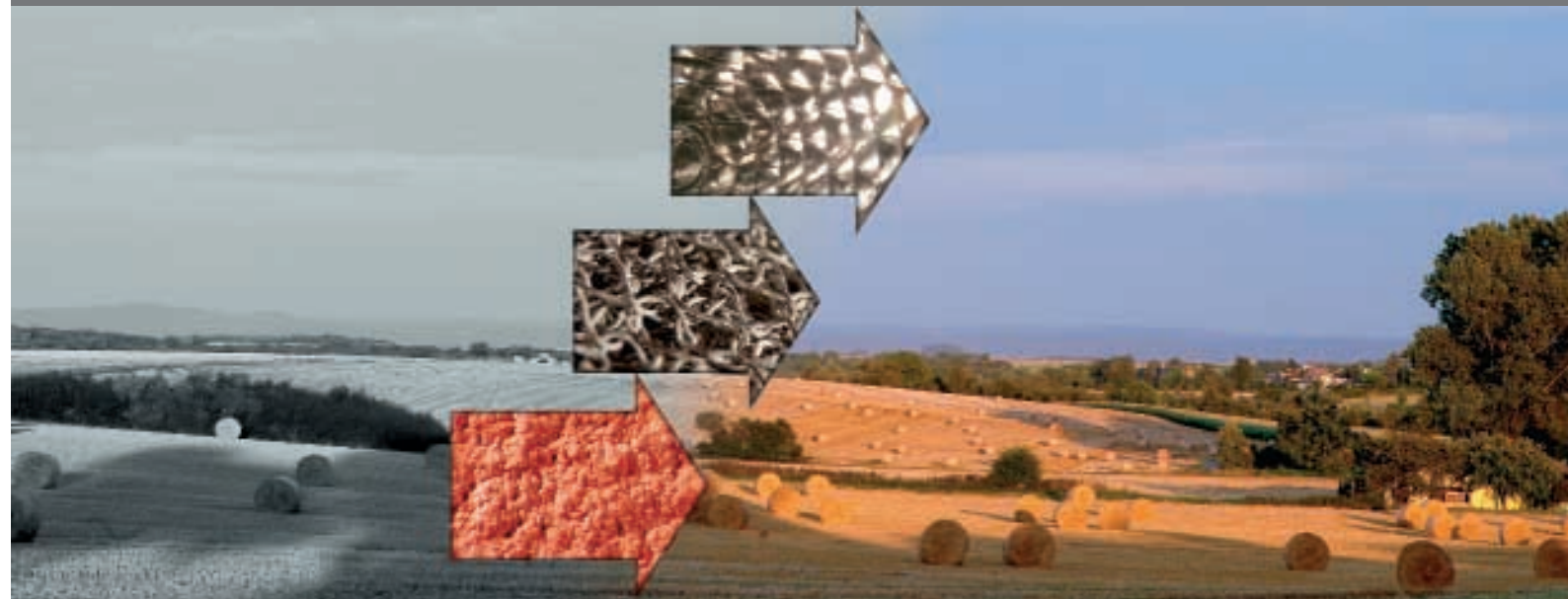


Heraeus



Environmental Catalysts

W. C. Heraeus GmbH
Chemicals Division
Business Unit Catalysts
Heraeusstraße 12 – 14
63450 Hanau, Germany

Phone + 49 (0) 61 81/35-92 83
Fax + 49 (0) 61 81/35-82 90
E-mail: catalysts@heraeus.com
www.wc-heraeus.com

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W. C. Heraeus



W. C. Heraeus Competence in precious metals

1851

In 1856 when, after many attempts, Wilhelm Carl Heraeus succeeded in melting platinum, its application in catalysts was an idea still to be born in the distant future. However, this brilliant pioneering work was to become a factor in revolutionising manufacturing technologies in chemistry and physics.

At the beginning of the 20th century the platinum melting works in Hanau was already one of the most important com-



W. C. Heraeus GmbH (WCH), Hanau, founded in 1851

panies of its type in the world. From that time on, the supporting pillars which have made the Hanau company so successful have been inventions which write history, on-going research work, the development of new materials and the generation of ultra-modern technologies.

Today no one could imagine the key global markets without the range of products provided by W. C. Heraeus. It is one of the most innovative international high-tech companies, especially in the industrial use of precious metals and their alloys.

Due to our worldwide presence in precious metal trading, we are always in a position to guarantee our customers current market prices and leasing rates. The manufacture of precious metal compounds and the recycling of precious metals are part of our business.

