

PALLADIUM

AUTOCATALYST

The sustained price differential between platinum and palladium has ensured that the process of switching production to the cheaper metal, both in gasoline and in diesel autocatalysts, has continued this year. Increased Asian vehicle production will also help demand from this sector to rise 8.4 per cent to 4.38 million ounces in 2007.

Europe

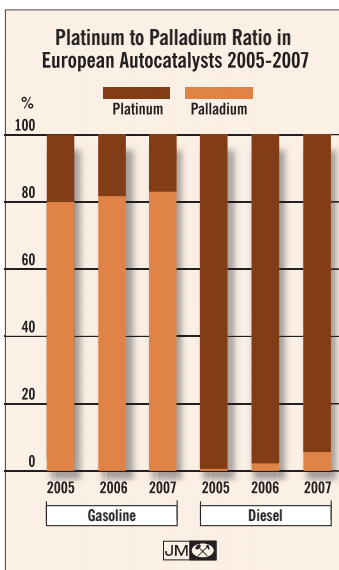
In Europe, autocatalyst palladium demand is set to be slightly higher in 2007 than in the previous year, at 895,000 oz. With little growth in the number of vehicles made – full year sales of passenger cars should be practically level with 2006 at 15 million units this year – what growth there has been in palladium usage is mainly due to it replacing platinum in some diesel catalyst formulations.

Few European auto makers use much platinum in their three-way (gasoline) catalysts, typically preferring palladium-rhodium formulations instead. This was already the case in 2006 so the number of catalysts in which platinum will be replaced by palladium this year will be relatively limited. In fact, with no new legislation to focus development efforts on, cost reduction programmes have been able to achieve a decrease in the average palladium loadings of gasoline vehicles.

Since 2005, though, these same companies have

been moving to introduce palladium into some of their diesel catalytic converters in an attempt to replace a proportion of the platinum used. Currently, these converters use about three times as much platinum as palladium. These platinum-palladium diesel catalysts were not especially widespread in 2006 but have been fitted to many more models already this year. With the diesel engine's market share growing too, palladium usage on diesel engines is certain to increase, outweighing a drop in gasoline palladium usage.

Although increasing amounts of palladium are being used in diesel catalysts, much more is employed in gasoline exhaust aftertreatment.



Japan

Use of palladium in autocatalysts in Japan is expected to rise by 6 per cent in 2007 to 840,000 oz. As previously reported, the Japanese car makers were initially slower than those elsewhere at switching from platinum-based catalyst technology to palladium formulations. However, they are now following other manufacturers in this process and average palladium loadings per vehicle should rise in 2007. Palladium purchases will be further boosted by a 2 per cent rise in domestic light duty vehicle production.

Although there were announcements in 2007 by Mazda and Nissan of their ability to reduce platinum group metal loadings on autocatalysts, there is no evidence of a breakthrough in thrifting. Adding weight to this view, these catalysts will not be introduced on any vehicles in the near term. They will therefore not affect palladium or other pgm demand at all on that timescale. In fact, with production set to rise again in 2008, palladium demand could well grow instead.

North America

North American purchases of palladium should rise 170,000 oz to 1.64 million ounces in 2007. The ongoing tightening of Federal Tier II legislation and the process of replacing platinum catalysts by palladium ones have tended to raise the precious metal content of a typical car or truck. However, US light duty vehicle production is expected to fall by 1.5 per cent to 15 million units this year, which will constrain some of the growth in demand.

Palladium has, though, made inroads into the North American diesel market. Just as in Europe, palladium is being used in place of up to a third of the platinum in some diesel aftertreatment – both for light duty and heavy duty vehicles. Recent legislation has driven catalyst fitment on all sizes of diesel vehicle. With the number of such catalysts rising quickly and the average palladium content growing as well, demand for this metal from the relatively small North

	2006	2007
Europe	880	895
Japan	795	840
North America	1,470	1,640
Rest of the World		
China	220	270
Other	675	735
Total	4,040	4,380

American diesel market is expected to grow healthily in 2007 and 2008.

China

Continued fast economic growth in China has been reflected in annual increases of more than 10 per cent in automotive sales. With domestic car production expected to rise at a similar rate in 2007 to 5.3 million units, demand for palladium is forecast to grow another 23 per cent to 270,000 oz.

In the short term, 2007 was scheduled to see the implementation of new nationwide legislation in the form of Euro 3 rules. However, due to concern over the availability of sufficient quality fuel, it now appears likely that these rules will come into force in July 2008.

