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JOHNSON MATTHEY APPLICATION FACT SHEETS COMPILED BY:
Case No. 501: New QXC Silencer/Converter Installed on Waukesha H24GSID 375 KW Natural Gas Engines Achieves 2007 California NOx Regs

Generating power with natural gas engines in large commercial buildings, while controlling emissions and noise from the engines requires a unique catalytic solution. Johnson Matthey’s new QXC model 3-Way converter silencer was chosen for the task. This design contains a unique catalyst element sealing system that insures against pollutant bypass.

**NOx Limit 42 ppm………Achieved 2 ppm**

**CO Limit 210 ppm……….Achieved 43 ppm**

(Multiple source tests)

**Summary**

- **Product:** QXC 70-12
- **Application:** Gensets with Waukesha H24GSID 375 KW natural gas engines
- **Customer:** Equity Offices
- **Location:** Orange, CA,
- **Installed By:** Johnson Matthey SSEC
- **Date Installed:** March 2005
- **Operation:** Prime Power
- **Pollutants:** NOx and CO
- **Comments:** The installation in the basement of each building created special space constraints, which the JM engineering team had to tackle. The QXC was installed neatly and the catalyst element sealing system proved to give superb emissions reductions far exceeding the current SCAQMD limits.

This project was an engineering challenge due to the limited space in the basement of each building, but the final installation was neat, clean and accessible.
Snow Summit Ski Resort of Big Bear Lake, California had a unique requirement to control PM, NOx, CO and VOC emissions from their Cummins QSK78 engine. They chose Johnson Matthey’s SCRT®, which contains a patented CRT® filter system and a urea injection SCR catalyst system.

**Case No. 502: SCRT® Installed on 3500 HP Cummins Diesel Engine used to Generate Power for Snow Making Equipment in California**

**Background**

During ski season, Snow Summit Ski Resort must operate their Cummins QSK78 engines almost continuously to generate power for their remote site. This power is used to operate snow making and other auxiliary equipment. To meet the SCAQMD stringent air emissions limits, Snow Summit contacted their local Cummins distributor, who in turn contacted Johnson Matthey. Since high level reductions of PM, NOx, CO and VOC was required, Johnson Matthey proposed their SCRT system, comprising a patented CRT system and a urea SCR system. The CRT incorporates an active oxidation catalyst plus particulate filter and the urea SCR system includes a urea injection module, SCR catalytic converter and electronic controls. The SCRT has been operating more than 2000 hours meeting or exceeding the SCAQMD limits.

**Summary**

- **Product:** SCRT® system
- **Application:** Cummins QSK78 3500 HP diesel engine
- **Customer:** Snow Summit Ski Resort
- **Location:** Big Bear Lake, CA
- **Installed By:** Snow Summit
- **Date Installed:** September 2003
- **Operation:** Seasonal Support (1200 hours/year)
- **Pollutants:** PM, NOx, CO, VOC and NH₃
- **Comments:** Snow Summit buying the Cummins engine and equipping it with a JM SCRT emissions control system was a very cost effective solution. Now they can generate snow cleanly from November through April.
Diesel Oxidation Catalyst (DOC) has proven to be effective in achieving low to moderate reductions in particulate matter emissions, while simultaneously reducing CO and HC. To meet SCAQMD Rule 1470 for emergency backup diesel engines, Cal State Fullerton had to reduce PM emissions by 20%. Johnson Matthey’s Diesel Catalytic Converter (DCC™), a high performance DOC was chosen.

**Case No. 503: Johnson Matthey DOC Controls PM from Emergency Standby Caterpillar 3412 Diesel Engine**

Diesel Oxidation Catalyst (DOC) has proven to be effective in achieving low to moderate reductions in particulate matter emissions, while simultaneously reducing CO and HC. To meet SCAQMD Rule 1470 for emergency backup diesel engines, Cal State Fullerton had to reduce PM emissions by 20%. Johnson Matthey’s Diesel Catalytic Converter (DCC™), a high performance DOC was chosen.