We, the Business Unit Catalysts, manufacture heterogeneous catalysts for the reduction of emissions from industry, private households and various internal combustion engines and thus belong to the core working area of W. C. Heraeus. Our product spectrum ranges from the standardised large series to customer-specific solutions for exhaust gas catalysts.

The competitive factors of the future are worldwide presence, maximum flexibility and above all the maximum possible orientation to meet the needs of individual customers. We have risen to this challenge and consider ourselves as a partner for the realisation of tailor made catalysts. We regard it as our job to

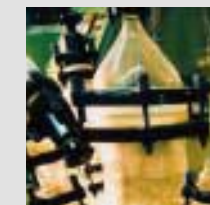
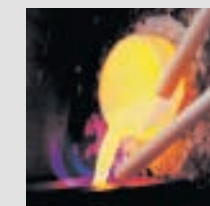
select and put into effect the best combination for you from a large range of precious metal compounds we have developed, different impregnation technologies and various types of supports.

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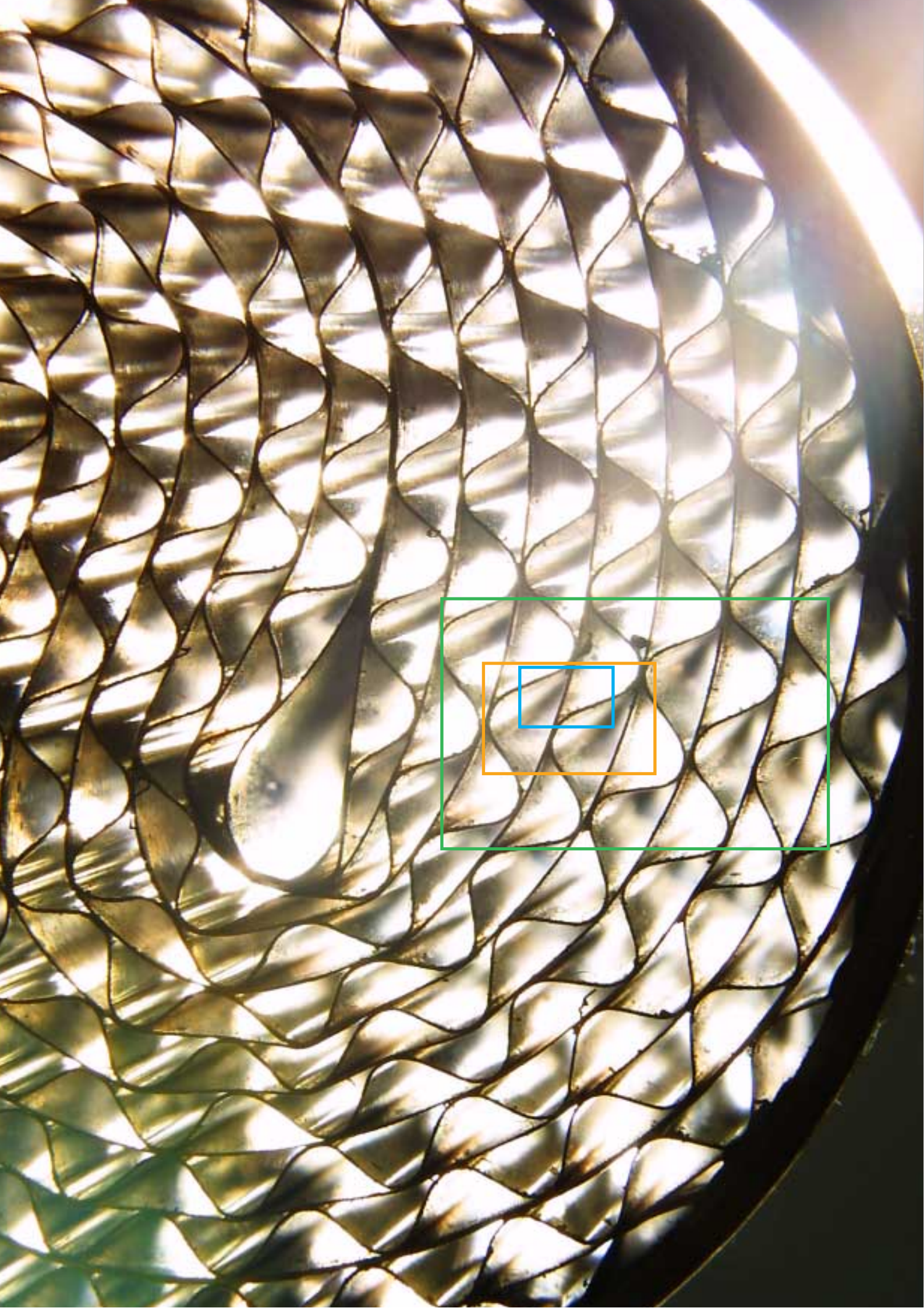
The Chinese ideograph for catalysts (tsoo mei) means "marriage broker".

