Silver Report - 1

MCX
Trade with Trust

Multi Commodity Exchange of India Ltd
102 A, Landmark, Suren Road, Chakala,
Andheri (East), Mumbai - 400 093
Tel: 022 66494000 / 26836016, Fax: 022 66494151
Email - info@mcxindia.com www.mcxindia.com

Table of Contents

© Multi Commodity Exchange of India Ltd.

1. Background

For what is often called as 'Industrial Commodity', silver's unique properties include its strength, malleability and ductility, its electrical and thermal conductivity, its sensitivity to and high reflectance of light and, despite it being classed as a precious metal, its reactivity which is the basis for its use in catalysts and photography. This versatility means that there are few substitute metals for silver in most applications, particularly in high-tech uses in which reliability, precision and safety are paramount.

Demand for silver is built on three main pillars; industrial uses, photography and jewelry & silverware. Together, these three categories represent more than 95 percent of annual silver consumption. In 2002, 342 million ounces of silver were used for industrial applications, while over 205 million ounces of silver were committed to the photographic sector, and 259 million ounces were consumed in the jewelry and silverware markets.

Today, the demands of modern technology have revealed the remarkable range of electrical, mechanical, optical, and medicinal properties that have placed silver as the key metal in many applications.

Basic Information
Symbol: Ag
Mass: 107.868
Density @ 293 K: 10.5 g/cm3
Melting Point: 961.93 C (1235.1 K)
Boiling Point: 2212 C (2428 K)
Classification: Transition Metal
Crystal Structure: Face-centered Cubic
Color: silver
Characteristics: soft, ductile, tarnishes

Abundance
Silver occurs in the metallic state, commonly associated with gold, copper, lead, and zinc. It is also found in some 60 minerals including: argentite (a sulfide), cerargyrite (a chloride), many other sulfides and tellurides. Relative abundance in solar system is -0.313 log and abundance earth's crust is -1.2 log.

2. International Scenario

Table 1: World Silver Supply & Demand
(Million ounces)

	2001	**2002**	**Change y-o-y**
Supply			
Mine Production	589.2	585.9	-1%
Net Government Sales	87.2	71.3	-18%
Old Silver Scrap	182.7	184.9	1%
Producer Hedging	18.9	-	n/a
Implied Net Disinvestment	-	20.9	n/a
Total Supply	**878**	**863**	**-2%**
Demand			
Fabrication			
Industrial Applications	338.1	342.4	1%
Photography	213.9	205.3	-4%
Jewelry & Silverware	286	259.2	-9%
Coins & Medals	30.5	31.3	3%
Total Fabrication	868.5	838.2	-3%
Net Government Purchases	-	-	n/a
Producer Hedging	-	24.8	n/a
Implied Net Investment	9.5	-	n/a
Total Demand	**878**	**863**	**-2%**

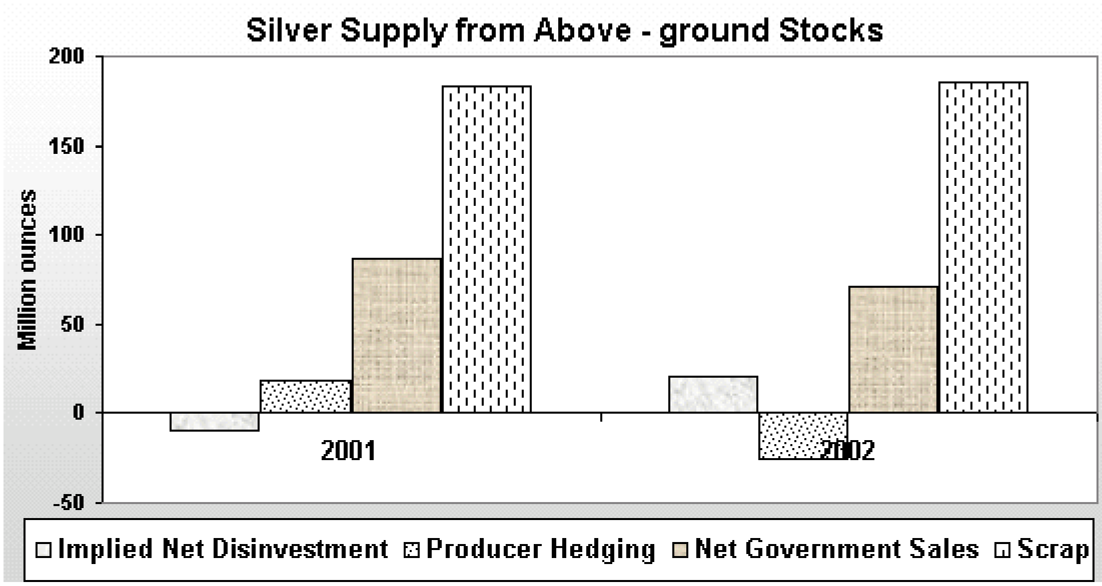
Source: GFMS

3. Silver Supply

Silver supply is derived from two sources- new mine production and existing above-ground stocks of bullion and fabricated products. In 2002, some 30% of the market's requirements – equivalent to around 7,840 tons – were met by recycled above-ground stocks, the balance being provided by newly mined silver.

The Figure below shows the contribution made by each of the components of above-ground stocks supply in 2001 and 2002.

Figure 1: Silver Supply from Above Ground Stocks



Silver Supply Components

Mine production is unsurprisingly the largest component of silver supply. It normally accounts for a little under two-thirds of the total (last year was slightly higher at 68%). But mine production is not the sole source - the others being scrap, disinvestment, government sales and producer hedging. Scrap, or more properly, “old scrap”, is the silver that returns to the market when recovered from existing manufactured goods or waste. This could include old jewelry, photographic chemicals, even discarded computers

(but it excludes silver that is returned untransformed by the manufacturing process - so called “process scrap”). Old scrap normally makes up around a fifth of supply. Disinvestment and government sales are similar in that both comprise the return to the market of old coins or bars respectively by the private sector or governments. It is worth bearing in mind that these sources may not add to supply every year on a net basis. In some years, individuals have been net investors (as appears to have been the case in 2001) and governments net buyers (as occurred most recently in 1997). The final, though normally minor, component of supply is producer hedging or the early sale by mining companies of future production, a form of “accelerated supply”. Hedging may also not appear every year as an element of supply on a net basis as it can contribute to demand (the case in 2002).

Mine Production

Geographically, just over half of mined silver comes from the Americas with Mexico, Peru and the United States, respectively, the first, second and fourth largest producing countries. The third largest is Australia. Of greater market relevance, however, is the type of mine that silver comes from - most silver emerges as a by-product of the mining of other metals. Only a little over a quarter of output comes from mines where the main source of revenue is silver, a so-called primary silver mine. A much more comes from lead/zinc mines. Primary mines produce about 27 percent of world silver, while around 73 percent comes as a by-product of gold, copper, lead, and

© Multi Commodity Exchange of India Ltd.

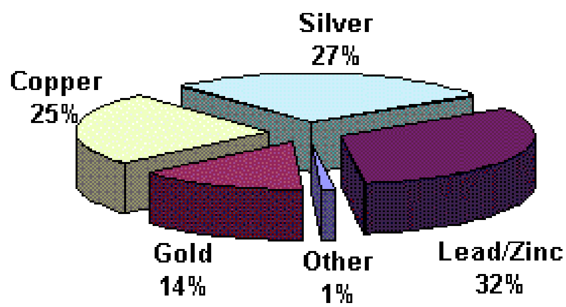
zinc mining. This is important, as the price of silver will only have a direct impact on primary output, which means the amount of silver mined is more a function of the price of other metals.

Silver from recycled materials accounts for about 20 percent of world silver supply, coming primarily from used photographic materials. Today, silver bullion stocks make up another significant component of silver supply. Robust silver demand in the 1990s outpaced conventional supply - mine production and recycled scrap - leading to a substantial drawdown of silver stocks held by governments and investors. From 1990 to 2000, silver inventories declined by more than 1.2 billion ounces.

2002 Supply

Global silver production edged slightly lower in 2002, slipping from the record levels set in 2001 to finish the year at 585.9 Moz, a decline of around 1 percent. Europe was the only region in the Western World to record an increase in production with gains posted in Russia and Kazakhstan. The Americas, Asia, and the African regions all reported output reductions.

2002 World Mine Production of Silver by Source



Note: Totals may not add to 100% due to rounding.