**SCAQMD PM Limit……..0.15 g/bhp-hr**
- **Expected PM Reduction……..20%**
- **Expected CO Reduction……..90%**
- **Expected HC Reduction… ….80%**

**Background**
South Coast AQMD Rule 1470 requires owners of new and existing emergency backup diesel engines greater than 50 Hp to control particulate emissions. Rule 1470 was developed in response to the California Air Resources Board’s Airborne Toxics Control Measure (ATCM). Quinn Power Systems, a Caterpillar engine distributor was contacted by Cal State Fullerton for help. Quinn Power in turn contacted JM. Having installed over 30,000 DCCs on trucks and buses, Johnson Matthey is experienced with DOC design and manufacturing. In this case, the requirement to reduce PM from an uncontrolled level of 0.16 g/bhp-hr to meet the limit of 0.15 g/bhp-hr was easily achieved with a standard DOC.

In addition to the DCC, Johnson Matthey can also supply California ARB verified CRT® particulate filter control systems for 90+% PM reduction.

Johnson Matthey SSEC has a wealth of experience in air pollution control applications, including maintenance service to complement initial pilot trials and its design and installation expertise.

**Summary**
- **Product:** Johnson Matthey DCC™
- **Application:** Caterpillar 3412 diesel engine
- **Customer:** California State University at Fullerton
- **Location:** Fullerton, CA
- **Installed By:** Quinn Power Systems
- **Date Installed:** July 2005
- **Operation:** Emergency standby
- **Pollutants:** PM, CO and HC
- **Comments:** Johnson Matthey’s DCC easily met the 0.15 g/bhp-hr PM limit by reducing the uncontrolled PM by 20%.
Teck Cominco Alaska, Inc. had a need to control NOx emissions from their new Wartsila diesel engine at Red Dog Mine to meet Alaska DEC permitted NOx limits. The engine is operated more than 6,000 hours per year to provide prime power for the site.

**NOx Limit 18.2 lbs/hr.................Achieved 4.85 to 14.09 lbs/hr (70% to 100% load)**

**NOx conversion.........................Achieved 87.6% to 93.4%**

**NH₃ Slip Limit 30 ppmv...............Achieved < 2 ppmv**

*(All limit requirements were exceeded)*

**Background**

Teck Cominco Alaska Inc. (TCAK) operates the Red Dog Mine facility, located 90 miles north of Kotzebue, Alaska. Prime power for this mining campus, including living quarters is provided by six existing and one new Wartsila 16V32 diesel engines. To meet the Alaska DEC air permit NOx limits for the new engine (MG-17), TCAK contacted AMEC E&C Services Ltd., of Vancouver, BC, who in turn contacted Johnson Matthey for an SCR system.

This challenging installation, due to its location, was handled by AMEC E&C Services with commissioning by Johnson Matthey. After initial start up, it was observed that ash build up on the catalyst was reducing NOx conversion performance. This was remedied by use of a lower ash non-marine lube oil and a more open catalyst cell structure. After these changes, the SCR system has operated over 8,000 hours to date with no problems.

**Summary**

- **Product:** Urea SCR system
- **Application:** 6555 Hp Wartsila 16V32 diesel engine
- **Customer:** Teck Cominco Alaska, Inc.
- **Location:** Kotzebue, AK
- **Installed By:** Red Dog Mine
- **Date Installed:** November 2003
- **Operation:** Prime power, 6,000+ hours/year
- **Pollutants:** NOx and NH₃
- **Comments:** Johnson Matthey was chosen to supply this urea SCR system because of their excellent reputation and human and financial resources.
Case No. 701: Turnkey SCRT System Installed on Three 2220 HP Cummins KT TA50-G2 Diesel Engines Used for Emergency Backup Power in Puerto Rico

Janssen Ortho, a subsidiary of Johnson & Johnson had a need to control NOx and PM emissions from their Cummins diesel engines. The engines were installed to provide emergency backup power for their pharmaceutical R&D and manufacturing facility in Puerto Rico.