We believe, though, that the majority of manufacturers will still fit Euro 3 compliant catalysts to their vehicles this year. Any cars sold in Beijing and Shanghai already have to meet these emissions rules and most car makers have chosen to fit one catalyst formulation for all domestic sales of a specific model. Catalyst loadings are therefore rising in 2007. In the longer term, however, this delay in enforcing the Euro 3 standards could lead to knock-on delays in moving to yet stricter emissions rules in the future.

Rest of the World

Palladium demand for autocatalysts from the Rest of the World region is expected to rise to 735,000 oz in 2007, 9 per cent more than in 2006. Many of the catalysts fitted to vehicles are based on technology that has previously been in use in Europe. These have typically already been optimised in terms of lowest cost by the implementation of thrifting or the use of cheaper palladium instead of platinum. Growth in gasoline vehicle production in these second tier markets is therefore translating directly into increased demand for palladium.

Autocatalyst Recovery

The global weight of palladium recovered from scrap autocatalysts in 2007 will increase to 945,000 oz. This represents forecast growth of 18 per cent since 2006.

The bulk of the metal recovered (560,000 oz) will

come from end-of-life vehicles in North America. In this market, an efficient and widespread collection system for spent autocatalysts has been in place for some time. The increase in palladium recovered therefore reflects the increasing amounts of this metal used on new autocatalysts at the end of the last century in this market.

The weight of palladium reclaimed in Europe will also grow but at a faster rate. The collection system is improving in terms of efficiency and the average palladium loading of an end-of-life catalyst has risen over recent years. The increase in metal returned is therefore forecast to be 34 per cent this year.

Palladium Demand: Autocatalyst Recovery		
	'000 oz	
	2006	2007
Europe	(220)	(295)
Japan	(30)	(35)
North America	(500)	(560)
Rest of the World	(50)	(55)
Total	(800)	(945)

DENTAL

The dental sector is set to consume 620,000 oz of palladium in this calendar year, the same as in 2006. Much of this demand will occur in Japan where palladium finds wide use in the so-called Kinpala alloy. The American dental sector will use significant amounts of palladium too.

Although the average prices of palladium and of the other precious metal components used in this alloy were higher in the first nine months of 2007 than in 2006, volatility was, in general, lower. This meant that the Japanese government subsidy which is changed periodically to account for material costs kept closely in step with the Kinpala price. There was therefore little price disincentive for the use of this alloy in state-funded treatment, unlike in some previous years.

However, other materials have started to erode the market share of this alloy. In particular, resin systems have had some success. The cost of dental treatment is also rising, with a resultant drop in the number of visits to dentists. Together, these trends are likely to continue to depress dental demand in the near future.

One aspect of note in this market is that we believe that the level of recycling is greater

Palladium Demand: Dental		
	'000 oz	
	2006	2007
Europe	75	70
Japan	270	265
North America	260	265
Rest of the World	15	20
Total	620	620

than previously thought. Quite large amounts of metal are produced as scrap in the manufacturing process for Kinpala bridgework. The rise in the palladium price has encouraged more aggressive activity from collectors and refiners and the recycling system has become more efficient.

ELECTRONICS

Palladium uptake from the electronics industry will grow for a sixth successive year. While demand from this sector is still well below its historical peak, it should climb to 1.10 million ounces in 2007, a rise of 40,000 oz over the 2006 figure. Much of the driving force for this growth is due to strong computer sales, with 11 per cent more units likely to be shipped in 2007 than the year before.

Palladium Demand: Electronics '000 oz		
	2006	2007
Europe	105	145
Japan	275	260
North America	190	200
Rest of the World	490	495
Total	1,060	1,100

The use of palladium in multi-layer ceramic capacitors, or MLCC, remains the cornerstone of this electronics demand. These are used in large numbers in almost every device. However, palladium usage in MLCC will remain flat. While shipments of IT equipment and other electronic goods are booming,

there is still ongoing slow substitution of nickel for palladium by some capacitor manufacturers. More importantly, the average size of a MLCC is decreasing. Two years ago, only 8 per cent were the ultrasmall 0201 size – 0.6mm by 0.3mm – or smaller, a figure which is expected to exceed 20 per cent this year.

Although MLCC palladium demand is likely to be steady, there will be modest growth in other applications such as plating. Use in leadframes is also forecast to increase, in line with sales of silicon chips.

JEWELLERY

Global demand for palladium from the jewellery trade is forecast to reach 745,000 oz in 2007, substantially below the previous year's level of 995,000 oz. Once more, the picture is highly dependent on the region of demand. New metal requirements are set to rise in Europe and North America. However, demand will be lower in Asia,

with a hefty decline in China.