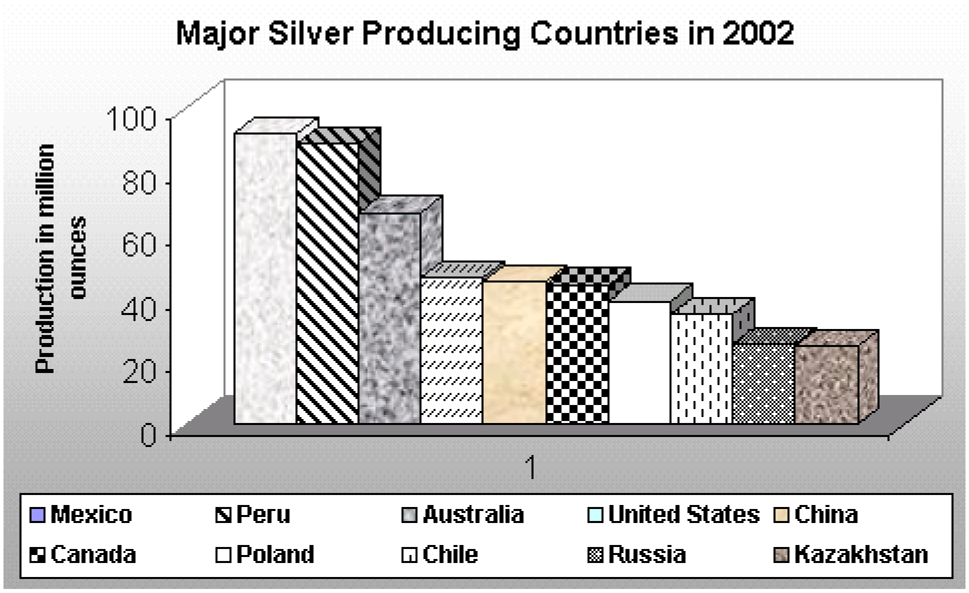
In 2002, the major source of silver mine production was generated as a by-product of other metals. This is, in part, a consequence of the scarcity of large silver deposits, which can be economically exploited at prevailing silver prices. However, the dominance of by-product or co-product silver in total mine supply testifies to the fact that silver often occurs naturally with a variety of other metals. Silver is typically found in the oxidized zones of ore deposits, or in the hydrothermal veins associated with sulfide ores. This natural association with lead and zinc (which often occur together), gold and copper, results in significant quantities of silver being produced at operations where it is not the primary target nor the principal earner of revenue - in fact, in many cases silver is regarded as a "bonus" of base metal or gold mining.

In 2002, Mexico, Peru, Australia and the United States were the top four silver producing countries. Mexico remained at the head of the ranking, and for the third consecutive year recording higher output. Nevertheless, strong growth in Peru left only 2.9 Moz between the two. Australia, the world's third largest silver producer, saw a noteworthy 5 percent increase in

© Multi Commodity Exchange of India Ltd.

production in 2002. The United States held its fourth place ranking despite a sharp drop in production, meanwhile, Canada and Poland moved up the table as Chile slipped from 2001's sixth to 2002's eighth largest producer.

Figure 2: Major Silver Producing Countries in 2002



4. Silver Demand

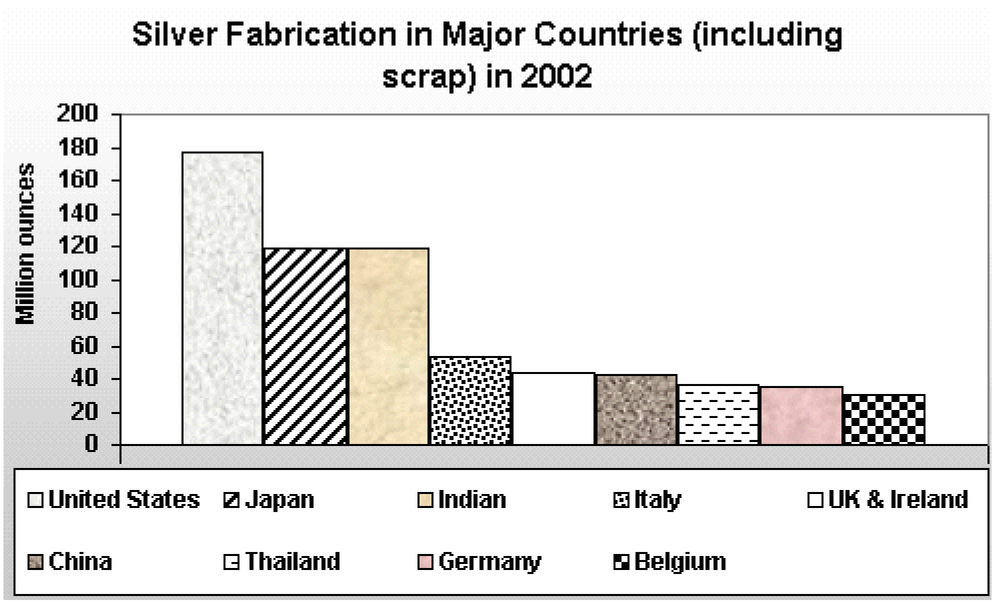
Total industrial demand rose by 1.3% in 2002 to 10,651 tons though this remains substantially lower than 2000’s 11,705 tons. There were sizeable gains in Japanese and US demand, in part due to restocking, but this was countered by heavy losses in India.

Silver Demand Components

Demand is dominated by three main categories: jewelry and silverware; industrial and photographic fabrication. These accounted respectively for 30%, 40% and 24% of demand in 2002. These shares have been broadly stable though photographic’s share has slipped a little over the last decade. Coin demand, the final part of fabrication offtake, has also seen a slight fall in its share of the total. The remaining elements of demand, government purchases, producer hedging and investment, are alike in that, on a net basis, they may not feature every year on the demand side. The official sector, for example, has not generated significant net purchases since 1992, whilst investment’s appearance on the demand side in 2001 was the first in a decade. Net hedging contributed to demand last year though it added to supply in 2001.

© Multi Commodity Exchange of India Ltd.

Figure 3: Silver Fabrication in Major Countries in 2002



Fabrication demand

- Total fabrication demand fell by 3.5% to 26,071 tons in 2002. Total offtake has now declined for consecutive years, mostly reversing the gains recorded in 1999 and 2000.
- Surprisingly the biggest contributor to the 942 tons fall in fabrication demand was not sluggish economic growth impacting on industrial and photographic demand for silver. In fact the single biggest factor a 900 tons fall in jewelry demand in India. Total Indian offtake fell by 1,104 tons year-on-year.
- Industrial demand for silver rose slightly by 1.3% to 10,651 tons, representing 41% of total fabrication demand. Increases in North America, Asia and the Middle East more than offset falls in India and Europe.
- Photographic demand fell for the third year running. The 4% drop was a result of softer demand, in particular the consumer sector, which was affected in part by the soft economy and the weakness of the tourist industry.
- Jewelry and silverware demand fell by 9.4% to 8,061 tons. Much of the loss was in India though European offtake also fell. In contrast, fabrication rose in East Asia, North America, the CIS and Middle East.

The tie between silver and economic activity is strong, given that around two-thirds of total silver fabrication is in the industrial and photographic sectors. This differentiates silver from gold where an element of investment is present in the purchase of jewelry and bars (jewelry accounted for nearly 70% of total gold demand last year). Sluggish economic activity in the world's major economies had a material impact on total fabrication offtake in 2002. This was quite marked in

Europe where fabrication on the jewelry side was also hit by market share loss to low labor cost producers. However it was a particular set of economic circumstances in India that accounted most of the decline in global fabrication offtake. In fact, without India, world fabrication would have risen.

In contrast to India, 2002 fabrication demand grew by 3% in East Asia and by 5% in North America. Growth in Japanese industrial demand and Thai jewelry demand accounted for much of the former's increase while higher Mexican jewelry fabrication and US industrial demand explain much of the latter change. Photographic offtake was broadly flat year-on- year in North America but down significantly in Europe and Japan.

Jewelry and Silverware

- Total jewelry and silverware fabrication fell by 9% in 2002 to 8,061 tons.
- India's 28% or 900 tons fall accounted for much of this, its drop being due largely to a poor year for its farmers.
- European offtake also fell whereas most other regions saw gains with Thailand up 97 tons.
- Jewelry consumption was robust in many regions whereas silverware saw further major losses.

5. Domestic Scenario

Imports

For the third year in a row, flows of silver out of China, primarily to India, continued to affect both regional global trade patterns. However, shipments from the mainland did fall slightly year-on-year in 2002.

Silver imports into India for domestic consumption fell sharply in 2002, down by 25% to a touch under 3,400 tons as against a record year in 2001 when around over 4,540 tons was imported. Furthermore, imports last year were well up on the average level seen throughout the 1990s, this in spite of difficult conditions for the metal.

According to Gold Fields Minerals Services, London (GFMS) data, Open General Licence (OGL) imports are the only significant source of supply to the Indian market, with shipments by Non-resident Indians (NRIs) having all but disappeared. Replenishment silver imports (non-duty paid silver for the export sector) rose sharply in 2002, up by close to 200% year-on-year to 150 tons. Import duties remained unchanged throughout the year, at 500 rupees per kilogram. Significantly, and in sharp contrast to gold, the rate of duty was not changed at the time of the 2003-04 budget. The last few months have shown what a profound impact changes in duty can have on imports and the pattern of shipments. In the case of gold, the reduction of duty on numbered, metric weight bars (in India the market standard has for many years been the unnumbered ten tola bar which weighs 116.63 grams) has seen an almost complete shift away from tolas to kilobars. Not surprisingly, the reduction in duty (by 60%) has stimulated gold imports at a time when demand was particularly weak (it has to be said that the fall in the gold price has also been an important recent stimulus). Unfortunately for the silver trade, the white metal is not high on the political or economic agenda and it seems unlikely that duty on imports will be changed in the near term.

