The Stationary Business of BASF Catalysts LLC is concerned with reducing greenhouse gas through either reducing energy consumption or destroying greenhouse gases after generation using proven catalyst technology. The specific technologies we offer are detailed in the chart below and in the accompanied product line descriptions. If the gas consumption is reduced, the greenhouse gas generation is reduced proportionately.

<table>
<thead>
<tr>
<th>Technology</th>
<th>Commercial Status</th>
<th>Pollutant</th>
<th>Industry</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOCat® RCO catalysts</td>
<td>Yes</td>
<td>VOC, Wood products coatings</td>
<td>Process Industry</td>
<td>Reduces natural gas consumption</td>
</tr>
<tr>
<td>CHARCat™ Charbroiler catalysts</td>
<td>Yes</td>
<td>VOC, PM charbroilers</td>
<td>Chain driven consumptions</td>
<td>50% lower gas</td>
</tr>
<tr>
<td>VOCat 360 PFC oxidation catalyst for halogenated hydrocarbons</td>
<td>Yes</td>
<td>CFC’s</td>
<td>Chemical Processes, Soil Remediation, Groundwater Treatment</td>
<td>95-99 %</td>
</tr>
<tr>
<td>Methane Catalyst</td>
<td>Development</td>
<td>Methane</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Oxidation Catalyst</td>
<td>Yes</td>
<td>CO, VOC</td>
<td>Broad range of industries</td>
<td>Pollutants catalytically rather than thermally destroyed, lowering gas consumption ~50%</td>
</tr>
</tbody>
</table>
VOCat® 350HC
Oxidation Catalyst for chlorinated hydrocarbons

Product data

Chlorinated hydrocarbons are emitted from a wide variety of industrial processes, as well as many soil remediation and ground water clean-up operations. Most conventional catalysts used to oxidize volatile organic compounds (VOCs) have proven inadequate for dealing with chlorinated compounds because they cannot provide the full combination of activity, selectivity and stability needed for these hard-to-oxidize emissions. VOCat 350 HC catalyst provides high activity, excellent selectivity and outstanding stability required for oxidizing chlorinated hydrocarbons.

Activity

Compared to platinum or transition metal-based catalysts, VOCat 350 HC catalyst shows significantly higher activity. This reduces temperature requirements and can allow fuel savings (Chart 1).

The high activity of VOCat 350 HC catalyst is exhibited over a wide range of chlorinated species making this a versatile catalyst ideal for most situations. The activity increases when going from aliphatic to aromatic chlorocompounds and in going from C₂ to C₁ species (Chart 2).

Selectivity

Selectivity is critical when dealing with chlorinated compounds. VOCat 350 HC catalyst will form predominantly CO₂ and HCl when 1.5% or more water is present in the feed stream. The formation of HCl is preferred over C₂ because it is easy to scrub and has minimal effect on catalyst life.

Stability

Aging studies over a period of 1200 hours show that VOCat 350 HC catalyst maintains high activity with no measurable decline. This catalyst effectively operates at temperatures 75°C higher than other catalysts designed for chlorinated hydrocarbon destruction. This high temperature stability makes VOCat 350 HC catalyst suitable for the most demanding applications (Chart 3).

Catalyst Features

The BASF catalysts are supported on ceramic substrates and feature:
- excellent adhesion of catalyst coating to the substrate
- high temperature stability and thermal shock resistance
- low pressure drop
- high strength and excellent durability
- compact design

Typical Operation Specifications

- Temperature range:
  - 225°C to 475°C
- Cell Geometry:
  - 100 to 400 cell/in²
- Activity:
  - up to 99% oxidation

About BASF

As the world’s leading chemical company, BASF’s portfolio ranges from chemicals, plastics, performance products, agricultural products and fine chemicals to crude oil and natural gas. BASF’s intelligent system solutions and high-value products help its customers to be more successful. BASF develops new technologies and uses them to open up additional market opportunities. It combines economic success with environmental protection and social responsibility, thus contributing to a better future.
Chart 1:
**Destruction of Trichloroethylene**

1000 ppm TCE, 1.5% water, 7500 VHSV

For comparison purposes powder catalysts were used.

---

Chart 2:
**VOCat™ 350 HC Oxidation Catalyst**

1000 ppm TCE, 1.5% water, 7500 VHSV

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Chart 3:
**Stability of VOCat 350 HC Catalyst**

1000 ppm TCE, 1.5% water, 7500 VHSV, 450°C
Product data

Regenerative catalytic oxidation (RCO) technology combines the benefits of the rugged, proven reliability of regenerative thermal oxidizers (RTO), with the energy efficiency of catalytic technology. The result is a more cost-effective RCO system that can result in significant operating cost savings, lower CO and NOx emissions, and less maintenance than other systems. VOCat® RCO catalysts provide the highest activity, stability and durability of any RCO catalyst. Consequently, there are more VOCat RCO catalysts in more applications, treating more process flow, than all the other RCO catalysts combined. BASF currently has four commercial RCO catalyst formulations: RCO-5000, RCO-6000, RCO-7000, and structured block. Refer to the table for a summary of suitable applications.