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Targeted Emission Limits</th>
<th>Achieved (engine range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOx</td>
<td>1.28 g/bhp-hr</td>
<td>90% 50% Load 91 - 92.4%</td>
</tr>
<tr>
<td>CO</td>
<td>0.33 g/bhp-hr</td>
<td>85% 100% Load 97.8 - 99%</td>
</tr>
<tr>
<td>HC</td>
<td>0.03 g/bhp-hr</td>
<td>80% NA 99% 99% 99%</td>
</tr>
<tr>
<td>PM</td>
<td>0.017 g/bhp-hr</td>
<td>&gt;90% &gt;90%</td>
</tr>
</tbody>
</table>

**Background**

When Janssen Ortho LLC installed three Cummins KT TA50-G2 diesel engines at its Gurabo, Puerto Rico research and manufacturing site to provide emergency backup power, they needed to control NOx and PM emissions from these engines. However, they had a very limited amount of space around the engines. To solve the problem, Johnson Matthey and Janssen Ortho worked together to arrive at a compact and efficient solution - a platform design that allowed all of the emissions control equipment to be installed above the engines.

Johnson Matthey provided project engineering, project management and complete installation of the platform and all of the emissions control equipment. Johnson Matthey also integrated the engine signals into the urea injection system and provided load mapping with load banks.

**Summary**

- **Product:** Urea SCR and CRT diesel particulate filter system
- **Application:** 2220 Hp Cummins KT TA50-G2 diesel engines
- **Customer:** Janssen Ortho LLC
- **Location:** Gurabo, Puerto Rico
- **Installed By:** Johnson Matthey SSEC
- **Date Installed:** July 2007
- **Operation:** Emergency backup power
- **Pollutants:** NOx, CO, HC and PM
- **Comments:** Johnson Matthey was chosen to supply this turnkey urea SCR and CRT diesel particulate filter system because of their excellent technology, reputation for quality, engineering and installation capability.
Case No. 702: Skid Mounted Portable Urea SCR System reduces NOx by 80% to 90+% for 10 to 200 kW engines

Emissions Problem – A New England military contractor performs durability tests on each portable electrical generator they produced before they are shipped to Iraq. The generators vary in size from 10 to 200 kW and as many as six generators are tested at a time with each being run for a minimum of 50 hours. In addition, the company also wants the freedom of testing the engines at various locations at this site. During the NOx season of May 1 - September 30, they are capped at 137 lbs/day of NOx from all sources at the site. As a result, the company had to install NOx controls.

Emissions Solution – Johnson Matthey designed and built a self contained SCR system that is fully portable (forklift movable). It is skid mounted (8’ x 10’) and contains a NOx analyzer for closed loop urea injection control, an air compressor, urea injection system and urea tank. It is designed to handle the exhaust from as many as six engines sized from 10 kW to 200 kW each for a maximum of 1200 kW total. It is capable of achieving 80 to 90+% NOx reduction with a maximum ammonia slip of 10 ppm. It is fully weatherproofed for exterior use.

Engine Exhaust Manifold

SCR Catalytic Converter

Urea Injection Panel

NOx Analyzer

Air Compressor

Urea Tank

Pipe connecting the exhaust manifold to the SCR catalytic converter

NOx probe installed in exhaust pipe
Case No. 703: CRT® Diesel Particulate Filter
Installed on a Rock Crusher and Conveyor to Reduce PM and Odor

J Cloud Inc. of El Cajon, CA installed Johnson Matthey CRT2’s on their CAT 3408 and CAT 3306 engines. The CAT 3408 drives a hydraulic pump that powers a rock crusher and the CAT 3306 drives a generator that provides power for a conveyor. Each CRT2 contains two particulate filters and was selected to match the engine size and exhaust conditions.