Importing Centers

The bulk of the silver trade in India is actually still unofficial. For example, in the past, Mumbai in Maharashtra State used to attract around 80-90% of Indian silver imports because it was the premier bullion trading centre and a predominant fabrication centre as well. However, rising sales tax and octroi (a local tax) in the state meant that most of the official imports eventually shifted to low sales tax centers around the country.

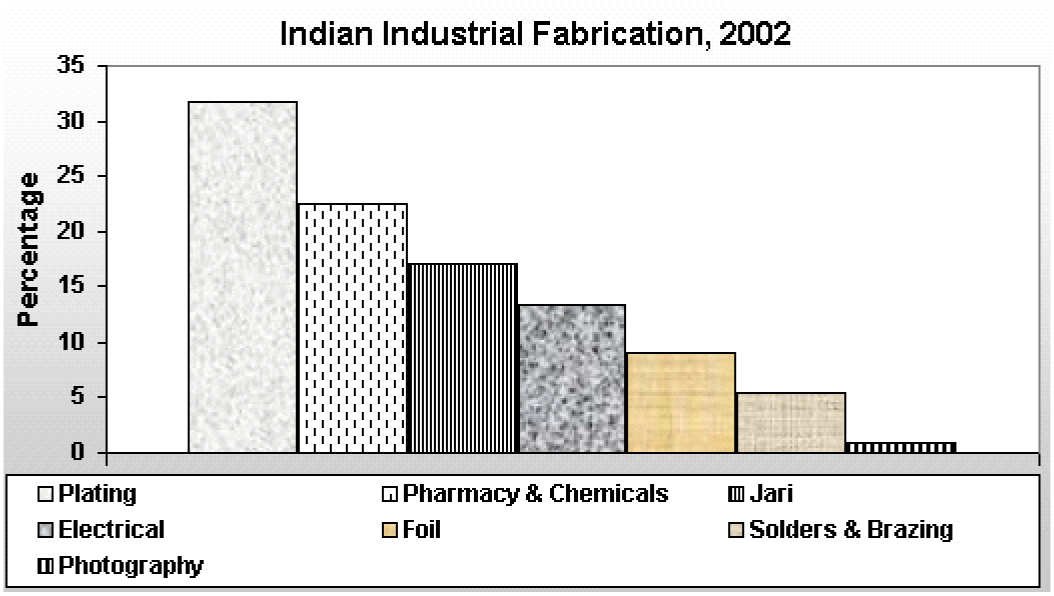
The main beneficiary of this in the early years was Ahmedabad with its low sales tax, and at one time that city accounted for almost all of the silver (and gold) imports coming into India. However, since it was neither a major consuming nor manufacturing center, most of the bullion imported was smuggled into other states (for example, a substantial portion of gold and silver imported into Ahmedabad eventually flowed into Mumbai illegally).

Initially, the disparity in sales tax between Ahmedabad and the rest of the country was substantial, which is why so much metal was shipped via that city. However, this changed dramatically when Jaipur (in Rajasthan) introduced a new system for bullion imports, the so-called 'green channel'. This system allowed traders or groups of traders to pay a lump sum tax of Rs.2.5 crore against which they could import as much gold as they liked. The incentive was, of course, to import ever-higher quantities to reduce the effective marginal tax rate.

Because of this inter-state tax arbitrage, attempts have been made over the past few years to introduce uniform VAT (value added tax) throughout India. In the 2003-04 budget, it was announced that uniform VAT would be introduced from April 1st 2003, but this was postponed yet again (it is worth remembering that the introduction of uniform VAT had already been postponed twice before this). In the meantime, some centers continue to attract imports due to lower taxes (in spite of a number of states introducing a uniform sales tax rate of 1% in February of this year). It seems probable that differential tax rates will continue to be the primary determinant of where in India silver is imported.

GFMS estimate that around 50% of India's silver requirements last year were met through imports of Chinese silver (both directly and indirectly via Hong Kong). This is a continuation of a trend first seen in the latter stages of 1998 and which picked up considerable steam in the following two years. Other important sources of supply include Europe (the United Kingdom being the second largest supplier of silver to India after China) the CIS, Australia and Dubai.

Figure 4: Indian Industrial Fabrication in 2002



Industrial Applications

Indian industrial demand is estimated to have fallen by around 13% in 2002, down from a record 1,579 tons the previous year to 1,375 tons. In spite of this fall, India is still one of the largest users of silver in the world, ranking alongside those Industrial giants, Japan and the United States.

By contrast with the United States and Japan, Indian offtake in this category is less “industrial”. Indeed, fabrication in hardcore industrial applications like electronics and brazing alloys accounts for only a fraction of total offtake in this category. For example, electrical, solders and brazing alloys are estimated to account for only around 205 tons of the total 1,375 tons of industrial offtake, a rather paltry 15% (contrast this with Japan, for example, where the ratio is probably around 80 plus %). The “real” industrial versus “other” industrial split is an important dichotomy in the Indian silver market and holds the key to understanding the fluctuations in offtake over the years.

The “other” category of demand in India covers a multitude of different end use applications, ranging from foils for use in the decorative covering of food to the plating of jewelry and silverware. One other very significant consumer of silver is jari. Jari is a thread used for saris and most is produced in Surat, Gujarat. It is a massive industry, utilizing a variety of materials which include gold and silver. “Real” jari is made of silver and electroplated with gold and is a major status symbol.

As might be expected, the consumption of jari is very much a function of how well the economy is doing and how much people are earning. It will come as no surprise then that GFMS estimate last year jari fabrication fell sharply, by around 18%, from 232 tons to 190 tons due essentially to the weakness in the agricultural sector.

The agricultural output in 2002 fell by around 3% (official estimates for the fiscal year 2002/ 03 are that it fell by 3.1%) due to the poor rains which adversely affected the kharif (summer) crop. The government's "Economic Survey" has estimated that there was a 13.6% fall in food-grain output to 183.2 million metric tons last year, the lowest absolute level since 1996-97.

The weakness in the agricultural sector has also had negative implications for all of the "other" industrial uses in India. For example, GFMS estimate that foil fabrication collapsed last year, although this was due to a combination of price, lower incomes and the ban on gukta (a tobacco based chewing product that contains silver) in certain states.

By contrast, fast growing sectors like telecoms, software and durable goods exports have all contributed to strong "real" industrial demand (data released at the time of the 2003/04 budget pointed to industrial production having risen 6.1% (fiscal year on- year) compared to just 3.3% the previous year). As a result, GFMS estimate that electronics/electrical, solders and brazing alloy offtake increased last year, by around 4 and 5% respectively.

Although "real" industrial offtake in India is still relatively low, there is every indication that this is likely to grow in the future. For example, India already plays host to the third largest optical media manufacturer in the world (the company has been an original equipment manufacturer for Sony and Samsung), which uses a substantial quantity of silver in various recording devices. The South Koreans also have a dominant presence in India and, increasingly, products are being made predominantly from locally sourced materials (for example, LG claims that its products have over 70% localized components and, in color televisions, this rises to 95%).

Jewellery and Silverware

GFMS data shows that Indian jewelry and silverware fabrication fell by close to 30% in 2002. It is important to note that this decline seems all the more dramatic because of the record levels of demand seen in 2001 [when offtake peaked at 3,200 tons]. Notwithstanding this observation, it is worthwhile pointing out that demand last year is estimated to have fallen to levels last seen in 1995. What have been the reasons for this precipitous fall? Probably there are two main reasons for this, namely the price and the agricultural/ rural economy.

Looking firstly at the former, there is little doubt that the price did play a role in holding back demand last year. At first sight this may appear a little surprising. Average rupee prices in 2002 rose by "only" 7% year-on-year, hardly sufficient, one would expect *a priori*, to precipitate such a marked decline in offtake. However, one needs to look further than the average to understand how the price affected demand. Two elements stand out here, the absolute price level and volatility.

In the Indian market, the 8,000 rupee/kg price level is a tangible psychological barrier for most buyers. It is no coincidence, for example, that when the price breached this level in the middle of the year imports and demand fell sharply (the former dropped to below 200 tons in both June and July when the price averaged 8,344 and 8,360 rupees/kg). As the price dropped back into the 7,000s, imports picked up, and indeed peaked for the year in October at over 620 tons.

© Multi Commodity Exchange of India Ltd.