Benefits:
- Significantly lower operating costs
- High CO and VOC destructive efficiency
- Long catalyst life and minimum maintenance
- Lower NOx emissions due to lower fuel consumption
- Durability
- Washability
- Lower operating temperature can extend life of oxidizer

Lower operating costs
The operating temperatures for VOCat RCO catalyst are typically 600 to 800°F for an RTO. Therefore, most gas streams require about 50-70% less fuel to destroy the VOCs.

With VOCat RCO catalyst in an RCO, electrical consumption is less because the combustion temperature is much lower than in an RTO. This lowers the air volume and pressure drop through the system. Also, electrical costs to operate the fans are reduced by 15-40% depending upon the design of the system.

High VOC destruction efficiency
With over 20 years experience in air pollution abatement of VOCs, BASF has developed a strong history of reliability and performance. BASF has a complete understanding of your processes and what catalyst will work best to achieve the highest VOC destruction. Depending on the application, BASF VOCat RCO catalyst can allow the regenerative oxidizer to reach destruction efficiencies of 95-98%. For typical performance in automotive and forest product applications, please refer to the following table.

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### VGCat® RCO Catalyst Applications

<table>
<thead>
<tr>
<th>Catalyst</th>
<th>VGCat RCO-5000</th>
<th>VGCat RCO-6000</th>
<th>VGCat RCO-7000</th>
<th>VGCat RCO Structured Block</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catalytic ingredients</td>
<td>PM</td>
<td>PM</td>
<td>Base Metals</td>
<td>PM</td>
</tr>
<tr>
<td>Shape</td>
<td>1” Saddle</td>
<td>1” Saddle</td>
<td>_ ring</td>
<td>5.91” cube</td>
</tr>
<tr>
<td>Temperature for oxidation</td>
<td>Low Aromatics, Alkenes, Alkynes Oxygenated VOC ≤ C6 Paraffins</td>
<td>Aromatics, Alkenes, Alkynes Oxygenated VOC ≤ C6 Paraffins</td>
<td>Oxygenated VOC</td>
<td>Alkynes, Alcohol, Aromatics Oxygenated VOCs ≤ C5 Paraffins</td>
</tr>
<tr>
<td>Medium</td>
<td>Aromatics, Alkenes, Alkynes Oxygenated VOC ≤ C6 Paraffins</td>
<td>Aromatics, Alkenes, Alkynes Oxygenated VOC ≤ C6 Paraffins</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>Oxygenated VOC</td>
<td>Aromatics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO removal</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Poor</td>
<td>Excellent</td>
</tr>
<tr>
<td>Poisons</td>
<td>Organo Silicates</td>
<td>Organo Silicates, Sulfur</td>
<td>Organo Silicate</td>
<td>Organo Silicates, Sulfur</td>
</tr>
<tr>
<td>Alkaline/acid washing</td>
<td>Yes</td>
<td>Yes</td>
<td>No (water wash only)</td>
<td>Yes</td>
</tr>
<tr>
<td>Typical applications</td>
<td>Spray Booths &amp; Forest Products</td>
<td>Automotive</td>
<td>Automotive</td>
<td>Various</td>
</tr>
<tr>
<td>Recommended minimum catalyst temperature °C</td>
<td>370</td>
<td>370</td>
<td>450</td>
<td>370</td>
</tr>
</tbody>
</table>

NOTE:
- Aromatics VOC: Toluene, xylene, benzene, ethylbenzene, etc.
- Oxygenated VOC: Ketones, acetates, etc.
- Paraffins: Methane, ethane, propane, butane, pentane, hexane

**Typical VGCat RCO Performance in Automotive Application**

![Typical VGCat RCO Performance in Automotive Application](image)

**Typical VGCat RCO Performance in Forest Products Application**

![Typical VGCat RCO Performance in Forest Products Application](image)
VOCat® 360 PFC
Oxidation Catalyst For Halogenated Hydrocarbons

Product data

Chlorinated/Fluorinated Hydrocarbons
Chlorinated and fluorinated hydrocarbons are emitted from a wide variety of industrial processes, as well as many soil remediation and ground water clean-up operations. BASF’s VOCat 350 HC catalyst has been used successfully for many years to destroy chlorinated hydrocarbons. BASF has now developed VOCat 360 PFC catalyst to destroy both fluorinated and chlorinated VOC compounds. Unlike many other catalysts, VOCat 360 PFC provides high activity, excellent selectivity and outstanding stability required for oxidizing fluorinated and chlorinated hydrocarbons.