At first, that sounds rather strange, but in a catalytic reaction bonds are broken first and then new bonds and molecules are formed. The molecules are "married".

A catalyst really functions like a marriage broker, who discreetly withdraws once he has brought the two "marriage partners" together.



Our joint target
"Clean Air"



Small spheres – Big effect

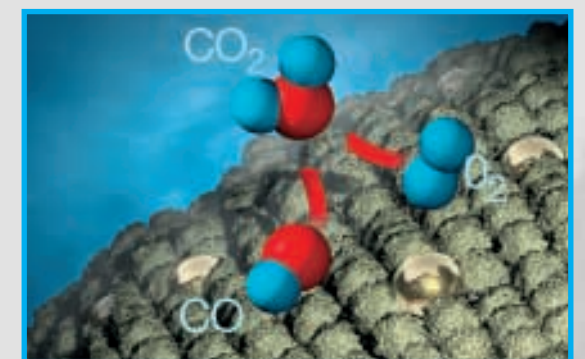
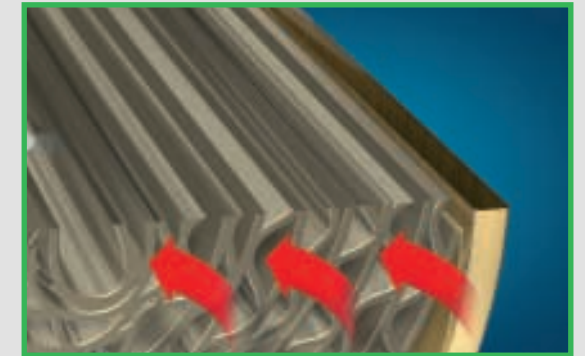
efficiency

In order to meet present and future exhaust gas limits, the catalyst is an essential element of every environmentally friendly exhaust system.

It converts the toxic exhaust components such as carbon monoxide, hydrocarbons and nitrogen oxides produced by internal combustion engines into carbon dioxide, water and nitrogen.

It consists of a shaped body which brings the catalytic coating into contact with the exhaust gases. These metallic or ceramic bodies can be produced in a large variety of different forms, for instance as honeycombs, knitted wire structures, woven screens, fibres and sintered metals.

Onto the surface of these shaped bodies the washcoat is applied and consists of fine ceramic particles which enlarge the surface by a factor of 5,000 to 10,000. This enormous surface is needed to deposit precious metals such as platinum, palladium or rhodium as nano-spheres. These extremely small precious metal spheres are the actual catalyst – the chemical reactions occur on their surface. The rate of the reaction and the catalytic activity can be varied by the composition of the precious metals, the use of different precious metal compounds and the procedure for depositing them.



Schematic view of the catalytic reaction on different magnification levels

Green: gas flow through the catalyst body

Orange: Interaction of the exhaust gas molecules with the catalytic coating

Blue: Catalytic reaction on a precious metal particle

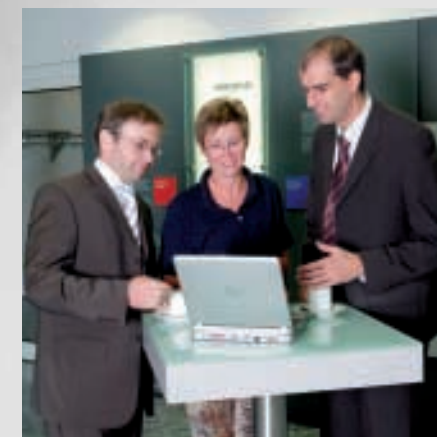


Your goals are our goals

go

For us, achievement means individual conception and the development of customer-specific catalyst compositions for optimum performance – that is our recipe for your success.

A broad based range of services is concealed behind this: from advice and definition of the optimum parameters to the combination of the most suitable components. Shaped bodies of different types and geometries (e.g. honeycombs, knitted wire structures), a great number of washcoat formulations as well as a variety of precious metal compositions are available.