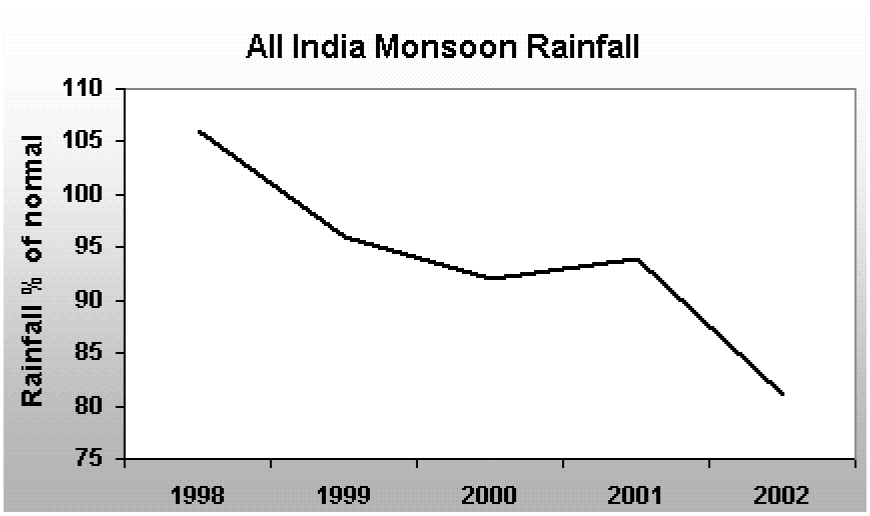
Price volatility is also an important determinant of silver demand (as it is for gold as well). Consumers are particularly sensitive to changes in the price and the oscillations throughout the year discouraged demand for extended periods of time. The received wisdom is that Indian consumers will tend not to buy on an upward trend in prices, expecting them to fall.

However, falling prices are not necessarily a signal to buy either. Instead, potential purchasers hold back waiting for the price to reach what is perceived to be the low for the period, which can result in lengthy periods of slack demand. As most Indians in the industry will attest, as a rule of thumb, price stability is crucial for demand to return.

Although the price level and volatility were important determinants of demand last year, the very mixed macro and micro-economic backdrop also contributed to weaker offtake. Even though the economic data is rather patchy, it is still possible to draw some broad conclusions about the impact of the economy on silver demand. The statistics available point to the agricultural sector having performed particularly poorly in 2002.

The broad consensus is that agricultural output in 2002 fell by around 3% (official estimates for the fiscal year 2002/03 are that it fell by 3.1%) due to the poor summer rains which adversely affected the kharif crop. The government's "Economic Survey" has estimated that there was a 13.6% fall in food-grain output to 183.2 million tons last year, the lowest absolute level since 1996-97, with most of this fall attributed to the decline in kharif production (from 111.5 million tones in 2001 to 90.3 million tons last year). The jury is still out on the impact the droughts had on the rabi (winter) crop, although some rain towards the end of the year appears to have lifted output.

Figure 5: All India Monsoon Rainfall Trend



The situation in the middle of last year was particularly dire on the agricultural front. Figures from the India Meteorological Department show that the country as a whole had received a cumulative area weighted rainfall during the period from June 1st to September 11th which was almost 18% below the historical long period average. Nearly 24 of the 36 meteorological divisions were rain deficient. To compound matters, important silver consuming areas in the east and north east had excess rains, with floods in parts of Assam and Bihar.

It has been suggested in certain quarters that India actually suffered one of the worst droughts in 100 years in 2002 and it seems reasonable to assume that this adversely affected rural incomes, which in turn had an impact on silver offtake (one needs to bear in mind that these difficult economic circumstances were taking place against the backdrop of high local silver prices) as farmers cut back sharply on their purchases of "new" silver (there was also an offsetting rise in scrap, although this was very small compared with the situation in the gold market).

Although the agricultural sector has been weak, other sectors of the economy were actually quite robust last year, as telecoms and software exports have been particularly strong and have contributed to robust industrial output. Data released at the time of the 2003-04 budget pointed to industrial production having risen 6.1% (fiscal year-on-year) compared to just 3.3% the previous year. All other things remaining equal, this should have seen incomes and expenditure in this sector of the economy rising, offsetting, to some extent at least, the fall in spending seen in the rural areas.

6. World Markets

Silver is predominantly traded on the London Bullion Market and Comex in New York. The former, as the global hub of OTC (Over-The-Counter) trading in silver, is the metal's main physical market. Here, a bidding process generates a daily reference price known as the fix. Comex, in contrast, is a futures and options exchange. It is here that most fund activity is focused. Silver is invariably quoted in US dollars per troy ounce.

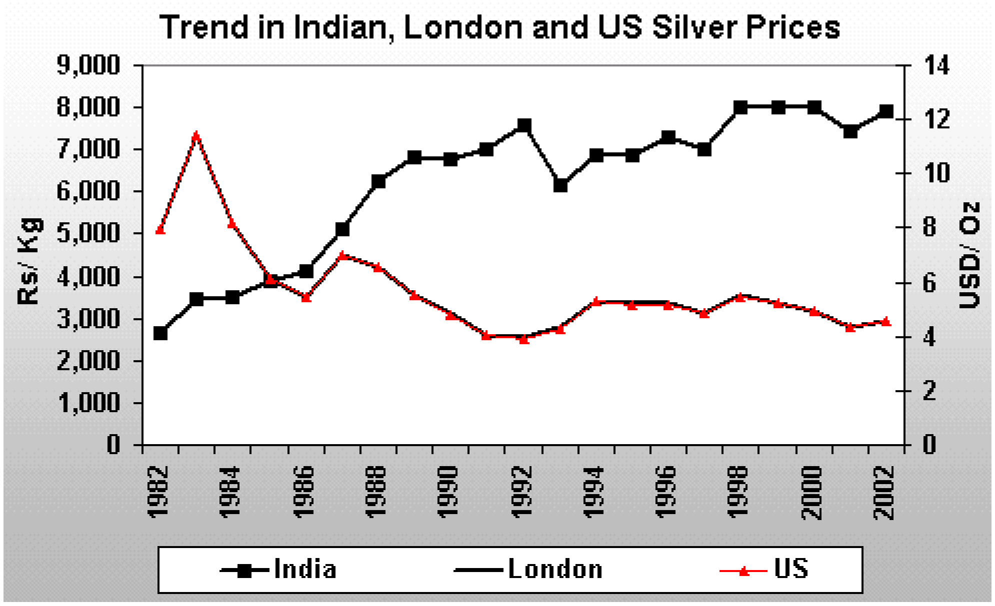
In COMEX the trading unit is 5,000 troy ounces. Trading is conducted for delivery during the current calendar month, the next two calendar months, any January, March, May, and September thereafter falling within a 23-month period, and any July and December falling within a 60-month period beginning with the current month. In fulfillment of each contract, the seller delivers 5,000 troy ounces (±6%) of refined silver, assaying not less than .999 fineness, in cast bars weighing 1,000 or 1,100 troy ounces each and bearing a serial number and identifying stamp of a refiner approved and listed by the Exchange.

Table 2: Volume of the International Silver Futures Exchanges

Exchange	Contract Size	2000	1999	1998
COMEX	5000 ounce	3117017	4157500	4094616
CBOT	1000 ounce	12272	20560	35505
MidAm	1000 ounces	15970	23493	14999
TOCOM		558700	966838	9373909

7. World Silver Prices

Figure 6: Trend in Indian, London and US Silver Prices



The annual average silver price rose over 5% in 2002 though the $4.60 reached remains low historically. The short-termism of investors, heavy Chinese selling towards $5 and weak fabrication largely explain the market's inability to hold on to gains achieved through speculative activity and supportive gold moves.

Silver prices missed out on much of the hefty gains that gold saw in 2002, rising just 5% year-on-year, though they fared better than many base metals which saw price declines. Silver's gain on an intra-year basis was even smaller at under 2%. This should not be taken as a sign that prices were stable since average volatilities actually reached a three year high. This also helped generate a quite wide trading range but only within 2002; silver prices over the last three years have been quite stable, seeing the smallest trading range of the four main precious metals. Despite the 2002 rise, silver prices remain low historically; excluding 2001, the last time the annual average was lower than 2002's was in 1993. In real (dollar) terms, the situation is yet more brutal; (again excepting 2001), the annual average has not been lower this side of World War II.

The situation as regards prices in other currencies in 2002 was mixed. On the producer side, Australian dollar prices, for example, only just managed a rise year-on-year and fell intra-year whereas silver in Mexican peso terms rose not far off 10% year-on-year. Similarly on the consumer side, euro and yen prices fell noticeably intra-year but rupee prices rose more than dollar prices both intra-year and year-on-year. Silver lease rates saw two distinct phases last year. The first was the volatile collapse that occurred in January 2002 as the squeeze, which had begun at end-November 2001, fell apart. This took the 3-month rate, for example, from over 10% to under 1% in less than a fortnight. The second phase, characterizing the remainder of the year, was a generally steady slide with periodic brief spikes. This left rates by year-end at near 'give away' levels, especially at the short end with 3-month silver only just holding above 10 basis

© Multi Commodity Exchange of India Ltd.

points. The picture, however, was not that rosier further up the curve with 12-month rates down to around 30 basis points. The fact that it was the short end which had collapsed to levels below which it would be hard to go any lower provided a good pointer to one of the main drivers of the slide in lease rates, weak fabrication demand. It is at the shorter end where fabricator borrowing tends to be heaviest.

Table 3: Prices of Silver in 2002

	US$/0z	Euro/kg	Rupees/kg	Yen/10gm
Annual average	4.599	156.7	7,934	184.9
Change y-o-y	5.3%	-0.1%	6.9%	8.5%
Maximum	5.098	174.4	8,655	206.6
Minimum	4.235	140.1	7,395	168.7

Figure 7: Spread between Mumbai and New York Silver Prices

8. Why Silver Futures

Suitability of Silver Futures

Uncertain Supply & Demand Factors

World mine production is more a function of the prices of other metals.