Activity
The activity of VOCat 360 PFC is much higher than platinum and transition metal-based catalysts. This activity is exhibited over a wide range of chlorinated and fluorinated hydrocarbons, and especially when both are present in the same process stream. This makes VOCat 360 PFC ideal for most halogenated VOC process streams.

Selectivity
When controlling the emissions of VOC’s it is also critical for complete oxidation to prevent the formation of secondary products. VOCat 360 PFC catalyst is very selective over a wide range of chlorinated and fluorinated hydrocarbon species. VOCat 360 PFC catalyst will form primarily CO₂, HCL and HF. The formation of HCL is preferred over Cl₂ because it is easy to scrub, and HF and HCl have a minimal effect on catalyst life.

Typical Process Applications
VOCat 360 PFC is ideally suited for a wide variety of applications, including:
- Chemical processes
- Soil remediation
- Groundwater treatment

Typical Operating Specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature Range</td>
<td>850°F to 950°F (45°C to 510°C)</td>
</tr>
<tr>
<td>Cell Geometry</td>
<td>100 to 400 cpsi</td>
</tr>
<tr>
<td>Performance</td>
<td>Up to 99+%</td>
</tr>
</tbody>
</table>

About BASF
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CHARCat™ 910
Charbroiler catalysts

Product data

In charbroilers, large amounts of organic compounds in the form of smoke and gases, are released during the cooking process. CHARCat allows for the destruction of these compounds and at the same time lowers gas costs by evenly radiating the heat in the broiler.

Operation
The catalyst shroud is designed to evenly distribute the heat from the broiler exhaust into the catalyst. Once the catalyst temperature reaches 450°F, smoke and gases from the charbroiler are burned or oxidized to carbon dioxide or water.

Efficiency
BASF's CHARCat meets or exceeds all the removal requirements for odor producing gases and smoke producing particulates as measured by the South Coast Air Quality Management District's approved independent lab in California. Efficiencies will vary slightly with exhaust hood ventilation rates and cooking rates.

Benefits
- Saves money by lowering fuel use
- Reduces grease build-up and lowers duct cleaning costs
- Easy installation
- Controls smoke and odors
- Runs on broiler exhaust heat
- No moving parts
- No utility hookup needed

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**CHARCat™ Specifications**

<table>
<thead>
<tr>
<th><strong>Size</strong></th>
<th>22.38&quot; outside diameter by 2.86&quot; high</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Weight</strong></td>
<td>Approximately 14 pounds</td>
</tr>
<tr>
<td><strong>Construction</strong></td>
<td>Coated metal alloy foil in a food grade stainless steel frame with heavy duty stainless steel protective screen on both faces.</td>
</tr>
<tr>
<td><strong>Cleaning and maintenance</strong></td>
<td>Cleaning with certain materials may damage the catalysts. Soaking the catalyst in a warm water bath should remove most residues that have built up on the catalyst. Use only approved cleaning materials when washing any portion of the catalysts. A list of approved materials is available from your local distributor.</td>
</tr>
<tr>
<td><strong>Handling and storage</strong></td>
<td>Always allow the catalyst to cool to room temperature before removing. Remove the catalyst using heat gloves by means of the side handles. The catalyst element is sensitive to shock and should not be dropped. If not in use, store in a safe place.</td>
</tr>
</tbody>
</table>
CHARCat™ 900
Charbroiler catalysts

Product data
In charbroilers, large amounts of organic compounds in the form of smoke and gases, are released during the cooking process. CHARCat allows for the destruction of these compounds and at the same time lowers gas costs by evenly radiating the heat in the broiler.

Operation
The catalyst shroud is designed to evenly distribute the heat from the broiler exhaust into the catalyst. Once the catalyst temperature reaches 450°F, smoke and gases from the charbroiler are burned or oxidized to carbon dioxide or water.

Efficiency
BASF’s CHARCat meets or exceeds all the removal requirements for odor producing gases and smoke producing particulates as measured by the South Coast Air Quality Management District’s approved independent lab in California. Efficiencies will vary slightly with exhaust hood ventilation rates and cooking rates.

Benefits
- Saves money by lowering fuel use
- Reduces grease build-up and lowers duct cleaning costs
- Installs easily
- Controls smoke and odors
- Runs on broiler exhaust heat
- No moving parts
- No utility hookup needed

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### CHARCat™ Specifications

<table>
<thead>
<tr>
<th><strong>Size</strong></th>
<th>Nominally 24.5” length x 24.5” width, 2-4” inches high. These dimensions can be adjusted to fit specific applications.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Weight</strong></td>
<td>Approximately 35 pounds</td>
</tr>
<tr>
<td><strong>Construction</strong></td>
<td>Coated metal alloy foil in a food grade stainless steel frame with heavy duty stainless steel protective screen on both faces.</td>
</tr>
<tr>
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