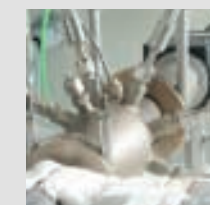


Together we find the optimum solution.

In close cooperation with our customers we offer top level consultation. Here we work out flexible solutions which can be rapidly put into effect in development and production. In everything that we do for you we have above all one thing in view: to find the best solution for your expectations.

For this reason we also make the highest quality demands on all components. This applies both for our own forward-looking developments in the areas of precious metal preparations, the washcoat and coating technology and also for the choice of the shaped bodies. The end result is always an integrated and individual solution which will bring you closer to your goals.

All parts of the company are certified according to DIN ISO 9001. Putting the philosophy of Business Excellence into effect guarantees a constant improvement in our products and services.



Teamwork and communication are conditions for best partnership.

Automotive catalysts – Aftermarket and Motor Sport

air

During fuel combustion in the engine, carbon monoxide (CO), hydrocarbons (HC) and nitrogen oxides (NO_x) are formed as emissions. The catalyst assists the almost total conversion of these three harmful substances into water, nitrogen and carbon dioxide, hence the designation "3-way cat". Since the introduction of the exhaust catalyst in the USA in the 70s, the

emission limits have been regularly tightened. Future exhaust regulations will require the emitted air to be cleaner than the surrounding air in larger cities. Because of these stricter regulations, used cars are affected by increased taxes.

The reduction in motor tax after an upgrade or after retrofitting catalyst technology makes these measures attractive for the vehicle owner. Small series applications such as in motor sport are also subject to restrictions due to tightened legislation.

As a supplier of catalytic coatings, Heraeus is actively engaged in these markets (retrofitting and motor sport). Besides the catalytic performance, additional parameters come to the forefront especially in motor sport. These include exhaust back pressure, weight and temperature resistance.

The competitiveness of projects in this market segment is decided more and more at its interfaces to customer and supplier. The systematic planning for efficient catalysts thus becomes a factor for success. Many years of experience and our capability to succeed in implementing unusual demands make us the ideal partner when it is a question of customer-specific catalysts.



Motor sports requires high quality products to succeed in tough conditions.



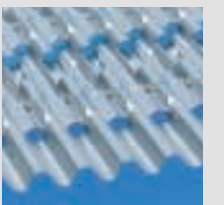


Diesel particle filter – Soot? No, thank you!

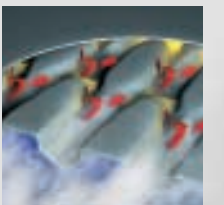
di

Diesel engines have lower emissions than modern gasoline engines. They operate fundamentally with a high surplus of air and therefore have a high proportion of oxygen in the exhaust combined with a low temperature of tail pipe emissions. Due to this method of operation, however, high soot emissions result in comparison to gasoline engines. These must be eliminated to meet recent legislation for maintaining the purity of air.

The catalyst for diesel engines oxidises carbon monoxide to carbon dioxide and hydrocarbons to carbon dioxide and water vapour – this is known as the oxidation catalyst. In contrast to 3-way-cats of gasoline engines the NO_x is not converted at the oxidation catalyst due to the oxygen surplus. But NO can be oxidised to NO_2 at the same time. The fine soot particles, however, can only be restrained to a very small extent by the oxidation catalyst. This means that additional efforts are necessary for the effective reduction of these emissions.



Using structured and perforated metallic supports, efficient systems have been created which are excellently suited for the precipitation of soot particles. We have developed special coatings and coating processes for these particle separators and particle catalysts. A continuous oxidation of soot particles with a reduction of more than 50% in the soot loading is made possible by depositing a layer which forms NO_2 .



Structured foil materials for soot deposition.

New developed coating technology has a minor influence on the deposition of the soot, while the regeneration of the soot is enhanced.

Specially developed coating processes for “filter types” such as knitted wire structures, honeycombs, bags and filter cartridges in combination with various filter materials such as metal fleece, cordierite, silicon carbide, sintered metal or ceramics give a marked increase in the separation efficiency of the particle filtration system.

Our coatings for oxidation catalysts, particle separators and soot filters find application in diesel engines for small working implements, in automotives, trucks and stationary aggregates. For the various regeneration concepts, we offer individually formulated solutions which distinguish themselves through maximum performance and efficiency.