<table>
<thead>
<tr>
<th></th>
<th>CAT 3408</th>
<th></th>
<th>CAT 3306</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Engine Out g/hp-hr</td>
<td>Guaranteed g/hp-hr</td>
<td>Reduction %</td>
<td>Engine Out g/hp-hr</td>
</tr>
<tr>
<td>PM</td>
<td>0.2</td>
<td>0.045</td>
<td>85</td>
<td>0.3</td>
</tr>
<tr>
<td>CO</td>
<td>1.6</td>
<td>0.52</td>
<td>80</td>
<td>2.6</td>
</tr>
</tbody>
</table>

**Background**

J. Cloud Inc. has a rock crushing operation near San Diego in El Cajon, California where Caterpillar diesel engines are used to provide hydraulics and power for the equipment. This site operates 8 hours a day for 5 days a week. After receiving complaints of diesel odors and dust, the San Diego APCD investigated and found that prevailing winds were responsible for transporting dust and odors to the residences nearby. As a result, J Cloud was required to remedy the situation by installing emissions control equipment. J Cloud chose to install Johnson Matthey’s CARB verified CRT particulate filter, a technology which contains an integrated oxidation catalyst and a particulate filter. The catalyst eliminated the odor and the filter reduced the PM. Both CRT2’s run at a backpressure of approximately 15”WC at full load and have only been cleaned once at 1200 hours to remove accumulated ash from the filters.

**Summary**

- **Product:** CRT2 Diesel Particulate Filter
- **Application:** 536 Hp CAT 3408 and 430 Hp CAT 3306 engines
- **Customer:** J Cloud Inc.
- **Location:** El Cajon, CA
- **Installed By:** J Cloud Inc.
- **Date Installed:** September 2, 2005
- **Operation:** Rock crusher and conveyor belt
- **Pollutants:** PM and CO
- **Comments:** The CRT2’s have operated for over 2,000 hours with no problems
Case No. 704: CXX-8-4 NSCR 3-Way Catalytic Converter Installed on an Agricultural Gas Pump Engine to Meet San Joachin Valley Unified APCD Certification Requirements


<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Converter Inlet (\text{lb/hr})</th>
<th>Converter Outlet (\text{lb/hr})</th>
<th>% Reduction</th>
<th>Certification Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOx</td>
<td>3.870</td>
<td>0.212</td>
<td>95</td>
<td>80</td>
</tr>
<tr>
<td>CO</td>
<td>5.405</td>
<td>0.288</td>
<td>95</td>
<td>80</td>
</tr>
<tr>
<td>VOC</td>
<td>0.094</td>
<td>0.001</td>
<td>99</td>
<td>50</td>
</tr>
</tbody>
</table>

Source Test Results by Aeros Environmental

Background

The San Joachin valley is the leading agricultural region in the US. It is ranked first or second in the supply of a number of staple fruits and vegetables as well as cotton and oil. To meet ozone non-attainment, the SJVAPCD recognized the need to control emissions from agricultural engines. Many of these engines are rich burning gas engines that can be easily retrofitted with 3-way catalytic converters and air fuel ratio controllers (AFRC).

In order for a catalytic converter company like Johnson Matthey to qualify its catalytic converter for application to these engines, the SJVUAPCD instituted an emissions certification process requiring the installation and operation of the catalytic converter and AFRC on a representative engine. This emissions package must pass a source test to prove it can achieve the emissions standards for NOx, CO and VOC. The JM converter and Gas Systems AFRC exceeded the standard.

Summary

- **Product:** CXX-8-4 Bandito 3-Way catalytic converter
- **Application:** Cummins 855A 200Hp engine
- **Customer:** Grimmway Farms (the world’s largest producer of carrots)
- **Location:** LaMont, CA
- **Installed By:** Black Hawk Services
- **Date Installed:** October 22, 2007
- **Operation:** Water pumping
- **Pollutants:** NOx, CO and VOC
- **Comments:** The CXX-8-4 Bandito converter exceeded the San Joachin Valley APCD certification requirements and is currently accumulating operating hours required for full verification.
The state of Wyoming and the Bureau of Land Management (BLM) requested all gas drilling companies in the Pinedale Anticline to reduce NOx emissions from their drilling rigs. After a competitor’s SCR systems failed to meet the requirements, Shell Exploration and Production Company contacted Johnson Matthey for a solution to this challenging application.

