%. Three forms of cordierite are known to exist: the alpha- form, also known as indialite, beta- and micro-cordierite. Among these three crystalline forms, indialite is the stable high-temperature form and the only one found in nature or achievable in ceramic bodies. Beta- and micro- cordierite can only be formed under special conditions. At 1460°C, the indialite form undergoes an incongruent fusion that converts it first to a mullite phase, then to a liquid phase, from which forsterite can be Developed. Both phases are crystalline phases with much higher thermal expansion coefficients. Cordierite, with a crystallo-cformula of Mg2Al3[Si5AlO18], contains coplanar tetrahedral groups bound in the shape of hexagonal rings with live SiO4 groups and one AlO4 group.

Between these tetrahedral groups are the octahedral groups MgO6 and AlO6, which form toward the inside of the structural unit's free cavities. (A structural unit is formed by three planes of tetrahedral rings, with two cavities between them.) The thermal behavior of cordierite, the anisotropy of its thermal expansion and the possibility to influence these characteristics are explained by its structure and they are very important from a theoretical and practical point of view. Important features related to it crystalline structure make cordierite an excellent material for ceramic substrates in our catalytic purifiers.



Higher Conversion Performance

Humex's diesel oxidation catalysts are proprietary platinum group metals based catalysts coated on ceramic or metallic monolith substrates. Humex's diesel oxidation catalysts have high efficiency for the removal of CO, hydrocarbons and organic faction of black particulate matters. The catalysts have little impact on back pressure and long durability.

Moreover, Humex's catalyzed diesel particulate filter utilizes "wall-flow" ceramic filter substrates for high efficiency black smoke filtration and catalyst coating for continuous regeneration of particulate filters. Proprietary catalyst formulations and coating processes result in negligible back pressure increases across the filter substrate and high efficiency for the oxidative removal of CO, hydrocarbons (HC) and particles.

Humex's DOC & CDPF are suitable for either OEM and retrofit applications, with high sulfur resistance and long durability and have been used for mobile and stationary sources emission reduction.

Humex range for Diesel Engine

DOC Only

DOC + PM Metallic Filter

DOC + Muffler

DOC+ Metallic Filter+ Muffler

CDPF Small Size

CDPF Large Size

Annex CDPF Model Table

CDPF= Catalyzed Diesel Particulate Filter

Exhaust Flow Rate	Classification	Filter Volume	Models	Overall Size(in)*
450(kg/h)	1 Filter	(5.67L)	HUM01-C56F	D13.0x33.5
700(kg/H)	1 Filter	(8.69L)	HUM01-C86F	D13.0x37.5
1000(kg/H)	1 Filter	(12.51L)	HUM01-C125F	D15.0x37.5
1350(kg/H)	1 Filter	(17.03L	HUM01-C170F	D17.1x41.8
1550(kg/H)	1 Filter	(19.59L)	HUM01-C195F	D17.8x41.8
1950(kg/H)	1 Filter	(24.44L)	HUM01-C244F	D17.8x44.8
2700(kg/H)	2 Filter	(17.03x2=34.08L	HUM02-C340F	D31.5x51.2
3150(kg/H)	2 Filter	(19.59x2=39.18L	HUM02-C391F	D31.5x51.2
3900(kg/H)	2 Filter	(24.44x2=48.88L)	HUM02-C488F	D31.5x54.2
4000(kg/H)	3 Filter	(17.03x3=51.09L)	HUM03-C510F	D43.3x58.7
4700(kg/H)	3 Filter	(19.59x3=58.77L	HUM03-C587F	D43.3x58.7
5000(kg/H)	4 Filter	(17.03x4=68.12L)	HUM04-C681F	D43.3x58.7
5800(kg/H)	3 Filter	(24.44x3=73.32L)	HUM03-C733F	D43.3x61.7
6200(kg/H)	4 Filter	(19.59x4=78.36L)	HUM04-C783F	D43.3x58.7
6800(kg/H)	5 Filter	(17.03x5=85.15L)	HUM05-C851F	D45.3x59.1
7800(kg/H)	4 Filter	(24.44x4=97.76L)	HUM04-C977F	D43.3x61.7
7800(kg/H)	5 Filter	(19.59x5=97.95L)	HUM05-C979F	D45.3x59.1
9400(kg/H)	6 Filter	(19.59x6=117.54L	HUM06-C1175F	D45.3x59.1
9700(kg/H)	5 Filter	(24.44x5=122.20L)	HUM05-C1222F	D45.3x62.1
11700(kg/H)	6 Filter	(24.44x6=146.64L)	HUM06-C1466F	D45.3x62.1
13700(kg/H)	7 Filter	(24.44x7=171.08L)	HUM07-C1701F	D48.0x62.5
15600(kg/H)	8 Filter	(24.44x8=195.52L)	HUM08-C1955F	D48.0x67.6

*: Maximum exhaust flow depends on engine type.

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