Purchases of new palladium metal by Chinese jewellery manufacturers are forecast to plummet in 2007, from 760,000 oz to 500,000 oz, with recycled metal from a variety of sources playing an important part in this fall. While palladium imports into China have risen, much of this metal has been destined for the autocatalyst, electronics and other industrial sectors.

Palladium Demand: Jewellery '000 oz		
	2006	2007
Europe	40	45
Japan	130	125
North America	40	50
Rest of the World		
China	760	500
Other	25	25
Total	995	745

Palladium is being recycled from scrap generated by these industries and from old jewellery. Although much Pd950 jewellery (95 per cent alloy) has already been returned by retailers for refining and re-manufacture into Pd990 (99 per cent palladium), this scrap material from jewellery retailers continues to flow back and impact on demand for new metal. By comparison, consumer recycling of used palladium jewellery is less important. High precious metal prices – gold and platinum in particular – have also encouraged careful stock control throughout the jewellery trade. These trends will greatly depress palladium purchases.

At the retail level, there is competition between palladium and both platinum and white gold. Similar rhodium-plated designs can be seen in all three metals although they are often sold from different counters or concessions in a single store. However, palladium has had limited market promotion outside Beijing and Shanghai – where it has not sold well to date – and consumer sales do not seem to be developing as quickly as had been expected.

The picture is mixed across the country. Neighbouring cities can have very different attitudes to palladium. Pd950 is still stocked in some locations and Pd990 at others. Many retailers are unsure about the benefits of selling palladium jewellery too. Nonetheless, very large stocks can be seen in many stores.

In Europe, demand for palladium from the jewellery trade is likely to rise by 12.5 per cent to 45,000 oz. Perhaps two thirds of this metal is used as a component in white gold alloys, a market which is growing as a result of both the popularity of white metals in general and of European anti-nickel legislation.

However, a number of manufacturers have

introduced palladium jewellery this year, leading to much of the growth in European demand. Palladium does not have a clear, unique market positioning at present and product ranges are experimental. Continued growth from this low level of demand can be expected over the next two to three years if more manufacturers decide to work with this material. However, the delay in the proposed introduction date for a palladium hallmark in the UK from 2008 to 2009 could set this specific market back.

In North America, we believe that palladium demand from jewellery manufacturers will rise to 50,000 oz in 2007. A period of relative price stability for the precious metals in the first half of the year removed some of the stimulus for using palladium as a new, intermediate-price material. However, as palladium products, particularly men's rings, are more widely trialled, sales are expected to rise.

Japanese palladium demand for jewellery is due to its use in white gold and platinum alloys. With lower platinum demand and the trend from 18 carat to lower carat (and lower percentage palladium) white gold products, palladium demand will drop slightly here.



is growing, driving palladium purchases higher. However, palladium demand for other chemical processes is scheduled to fall.

Palladium purchases for jewellery manufacture are expected to grow this year in Europe and North America as more companies start to experiment with this material.

CHEMICAL

Chemical sector demand for palladium is forecast to total 355,000 oz for 2007. Although commodity chemicals have experienced growing demand, some sectors will see less construction of plants this year than in 2006. Palladium demand will therefore fall 16.5 per cent from last year's levels.

Demand for purified terephthalic acid (PTA) is rising. Palladium is used in the purification process for this product and increased production should equate to enhanced demand for palladium from new charges and top-ups of existing catalyst.

Environmental concerns are also proving to be positive for chemical sector demand for palladium. This metal is used as the catalyst in the anthraquinone process which is a clean method of manufacturing hydrogen peroxide. This is a key input into the manufacture of polyurethane compounds, demand for which

Palladium Demand: Chemical '000 oz		
	2006	2007
Europe	165	90
Japan	25	25
North America	80	80
Rest of the World	155	160
Total	425	355

OTHER

Due to the introduction of exchange traded funds (ETFs), demand for palladium physical investment products will increase substantially from 50,000 oz to 250,000 oz. ETFs had already accounted for demand of 255,000 oz by the end of September. However, this has been offset by weak demand for palladium bars and coins, with some bars being returned to the market and melted down. Palladium demand in other applications, excluding investment, should reach 100,000 oz in 2007.

Two ETFs based on palladium were launched in Europe in the first half of the year. The opening volume in the Swiss palladium fund was high due to a weighty purchase by a large Swiss pension fund. Ongoing investments since then have been rather lower and there have been some sales of ETF shares, suggesting that the combined position at the end of the year will not be greatly higher than at the end of September.

Palladium Demand: Other '000 oz		
	2006	2007
Europe	20	290
Japan	5	15
North America	85	20
Rest of the World	20	25
Total	130	350