Often a faster growth in demand against supply leads to drop in stocks with government and investors.

Economically viable primary silver mine is a function of the world silver price level.

Silver demand stands on three pillers – jewellery & silverware, industrial and photography, which are in turn factors of monsoon & agricultural output, overall industrial growth and performance of the tourism & services industry at large, respectively.

In recent years India has seen increased imports from China both in the legal and illegal route via Hong Kong.

In India the inter-state disparity in sales tax and octroi on imported silver gives a huge scope of leverage to the domestic players.

In India the real industrial demand occupies a small share in the total industrial demand of silver in sharp contrast to most developed economy's like Japan and US.

In India like Gold the Silver demand is also determined to a large extent by its price level and volatility.

Price Variation

The below tables, shows the high instability in silver prices in international and Indian market during the past several years. This makes an ideal case for futures trading, so as to enable the silver importers and fabricators to hedge their price risk.

Table 4: Frequency Distribution of Price Variation in Percentage terms

Month on month variation in percentage terms	**0 – 2**	**2 - 5**	**5 & above**
Indian Silver Price between 1990 – 91 to 2000 – 01	43	39	18
London Silver Fixing between Jan 1985 – Aug 2003	43	36	21

© Multi Commodity Exchange of India Ltd.

Table 5: Maximum Price Variation in Percentage Terms

Mumbai (Rupees)	Percentage
Monthly	14.9
Yearly	10.3
London Silver Fixing	
Daily	22.7
Monthly	31.9
Yearly	28.5

Mumbai – 1990/91 – 2000/01
London – Jan 1985 – Aug 2003

Annexure – 1

General Information

Sparkling tableware, shining jewelry, and living spaces brightened by silvered mirrors are the obvious contributions of silver to our daily lives. It is, however, the silver behind the scenes that makes our modern world function efficiently. Inside switches, silver contacts efficiently and safely turn on and off the powerful electric current that flows into our homes, our lamps and our appliances. It is silver under the keys of computer keyboards, behind automobile dashboards, and behind the control panels of washing machines or microwave ovens that switch on or off at the touch of the finger. And inside the 220-volt line circuit breaker boxes in our homes or inside the 75,000-volt circuit breakers in power stations, silver performs a safe and steady task of switching on or off our most dependable servant, electric power, throughout our lives. Refer to the uses of Silver as detailed in Annexure-I.

Silver has been a multifaceted asset throughout history. It was found as a free metal and easily worked into useful shapes and was widely used by early man. The beauty, weight and lack of corrosion made silver a store of value, and hence one of the earliest of metals to be used as a medium of exchange.

The early discovery that water, wine, milk and vinegar stayed pure longer in silver vessels, led to its desirability as a container for long voyages. Herodotus (79 A.D.) wrote that Cyrus the Great, King of Persia (550-529 B.C.), a man of vision who established a board of health and a medical dispensary for his citizens, had water drawn from a special stream, "boiled, and very many four wheeled wagons drawn by mules carry it in silver vessels, following the king wheresoever he goes at any time."

In more contemporary times, when the first telegrapher tapped out his code in 1832, silver was the electrical contact that made the current flow. Earlier that century, when Joseph Nicephore Niepce created the first photographic image obtained through a camera-like device in 1813, it was silver nitrate that made it possible. Finally, when the German obstetrician, Dr. F. Crede made his medical breakthrough in 1884 to halt the disease that caused blindness in generations of children at birth, it was silver that killed the virus.

Annexure - 2

History

A major watershed of silver production was the discovery of the New World in 1492, after which time major silver mines in Mexico, Bolivia, and Peru were opened leading to a rapid rise in the annual world production of silver. This rise, coupled with improved techniques for extracting silver from ore, broadened both the quality and quantity of ore that could be exploited. Later improvements, particularly in the late 19th and early 20th centuries, vastly enhanced the base of silver production and accelerated the exploitation of silver as a byproduct of base-metal mining.

Only about 25 percent of cumulative world silver production occurred before the 1770s. Records remain somewhat incomplete for the periods before 1900, however they play a critical part in determining cumulative historical production.

Old World Silver (4000 BC - 1500 AD)

The area of Anatolia (modern Turkey) is considered the first major source of mined silver, having provided the resource to craftsman throughout Asia Minor. Silver from the Anatolian region largely served as the source of silver for the Western cultures flourishing in the Near East, Crete, and Greece.

Silver craftsmanship was centered largely in Asia Minor and Greek Islands, along with areas of mainland Greece dominated by the Mycenaean culture. Asia Minor provided most of the supply for the flourishing silver market.

A concentrated effort to mine silver began sometime after 3000 B.C. The first sophisticated processing of silver ore was attributed to the Chaldeans in about 2500 B.C., who used a "culpellation" process to extract silver from lead-silver ores. The need for traditional silver (particularly for the flourishing Minoan and later Mycenaean civilizations) resulted in the location and exploitation of silver deposits in what is now Armenia.

After the catastrophic destruction of the Minoan (cretan) civilization in 1600 B.C. and the decline of the Mycenaean culture around 1200 B.C., the focus of silver production changed. The mines of Laurium (near Athens) became the leading production center and provided silver for the burgeoning Greek civilization. Further, the silver trade throughout Asia Minor and North Africa expanded significantly after the 8th century B.C.

The Laurium mines were highly productive; estimates from historical writings and physical evidence from old mine dumps indicate silver production to have been about 1 million troy ounces per year at Laurium during the height if production (600 B.C. to 300 B.C.). In fact, for about 1,000 years ending around the 1st century A.D., the Laurium mines were the largest individual source of world silver production. Outside the Laurium mines, production was concentrated mainly in Asia Minor, Sardinia, other Grecian locations and, to a limited extent, in Asia.

The period following the heyday of Greek mining in Laurium included the Carthaginians' exploitation of Spanish silver. After the Punic Wars, the Romans replaced the Carthaginians as the exploiters of Spanish silver and extended their silver mining to other areas of continental Europe.

Spanish mines became a critically important source of silver for nearly 1,000 years, thought their exploitation was halted temporarily by the Moorish conquest of Spain in the 8th century A.D. The Spanish mines not only provided a substantial portion of domestic needs of the Roman Empire until 476 A.D. but also served as a critical source of silver for the Asian spice trade. To meet the burgeoning trading requirements, Greece, Asia Minor, and Italy supplemented the Spanish production.

The Moorish invasion of Spain necessitated that the exploitation of silver move to a broader spectrum of countries, principally in Central Europe. Several major silver mine discoveries occurred between 750 and 1200 A.D., including the classic Schemnitz, Rammelsburg, Goslar, and Saxony regions in Germany. Concurrently, discoveries of silver were made in Austria-Hungary and elsewhere in Eastern Europe.

Based on the Analysis of available literature and historical records, the production levels from 300 B.C. to 1000 A.D. are not likely to have risen significantly from the estimated 1.5 million troy ounces per year levels of the Laurium mine era. Although mine production in Spain dominated the first 1,000 years A.D., it was balanced by the decline in production at Laurium and Asia Minor. The real expansion in production occurred in the 500-year period from 1000-1500 A.D., when the number of mining locations and, to a lesser extent, the improvements in mining and processing technology occurred.

New World (1500 - 1875)

More significant improvements in technology and discovery of the "New World" in 1492 led to a vast storehouse of mined silver that expanded silver production by nearly an order of magnitude, most particularly in the development of the mercury amalgamation process. The first major exploitation of "New World" silver was in the Potosi district of Bolivia. Although the actual production from Bolivia from 1500 to 1800 A.D. is difficult to quantify accurately, Spanish records indicate that about 1 billion troy ounces were produced in this time-frame. For the same period, about 1.5 billion troy ounces were mined in Mexico with the bulk being mined from 1700 to 1800.

Peru's production has been more consistent – production averaged more than 3 million troy ounces annually from 1600 through 1800. Historically, the Cerro de Pasco district has been among the leading sources of silver in Peru.

The Spanish produced Mexican silver beginning in the early 1500s. Production increased significantly in the 1700s, averaging about 9 million troy ounces annually.

From 1500 through 1800, Bolivia, Peru and Mexico accounted for over 85 percent of world production and trade. The remaining production in the period was derived largely from Germany, Hungary, and Russia, with lesser amounts from other European countries, Chile, and Japan.
After 1850, several other countries increased production particularly the United States with its discovery of the Comstock Lode in Nevada. Silver production continued worldwide, growing from 40 to 80 million troy ounces annually by the 1870s.

The Rise of North America (1876 - 1920)

The period from 1876 to 1920 represented an explosion in both technological innovation and exploitation of new regions worldwide. Production over the last quarter of the 19^{th} century quadrupled over the average of the first 75 years to a total of nearly 120 million troy ounces annually.

A good deal of the new production was added from major new discoveries in the U.S., most notably the Comstock Lode area in Nevada, the Leadville district in Colorado and various districts in Utah.