Soot particle reduction is of major interest.



Motorcycle catalysts – we make superbikes cleaner

bike

Emission limit in g/km						
Level	Directive	effective from	class	Test cycle	CO	HC NO _x
Moped						
Euro1	97/24/EG	17.06.1999	–	ECE R47	6	3,0*
Euro2	97/24/EG	17.06.2002	–	ECE R47	1	1,2*
Motorcycle						
Euro1	97/24/EG	17.06.1999	2 stroke	ECE R40	8	4 0,1
			4 stroke	ECE R40	13	3 0,3
Euro2	02/51/EG	01.04.2003	<150ccm	ECE R40	5,5	1,2 0,3
			≥150ccm	ECE R40	5,5	1 0,3
Euro3	02/51/EG	01.01.2006	<150ccm	ECE R40,cold	2	0,8 0,15
			≥150ccm	ECER40,cold+EUDC	2	0,3 0,15

*Total limit for HC and NO_x

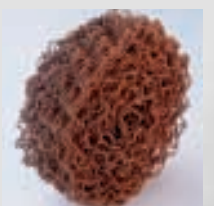


Since the introduction of the EURO 2 limits, all new motorcycles in Europe are equipped with catalysts as standard. The topic of catalyst concepts for motorcycles has become even more important for manufacturers with the tightening of European emission limits for motorcycles (EURO 3).

It is a similar situation for Quads and ATVs, which will not be able to do without catalysts very much longer if they are to satisfy the future limits.

The fun of motorcycling lies not only in good acceleration values but also in the sound of the machines. We achieve the ideal compromise between riding dynamics and environmental protection from the biker's point of view by intensive cooperation with the manufacturers of catalyst supports and by tailoring catalyst concepts to each type of motorcycle.

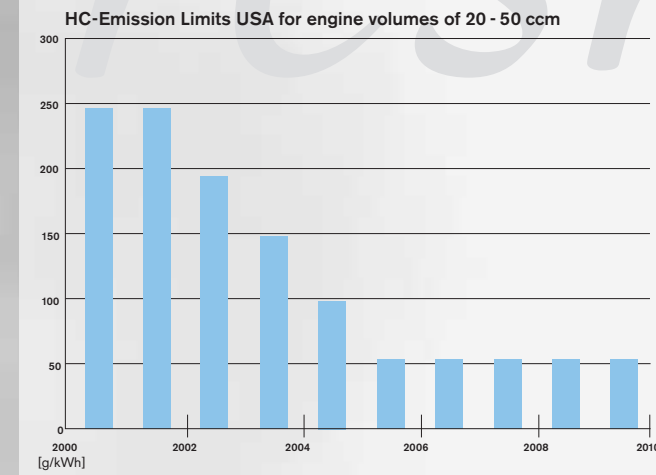
Our coatings for motorcycle catalysts are precious metal compounds and washcoats specially developed for this area of application, both for two-stroke and four-stroke engines. Besides meeting the EURO 3 standard, the achievement of reasonable costs are a matter of course while maintaining the motor performance and optimal design with our catalyst concepts. The success factor is the dynamic teamwork of our customer-orientated product development together with the manufacturers of motorcycles and the manufacturers of sport and retrofit exhaust systems.



Bikes and Catalysts – minor performance is history!

Small Engine Catalysts – for fresh air in the garden

fresh



The general tightening of emission limits is bringing internal combustion engines more and more into focus which in the past were regarded as insignificant sources of emissions.

Petrol driven lawn mowers, blowers and chain saws are being equipped with catalysts so that working in the garden is even more fun. The combination of special motor oils and the use of small engine catalysts result in a considerable reduction of emissions and thus to a reduction in odours caused by unburned hydrocarbons. Although initially only available in a few applications, it is now difficult to imagine lawn mowers, motor saws, blowers, etc. without catalysts due to the relevant legal regulations.

The challenge for this application lies in the requirement of installing a highly effective catalytic surface in the smallest space in a compact shaped body. With catalytic coatings for knitted wire and honeycomb catalysts we offer solutions which permit miniaturisation to the limits of the technologically possible.

Through our experience of ten years as market leader in the area of coatings for small engine catalysts we are in a position to approach customer-specific requirements flexibly and at the same time to offer fair prices. Your products can be produced more economically and your customers can breathe freely when working in their gardens.



Clean air and combustion engines? – Thanks to the catalyst technology no objection.

*Pure Air everywhere –
Catalysts for small engines*