**Background**

Rapidly expanding natural gas drilling activity in the Pinedale Anticline in Wyoming has resulted in the need for environmental emissions reduction regulations for all gas drilling rigs in Southeastern Wyoming.

Shell Exploration and Production Company needed to control NOx emissions from their natural gas drilling rigs (each equipped with three Caterpillar 3512BDITA engines). However, the dramatic engine load swings experienced in the drilling operation coupled with the harsh environment led to the near immediate failure of all the SCR systems provided by a competitor.

To solve the problem, Johnson Matthey and Shell worked closely together to replace the competitor’s non-functioning systems with Johnson Matthey equipment and their more advanced catalyst technology.

Johnson Matthey provided extensive engineering, project management and complete installation and commissioning support for the project. The modular design of the Johnson Matthey SCR systems also makes them easy to transport and reassemble at a new drilling location with minimal effort.

**Summary**

- **Product:** Urea SCR system
- **Application:** Three 1476 hp Caterpillar 3512 BDITA diesel engines
- **Customer:** Shell Exploration and Production Company
- **Location:** Pinedale, Wyoming
- **Installed By:** Johnson Matthey SSEC
- **Date Installed:** March 2008
- **Operation:** Drilling rig prime power
- **Pollutants:** NOx
- **Comments:** In this harsh environment, the Johnson Matthey SCR system reduced NOx emissions by >90% and maintained ammonia slip of <10ppm throughout the extreme engine load swings of the gas drilling operation.

**Pollutant Targeted Emission Level Achieved**

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Targeted Emission Level</th>
<th>Achieved</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOx</td>
<td>90% reduction or 0.70 g/hp-hr</td>
<td>91 to 99%</td>
</tr>
<tr>
<td>NH3</td>
<td>≤10 ppm</td>
<td>Average 2 to 3 ppm</td>
</tr>
</tbody>
</table>

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Case No. 901: Controlling NOx from Boilers on a LNG Carrier Marine Vessel with Johnson Matthey’s SiNOx® Urea SCR System

Increased global demand for natural gas has forced a dramatic increase in the export of natural gas, in the form of LNG, mainly from Europe to North America. Owners and customers of the refrigerated LNG carriers wanted to control the NOx emissions from these ships. Exmar NV, a major owner/operator of LNG carriers chose Johnson Matthey’s SiNOx® SCR system.

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Boiler Uncontrolled Emissions @ max. load</th>
<th>Achieved</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOx @ 0% O2</td>
<td>Gas Fired: 156 ppm</td>
<td>Oil Fired: 515 ppm</td>
</tr>
<tr>
<td>NH3</td>
<td>&lt; 2 ppm</td>
<td></td>
</tr>
</tbody>
</table>

Background

Exmar NV owns and operates a fleet of LNG tankers. The Excelerate, which was built at the Daewoo shipyard in South Korea, installed a SCR system to control NOx emissions. After competitive bidding, Exmar chose Johnson Matthey’s SiNOx® urea SCR system. JM has over 150 SiNOx® SCR systems installed on ocean going vessels on drive and auxiliary power engines and boilers. The Excelerate has two Mitsubishi boilers supplying 60 MW of power to drive turbines fueled by LNG boil-off from the tanker and fuel oil. JM engineers designed the SiNOx® SCR system to fit and it achieved > 95% NOx reduction.

Summary

- **Product:** SiNOx® urea SCR system
- **Application:** Mitsubishi oil and gas-fired H.2254/63 MB-4E-KS2 Boiler (70 tons steam/hour)
- **Customers:** “Excelerate” Exmar NV, Antwerp, Belgium
- **Operation:** Mediterranean, Caribbean, SE Asia, East Coast USA and West Africa
- **Installed By:** Johnson Matthey
- **Date Installed:** August, 2008
- **Operation:** Boilers for the main drive turbines
- **Pollutants:** NOx
- **Comments:** Two separate SCR systems for two boilers. Cold commissioning in Dubai and hot commissioning, which includes urea dosing adjustment, in the Virgin Islands.
SINOx\textsuperscript{®} SCR System for 2-stroke Diesel Engine Power Plant