Similarly, new discoveries in Australia, Central America and Europe greatly augmented total world production. The succeeding decades from 1900 to 1920 resulted in another 50 percent expansion in production to about 190 million troy ounces annually. These increases were spurred by discoveries in Canada, the United States, Africa, Mexico, Chile, Japan, and various other countries.

The explosion of technology that enabled steam-assisted drilling, mining, mine dewatering, and improved haulage was a major breakthrough. Further improvements in mining techniques enhanced the ability to handle ore and allowed for exploiting larger volumes of ore that contained silver. For example, the removal of precious metals from zinc by a technique called "fuming" provided a way to separate economically precious metals from moderate-grade complex ores.

The Modern Era (1921 - 1990s)

A variety of advances in the early part of this century that allowed for the increasing production worldwide. This was critical, as many of the high-grade ores throughout the world had been largely depleted by the end of the 19^{th} century. These advances include:

- Bulk mining methods, both at the surface and underground, capable of handling large amounts of lower grade base-metal ores that contained byproduct silver.
- Refinement of extraction techniques capable of separating various base-metal concentrates from ores.
- Improved techniques in ore separation, notably froth flotation (post 1910) that allowed for concentration of silver in lead, zinc, and copper concentrates.
- Improvements in electrorefining techniques allowing for the easy separation of silver and other base metals from refinery slimes, thus providing an increasingly important source of silver.
- Thus, the explosion in the production of these various base-metal sources throughout the 20^{th} century led to an increasing output of silver-bearing residue and ultimately, refined silver.

Grades of Silver

Indian Standard specifies six standard grades of silver depending on their fineness as under:

Table 9: Silver Grades

Grade	Fineness
9999	999.9
9995	999.5
999	999
970	970
925	925
916	916

The impurity limits for grades of purity 999 and above, as specified in Indian Standard are as under:

Table 10: Chemical Composition of Silver

Grade	Silver/ Mille Min	Percent, Max						
		Bi	Cu	Fe	Pd	Pb	Se	Te
9999	999.9	0.0005	0.01	0.001	0.001	0.001	0.0005	0.0005
9995	999.5	0.001	0.01	0.002	0.015			
999	999	0.001	0.08	0.002		0.015		

Note: No tolerance on the minimum fineness is permitted.

Accordingly, quality of the silver is taken and specified in the contract specification.

Annexure – 4

Uses of Silver

Silver's unique properties include its strength, malleability and ductility, its electrical and thermal conductivity, its sensitivity to and high reflectance of light and, despite it being classed as a precious metal, its reactivity which is the basis for its use in catalysts and photography. This versatility means that there are few substitute metals in most applications, particularly in high-tech uses in which reliability, precision and safety are paramount.

Jewelry and Silverware

Silver possesses working qualities similar to gold, enjoys greater reflectivity and can achieve the most brilliant polish of any metal. Consequently, the silversmith's objective has always been to enhance the play of light on silver's already bright surface. Pure silver (999 fineness) does not tarnish easily but to make it durable for jewelry, it is often alloyed with small quantities of copper. It is also widely used with base metals in gold alloys. Sterling silver, at a fineness of 925, has been the standard of silverware since the 14th century, particularly in the manufacture of "hollow-ware" and "flatware". Plated silverware usually has a coating of 20-30 microns, while jewelry plating is only 3-5 microns.

Silver possesses working qualities similar to gold but enjoys greater reflectivity and can achieve the most brilliant polish of any metal. To make it durable for jewelry, however, pure silver (999 fineness) is often alloyed with small quantities of copper. In many countries, Sterling Silver (92.5% silver, 7.5% copper) is the standard for silverware and has been since the 14th century.

The copper toughens the silver and makes it possible to use sterling silver for cutlery, bowls and other decorative items such as picture frames.

Coins

Historically, silver was more widely used in coinage than gold, being in greater supply and of less value, thus being practical for everyday payments. Most nations were on a silver standard until the late 19th century with silver coin forming the main circulating currency. But after the gold rushes, the silver standard increasingly gave way to gold. Silver was gradually phased out of regular coinage, although it is still used in some circulating coins and especially in American, Australian, Canadian and Mexican bullion coins for investors.

Silver, being a rare and noble metal, was a more desirable medium of exchange than beads, feathers, shells, and the like. Its use as a medium of exchange is known throughout all recorded history. Coins, in the sense of having an authenticating stamp on them, began to appear in the eastern Mediterranean during 550 B.C. By 269 B.C. Rome adopted silver as part of its standard coinage. Silver became the trading medium for merchants throughout the civilized world. (Gold being reserved for governments and the wealthy.) Today silver coins continue to be the medium of exchange wherever paper is not acceptable, for example, in parts of Africa and the Middle East. One example of a trade coin is the Empress Maria Theresia Taler, first minted in Austria in 1741. It was standardized in 1780 as 28 grams and 833/1000 silver (the remainder copper).

Some 370 million of these 1780 dated coins have been minted up to 1996 and a large proportion remain in circulation today.

Until the late 19th century most nations were on a silver standard with silver coins forming the main circulating currency - silver being in greater supply and of less value than gold, thus being more practical for everyday payments. As gold became more plentiful, however, silver was slowly replaced although it is still used in some circulating coins as well as in bullion coins for investors.

In the U.S., silver is used only in bullion, commemorative and proof coins. Mexico is the only country currently using silver in it's circulating coinage. During the past decade, the United States, Canada and Mexico began issuing pure silver bullion coins with nominal face values sold at a small premium over their bullion value (not their face value).

In 1982, Mexico began minting a 999-fine (99.9% pure) silver Libertad ranging in weight from 1/20 oz. to 5 ounces; over 16 million coins have been sold. The U.S. Mint issues a 999-fine Silver Eagle (a one ounce bullion coin with a face value of $1) bullion coin; over 76 million have been sold since 1986. The Royal Canadian Mint issues a 5 dollar 9999-fine silver bullion coin, the silver Maple Leaf; over 9.8 million have been sold since 1986. Australia has issued a 5-dollar, 1 ounce .999 fine silver bullion coin, the Kookaburra; over 6 million have been sold since 1990.

Industrial

Silver is the best electrical and thermal conductor of all metals and is hence used in many electrical applications, particularly in conductors, switches, contacts and fuses. Contacts provide junctions between two conductors that can be separated and through which a current can flow, and account for the largest proportion of electrical demand.

The most significant uses of silver in electronics are in the preparation of thick-film pastes, typically silver-palladium for use as silk-screened circuit paths, in multi-layer ceramic capacitors, in the manufacture of membrane switches, silvered film in electrically heated automobile windshields, and in conductive adhesives.

The ease of electro-deposition of silver from a double-alkali metal cyanide, such as potassium silver cyanide, or by using silver anodes accounts for its widespread use in coating. Silver solutions are made up of a cyanide, a carbonate, silver and a brightener. The silver is usually added as the single salt, silver cyanide, or the double salt, potassium silver cyanide. Various forms of silver are used as anodes and may be in the form of plates, bars, rods, grain or in customdesigned shapes. The plating thickness of some items, such as fuse caps, is less than one micron although the silver then tarnishes more easily, and coatings of two to seven microns are normal for heavy duty electrical equipment.

Silver is used as a coating material for compact disks, whilst in 2002 digital video disks also switched to a silver coating.The unique optical reflectivity of silver, and its property of being virtually 100% reflective after polishing, allows it to be used both in mirrors and glass coatings, cellophane or metals.

Many batteries, both rechargeable and non-rechargeable, are manufactured with silver alloys as the cathode. Although expensive, silver cells have superior power-to-weight characteristics than their competitors. The most common of these batteries is the small button shaped silver oxide cell (approximately 35% silver by weight) used in watches, cameras and similar electrical products.

Silver, usually in the form of mesh screens but also as crystals, is used as a catalyst in numerous chemical reactions. For example, silver is used in formaldehyde catalysts for the manufacture of plastics and, to an even greater extent, in ethylene oxide catalysts for the petrochemical industry.

Silver is employed as a bactericide and algicide in an ever increasing number of applications, including water purification systems in hospitals, remote communities and domestic households.

The joining of materials (called brazing if done at temperatures above 600º Celsius and soldering when below) is facilitated by silver's fluidity and strength. Silver brazing alloys are used widely in applications ranging from air-conditioning and refrigeration equipment to power distribution equipment in the electrical engineering sector. It is also used in the automobile and aerospace industries. Bearings electroplated with high purity silver have greater fatigue strength and load carrying capacity than any other type and are hence used in various high-tech and heavy-duty applications.

Batteries

Many batteries, both rechargeable and disposable, are manufactured with silver alloys as the cathode. Although expensive, silver cells have superior power-to-weight characteristics than their competitors. The most common of these batteries is the small button shaped silver oxide cell (approximately 35% silver by weight).

The silver battery provides the higher voltages and long life required for quartz watches. In fact, over 1.4 billion silver oxide-zinc batteries are supplied to world markets yearly, including miniature sized batteries for watches, cameras, and small electronic devices and larger batteries for tools and commercial portable TV cameras.

Bearings

Steel bearings electroplated with high purity silver have greater fatigue strength and load carrying capacity than any other type and are hence used in various hi-tech and heavy-duty applications.

It was a layer of silver on main shaft bearings of the 9,000 horsepower reciprocating engines of the World War II Superfortress that resolved the unacceptable failure rate of its giant engines. Silver, with its superior fatigue resistance, lubricity, corrosion resistance, and thermal conductivity came to the rescue.

Today's commercial and military jet engines deliver 35,000 to 100,000 pound thrusts under high-temperature conditions. Despite the far higher power and a far more rigorous internal environment, silver coated bearings continue to provide the superior performance and critical margin of safety for today's jet engines.

The fan/compressor/turbine rotating components that push the air through the jet engine are all attached to the main shaft. This main shaft rotates on steel ball bearings that roll within steel retaining rings, called cages. Similar bearings are required for the connecting gear boxes that drive accessories such as hydraulic pumps and fuel pumps; all rotate at much higher speeds than

© Multi Commodity Exchange of India Ltd.

ground-based machinery. Steel has a poor coefficient of friction, but placing a layer of silver between the steel ball and the steel cage reduces the friction between the two to a minimum, increasing the performance of the engine and its accessories.

But silver also plays another critical role. Safety in jet engines is a paramount consideration. Failure of any one of the jet engine bearings would be catastrophic. Rolling contact bearings are lubricated and cooled with synthetic engine oil. In the event of an oil interruption, such as a pump failure, the silver plated bearings provide adequate lubricity to allow a safe engine shut-down before more serious damage can occur. To prepare for such a possibility, the U.S. Federal Aviation Authority (FAA) and airplane manufacturers require fail-safe engine testing for the bearings. The test requires stopping the lubricating oil system for 15 seconds with the engine running at full power and then turning on the lubricating system, then turning off lubrication again for 15 seconds, and repeat for four successive cycles. The dry lubricity of silver always allows jet engines to pass the tests.

The use of silver in high-performance bearings provides the wide margin of safety demanded by Pratt & Whitney, General Electric, Rolls Royce, and all other producers of jet engines that power modern aircraft.

Brazing and Soldering

Silver facilitates the joining of materials (called brazing when done at temperatures above 600^{o}Celsius and soldering when below) and produces naturally smooth, leak-tight and corrosion-resistant joints. Silver brazing alloys are used widely in applications ranging from air-conditioning and refrigeration equipment to power distribution equipment in the electrical engineering sector. It is also used in the automobile and aerospace industries.

The unique combination of properties that silver provides has been important to plumbers, the manufacturers of appliances that use water, in electronics, and other manufacturing industries. Silver brazes and solders combine high tensile strength, ductility, thermal conductivity, with unusual wettability to most metals plus the added value of being bactericidal. Silver-tin solders are used for bonding copper pipe in homes not only to eliminate the use of lead-based solders, but to provide the piping with built-in antibacterial action. Major faucet manufacturers use silver-based bonding materials to incorporate all these advantages. Refrigerator manufacturers use silver-based bonding materials to provide the ductility required for constant changes in temperature of the cooling tubes providing the consumer with a long performing product.

In combination with other metals, silver-based alloys provide a melting range from 143^{o}C to over 1000^{o}C. Silver alloys provide strong bonds for ceramic-to-ceramic joints (e.g., high-power radar tubes), silicon chips to metallic surfaces (computers), and surface mounted electronic components soldered to printed circuit boards (all types of electronic devices).

Silver's advantageous alloying and wetting properties are especially useful to hermetically seal together the components of electron power tubes such as the radar tubes now being installed at US airfields to warn pilots of deadly wind shear, which can cause airplanes to crash.

In 2000, 38 million ounces of silver were used for brazing and soldering.

© Multi Commodity Exchange of India Ltd.

Catalysts

A catalyst is a metal or compound that enhances the efficiency of a chemical reaction without becoming part of the reaction itself. The use of silver to act as a catalyst for the production of formaldehyde has been known since at least 1908. Only with the advent of modern analytical methods has the unique interaction between silver and oxygen been understood. This activity has made silver an essential catalyst for the production of formaldehyde with an estimated world production exceeding 15 billion pounds per year, and ethylene oxide which exceeds 14 billion pounds per year. Both are used in making various plastics. It is the steadily growing demand for plastics, both hard and flexible, that drives the increasing use of silver catalysts.

Silver, usually in the form of mesh screens but also as crystals, is used as a catalyst in numerous chemical reactions. Silver catalysts are particularly important in the production of formaldehyde which is the building block for the production of adhesives, laminating resins for construction plywood and particle board, finishes for paper and textiles, surface coatings including paints, dinnerware and buttons, casings for appliances, handles and knobs, packaging materials, automotive parts, thermal and electrical insulating materials, toys, Ethylene oxide is the chemical intermediate for the production of polyester resins used to manufacture all types of clothing and a great variety of specialty fabrics, molded items (such as insulating handles for stoves, key tops for computers, electrical control knobs, domestic appliance components, and electrical connector housings), and Mylar recording tape which makes up 100% of all audio, VCR, and other types of recording tapes. About 25% of ethylene oxide production is used to produce antifreeze for automobiles and other types of vehicles. An additional 10% is used to produce cleaning and wetting agents, and the remaining 5% to make cleaning solvents.

Silver is second only to gold with the weakest interaction with oxygen: silver cannot exist as an oxide over 200^{o}C. In the production of the chemical intermediate ethylene oxide, silver dissociates molecular oxygen from the air and weakly holds onto the separated oxygen atoms until an ethylene gas molecule bumps against it. The free oxygen atom then reacts with the ethylene gas to form ethylene oxide. The catalytic oxidation of ethylene to ethylene oxide is unique to silver.

For the production of formaldehyde, the catalytic action of silver strips off the hydrogen from the methanol molecule leaving formaldehyde, a simple reaction.

A worldwide inventory of some 23 million ounces of silver are in daily use for catalytic oxidation in chemical reactors.

Electrical

Silver is the best electrical conductor of all metals and is hence used in many electrical applications, particularly in conductors, switches, contacts and fuses. Contacts, a junction between two conductors that can be separated and through which a current can flow, account for the largest proportion of electrical demand.

When Samuel F. B. Morse tapped out, "What hath God wrought," on May 24, 1844, the contact points on his telegraph were silver. The high amperage required to push the signal over iron wires from Baltimore to Washington, D.C., demanded a high capacity, non-corroding make/break contact; only silver could do he job.

Ordinary household wall switches, which normally carry high electric current for electrical appliances from irons to refrigerators, use silver. Silver is the metal of choice for switch contacts because it does not corrode, which would result in overheating, which could lead to fire. The U.S. electric switch market is on the order of $1.5 billion per year.

Today switch manufacturers play it safe by using high-performance silver for ordinary household switch and circuit breaker contacts. Less expensive metal contacts have high resistance which can overheat and cause a fire, says a major supplier of switch contacts. It is this consideration of liability that assures the public of continued preference for silver in switch contacts. With an increasing concern for quality, warranties become more important, and extended warranties mean that industry cannot chance even one failure in a million; that level of performance requires silver.

From the very beginning of electricity, silver has been the metal of choice for switch contacts because of its low contact resistance, high thermal conductivity, mechanical wear resistance, chemical stability (it does not corrode), low polymer formation (the build-up of an insulating carbon-polymer film over the contact as a consequence of arcing), and cost-effectiveness (it provides the longest functional life). The US Department of Commerce, Bureau of Census (MA36K(96)-1) report shows 18 billion precious and other metal contacts were shipped in US during 1996, with a value of $275 million.

"Silver's tendency to tarnish does not affect its electrical performance," says a report of a 20-year exposure test of thousands of electrical contacts at 4,000 locations in different environments ranging from business offices to severe industrial locations such as petroleum refineries. The tests conducted by the Battelle-Columbus Laboratories, Columbus, OH, show that silver tarnish films are soft and readily wiped off with use; therefore in the field they perform well on tarnish because they are tough and offer high resistance. Films on other metals like copper, even when the corrosion is barely visible, cannot be tolerated.

Over 50 categories of electrical components incorporating silver as the contact material are listed by The National Electrical Manufacturers Association, Washington, D.C. These range from silver thick films that are used to make membrane switches which carry 5 volts or less for electronic systems, to large circuit breaker contacts required to interrupt or close the circuits of 75,000-volt power distribution lines.

The use of silver for motor control switches is universal. In the home, wall switches, timing devices, thermostats, sump pumps, and virtually all electrical appliances use silver contacts. A typical washing machine requires 16 silver contacts to control its electric motor, pump, and gear clutch. A fully-equipped automobile may have over 40 silver-tipped switches to start the engine, activate power steering, brakes, windows, mirrors, locks, and other electrical accessories.

The household and general use switch market amounted to over 200 million units in 1996, with automotive types an additional 290 million units (US Bureau of Census). The value of shipments of switches made in the USA of all types (except mercury) for 1996 was $1.6 billion (Bureau of Census).

Relays are another important market for silver contacts. Relays are used when low voltage switches (such as membrane switches) are used to activate considerably higher voltage or amperage switches. The increasing use of automated appliances has increased the number of silver contacts manufactured in the US. In 1996, the US Bureau of Census reported the US relay market to be $806 million.