Expanding tourism and population growth in the vicinity of the Coloane Power Station in Macau, SAR, PR China, resulted the city’s authorities taking a decision back in 2002 to introduce controls on the exhaust plumes emanating from the six base load two-stroke diesel engines at the plant operated by Companhia de Electricidade de Macau (CEM). A consortium of three world-leading companies, Burmeister & Wain Scandinavian Contractor (BWSC), Mitsui Engineering & Shipbuilding Co Ltd (MES) and Johnson Matthey secured the tender for the successful retrofit emissions control project which, to this day, remains one of the largest and longest running, pre-turbocharger retrofit SCR system installations on an HFO-fuelled two-stroke engine application.

<table>
<thead>
<tr>
<th>Pollutant Type</th>
<th>Unregulated Emissions</th>
<th>Emissions Post SINOx\textsuperscript{®} SCR System</th>
<th>World Bank Guidelines</th>
<th>Macau Government Guidelines</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOx</td>
<td>3,100</td>
<td>300</td>
<td>2,000</td>
<td>500</td>
</tr>
<tr>
<td>Particulate Matter (PM)</td>
<td>60</td>
<td>40</td>
<td>100 - 150</td>
<td>100</td>
</tr>
<tr>
<td>SOx</td>
<td>1,650</td>
<td>1,650</td>
<td>2,000</td>
<td>1,700</td>
</tr>
<tr>
<td>Unburnt Hydrocarbon (HC)</td>
<td>35</td>
<td>5</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Since initial operation, the SINOx\textsuperscript{®} SCR system has proven reliable and performed well since initial operation, meeting all contractual limits, achieving >90% NOx reduction with resultant minimisation of the yellow-brownish exhaust plumes.

Summary
- **Product:** 8 x SINOx\textsuperscript{®} ammonia SCR systems installed on 6 engines (i.e. 2 twin SCR systems)
- **Application:** 6 x MES low speed 2-stroke diesel engines at Coloane Power Station
- **Fuel:** Heavy Fuel Oil (HFO)
- **Customer:** Companhia de Electricidade de Macau (CEM)
- **Location:** Macau SAR, PR China
- **Operation:** 24 hours per day / 7 days per week
- **Installed by:** Johnson Matthey
- **Installed:** 2002 - 2004
- **Pollutants:** NOx, UHC, PM
- **Comments:** One of the largest and longest-running pre-turbo 2-stroke retrofit SCR system applications pioneered by Johnson Matthey. SCR catalyst replaced Oct’09. Continues to operate within permitted limits.
Johnson Matthey has successfully installed SCR and oxidation catalyst systems on a significant number of Caterpillar gas compressor engines to reduce NOx and CO emissions by up to 90%. Examples of engines and applications are shown in the following table by model no. and emissions rate:

<table>
<thead>
<tr>
<th>Engine Model</th>
<th>Power, Hp</th>
<th>NOx g/bhp-hr</th>
<th>CO g/bhp-hr</th>
<th>NOx Reduction</th>
<th>CO Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAT G3516 LE</td>
<td>1340</td>
<td>1.5</td>
<td>1.88</td>
<td>90%</td>
<td>90%</td>
</tr>
<tr>
<td>CAT G3608</td>
<td>2370</td>
<td>0.7</td>
<td>2.5</td>
<td>90%</td>
<td>90%</td>
</tr>
<tr>
<td>CAT G3612</td>
<td>3550</td>
<td>0.7</td>
<td>2.5</td>
<td>90%</td>
<td>90%</td>
</tr>
<tr>
<td>CAT G3616</td>
<td>4735</td>
<td>0.7</td>
<td>2.5</td>
<td>80%</td>
<td>90%</td>
</tr>
</tbody>
</table>

Each SCR and oxidation catalyst system has the following JM custom designed components:
- SCR catalyst, housing and mixing duct assembly
- Urea injector and control system
- Oxidation catalyst and housing
- Industrial grade silencer

Many of these systems have been installed and operating since 2004 meeting the NOx and CO limits required in the operating permits.
Case No. 1101: Reducing CO and VOC’s from PTA Plants  
With Johnson Matthey SC29 PTA Catalyst

Until recently, oxidation catalysts used to reduce VOC emissions from PTA plants contained high amounts of precious metals such as platinum and palladium (PGM) making these catalysts fairly expensive. After an extensive R&D effort by Johnson Matthey’s catalyst scientists, a new catalyst was developed that does not contain precious metals. This new SC29 PTA catalyst has maintained the same performance as the traditional PGM based catalyst, but has significantly reduced the cost.

PTA (Purified Terephthalic Acid) Uses

Nearly all purified terephthalic acid (PTA) is consumed in the manufacture of polyester including polyester fiber, polyethylene terephthalate (PET) bottle resin and polyester film.

PTA Process Emissions and PTA Catalyst

PTA plants emit carbon monoxide (CO) and a variety of volatile organic compounds (VOC’s), including methyl bromide, methyl acetate, xylene, acetic acid and methanol. VOC’s contribute to the formation of ground level ozone or smog when it reacts in the atmosphere with nitrogen oxides (NOx) and UV light. Methyl bromide is additionally a stratospheric ozone depleter.

PTA manufacturers have used oxidation catalyst since the mid 1990’s to reduce these emissions, making oxidation catalyst a standard practice in the PTA industry. Until recently, the standard oxidation catalyst contained precious metals such as platinum and palladium.

New Lower Cost Non-Precious Metal PTA Catalyst from Johnson Matthey

Johnson Matthey was approached by a PTA customer whose standard PTA catalyst was deactivating requiring them to increase their operating temperature in order to meet the VOC conversion rate. A typical new PTA catalyst operates at 280°C. As the catalyst deactivates, the operating temperature is gradually increased to accommodate, such that after 5 to 6 years, the catalyst outlet temperature reaches 375°C. Since PTA manufacturing plants have a very high volume of exhaust gas, the cost associated with operating at elevated exhaust temperatures is significant.

Johnson Matthey’s SC29 PTA catalyst was introduced to the customer offering the following benefits over standard catalyst:

- **Reduced Operating Cost** – The operating cost was reduced by reducing the operating temperature from 375°C to 280°C
- **No Precious Metals** – The SC29 PTA catalyst does not contain precious metals and the catalyst it replaced did have precious metals, which made the replacement very cost effective. In order to illustrate the cost effectiveness we compared the sell price of the SC-29 catalyst versus the value of the precious metals in the last two generations of Johnson Matthey PTA catalyst.
- **Reduced Cost of Ownership** – The sale price of SC-29 + site costs for catalyst removal and
installation of new catalyst is approximately $300K. The reclaim value for same volume of SC-24 catalyst (basis: Pt @ $1831/to, Pd @ $812/to) is $322K. The Approximate reclaim value for the same volume of 1-LMB catalyst (basis: Pt @ $1831/to, Pd @ $812/to) is $565K.

- **Net Gain** – The comparisons above show that the plant will make money by removing and refining the old PGM based catalyst and replacing it with the non-PGM SC29 catalyst. The exact amount of the savings will be determined by the level of precious metals that are in the catalyst being replaced.

The customer decided to replace the deactivated catalyst with the new SC29 catalyst. It has been running since November, 2009 and upon startup worked flawlessly at the designed operating temperature. After 16 months of operation, the SC29 catalyst is still performing like new, and the customer recently ordered catalyst for a second reactor.

**Conclusion**

This catalyst is a technological breakthrough for the PTA industry. PTA plants can now replace their existing PGM based catalyst with a non-PGM catalyst and the savings from reclaiming the PGM catalyst will more than pay for the cost of the replacement SC29 catalyst. In addition, the catalyst replacement will reduce plant operating costs by reducing the operating temperature.

New PTA plants that utilize the SC29 catalyst will have a definite advantage over plants that use a PGM based catalyst because it will dramatically decrease the capital cost associated with building a new plant.