Electric motor control switches use the largest amount of silver for each contact. The US Bureau of Census reports this to be a $4 billion market. The range of applications is enormous, covering: washing machines, dryers, automobile accessories, vacuum cleaners, electric drills, elevators, escalators, machine tools, and so on up to railway locomotives and marine diesel engines. Silver contacts start motors, set them to run forward or reverse, or at partial or full power. The silver contacts carry electrical power ranging from a fraction of an ampere, for small appliances, to 600-ampere loads required for oil-well drilling motors; their performance is required to be flawless.

Nearly half of the 20,000,000 troy ounces of silver consumed in the USA yearly for contacts and conductors is used for motor controls.

The circuit breaker is the second major user of silver for contacts. For circuit breakers, silver combines the highest heat conductivity and the highest electrical conductivity of all metals, with almost unlimited performance. Circuit breakers are used to interrupt loads ranging from 10 amperes (small household lines) to 4000 amperes (high-tension power lines). The US Department of Commerce, Bureau of Census reported that for 1996 the dollar value of shipments for all circuit breakers was $1.6 billion.

The circuit breaker is the most demanding use of silver contacts because the temperature of the arc generated by the interruption of high electrical power often exceeds the melting point of silver. As a consequence, silver is alloyed or infiltrated into other metals such as Tungsten to provide long-term performance.

Electronics

In electronics, silver is also widely used. Uses include silk-screened circuit paths, membrane switches, electrically heated automobile windows, and conductive adhesives.

Every time a home owner turns on a microwave oven, dishwasher, clothes washer, or television set, the action activates a switch with silver contacts that completes the required electrical circuit.

The majority of the keyboards of desk-top and lap-top computers use silver membrane switches. These are found behind the buttons of control panels for cable television, telephones, microwave ovens, learning toys like touch and tell or speak and spell, and the keyboards of typewriters and computers. The low-current capacity of the membrane switch matches the low electrical current used for digital electronics. In an office environment, membrane switches are normally rated for a life of 20 million cycles. Typically, the membrane switch is made of a conductive ink of silver flakes in a polyester binder with carbon. This thick film is then silk-screened in an electrical circuit pattern onto each of two Mylar sheets. The two surface patterns of silver face each other close enough so that gentle touch by a finger will make the electrical contact. A latching transistor circuit is simultaneously activated to keep the circuit closed after the membrane is released.

© Multi Commodity Exchange of India Ltd.

Today's electrical appliances, such as microwave ovens, are controlled by membrane switch panels, where the contacts are silver. Membrane switch panels are found in automobiles and under the keys of personal computers. Due to their reliability and wide use, the silver-contact membrane switch market in the U.S. has grown to over $35 million.

The use of silvered windshields in General Motor's all purpose vehicles reflects away some 70% of the solar energy that would otherwise enter the car, reducing the load on air conditioners in summer.

A universal safety feature of every automobile produced in America, and most throughout the world, is the silver-ceramic lines fired into the rear window. The heat generated by these conductive paths is sufficient to clear the rear window of frost and ice.

Printed circuit boards (PCBs) use silver in two ways: in solders for surface mounted components (see Brazing and Soldering) and for connecting paths of electronic circuitry.

Epoxy resin/silver formulations provide very low viscosity (important in filling holes connecting components) and higher silver content than is possible with other resins. Furthermore, silver-filled resins provide higher conductivity than copper systems, allowing smaller volume conductors and as well do not allow silver to migrate under any condition, which is not true of many other resin systems.

Du Pont’s laboratory studies have shown silver-epoxy thick films to provide a conductive network of extended reliability, higher conductivity, improved solderability, and more rapid assembly over other metal formulations. And silver particulate fillers provide superior long-term performance in polymer thick films. Copper, for example, is often unstable and deteriorates with age.

The critical importance of printed circuitry boards in the electronics industry is shown by the value of monolithic integrated circuits. The U.S. Bureau of Census reports U.S. shipments for 1999 to be in excess of $10 billion. Printed circuit boards are essential to the electronics that control the operation of aircraft, automobile engines, electrical appliances, security systems, telecommunication networks, mobile telephones, television receivers, etc.

Giant magnetoresistance is a newly discovered magnetic property of multiple layered silver/nickel-iron alloy films, each about a millionth of an inch thick. These films are being exploited by computer hard drive manufacturers. The films are potential candidates for the next generation of read-out heads for personal computer storage systems.

Not only do these new silver alloys exhibit extremely high changes in electrical resistance in response to infinitesimally small magnetic signals (hence the term giant magnetoresistance) but importantly the films maintain their physical dimensions unchanged despite the rapidly changing magnetic fields.

Elsewhere, the combination of giant magnetoresistance with zero changes in dimension in magnetostriction during recording head operations means that there is no unwanted shift in the optimal sensing function of the read head held over the spinning magnetic field of a personal computer's hard drive. By avoiding dimensional changes during head operations, unwanted magnetic fields generated by the recording head are eliminated. This results in improved fidelity in the playback of data, music, and video recordings, and larger storage capacity. Also eliminated is the expansion/contraction of the head that would limit its useful life.

Electroplating

The ease of electrodeposition of silver accounts for silver's widespread use in coating. The plating thickness of some items, such as fuse caps, is less than one micron although the silver then tarnishes more easily. Coatings of two to seven microns are normal for heavy duty electrical equipment.

Silver plating is used in a wide variety of applications from Christmas Tree ornaments to cutlery and hollowware.

Medical Applications

While silver's importance as a bactericide has been documented only since the late 1800s, its use in purification has been known throughout the ages. Early records indicate that the Phoenicians, for example, used silver vessels to keep water, wine and vinegar pure during their long voyages. In America, pioneers moving west put silver and copper coins in their water barrels to keep it clean.

In fact, "born with a silver spoon in his mouth" is not a reference to wealth, but to health. In the early 18th century, babies who were fed with silver spoons were healthier than those fed with spoons made from other metals, and silver pacifiers found wide use in America because of their beneficial health effects.

Silver also has a variety of uses in pharmaceuticals. In fact, silver sulfadiazine is the most powerful compound for burn treatment. It is used by every hospital in North America for burn victims to kill bacteria and allow the body to naturally restore the burn area. It is used world-wide. It is sold under the trade name of Silvadiene. In another application polyurethane central venus catheters impregnated with silver sulfadiazine and chlorhexidine to eliminate catheter-related bacteriemia are supplied by Arrow International, Reading, PA.

In a world concerned with the spreading of virus and disease, silver is increasingly being tapped for its bactericidal properties and used in treatments for conditions ranging from severe burns to Legionnaires Disease.

Mirrors and Other Coatings

Silver's unique optical reflectivity, and its property of being virtually 100 % reflective after polishing, allows it to be used both in mirrors and in coatings for glass, cellophane or metals.
Everyone is accustomed to silvered mirrors. What is new is invisible silver, a transparent coating of silver on double pane thermal windows. This coating not only rejects the hot summer sun, but also reflects inward internal house heat. A new double layer of silver on glass marketed as "low E squared" is sweeping the window market as it reflects away almost 95% of the hot rays of the sun, creating a new level of household energy savings. Over 250 million square feet of silver-coated glass is used for domestic windows in the U.S. yearly and much more for silver coated polyester sheet for retrofitting windows.

One out of every seven pairs of prescription eyeglasses sold in the U.S. incorporates silver. Silver halide crystals, melted into glass can change the light transmission from 96% to 22% in less than 60 seconds and block at least 97% of the sun's ultraviolet rays. The change is endlessly reversible.

Photography

The photographic process is based on the presence of lightsensitive silver halide crystals, prepared by mixing a solution of soluble silver, usually silver nitrate, with a soluble alkali metal halide such as sodium chloride or potassium bromide. These grains are then suspended in the unexposed film. The effect of light on the silver halide disturbs the structure of this compound, rendering it selectively reducible to metallic silver by reducing agents called developers. The resulting negative image is converted to the positive by repeating the process under specific conditions. Photographic film is used in radiography, the graphic arts and in consumer photography. Photographic film manufacturers demand very high quality silver.

When Joseph Nicephore Niepce created the first photographic image obtained through a camera-like device in 1813, it was silver nitrate that made it possible.

The photographic process is based on the presence of silver halide crystals suspended on an unexposed film, which, when exposed to light, are set in such a way that they are selectively reducible to metallic silver by agents called developers. Approximately 5,000 color photographs can be taken using one ounce of silver.

Although a wide variety of other technology is available, silver-based photography will retain its pre-eminence due to its superior definition and low cost. From it's very outset, silver halide has been the material that records what is to be seen in the photograph. As little as 4 photons of light activate silver halides which amplify that incident light by a factor of one billion times. In today's photography, silver halides are coupled with dyes that bring the color of the world around us into permanent record. An estimated 230 million troy ounces of silver were used worldwide in 2000 for photographic purpose.

William Conrad Roentgen's discovery of x-rays in 1895, led to his discovery that they activate silver halide crystals. This revolutionized medical diagnosis. Radiographic use of silver worldwide consumed 78 million troy ounces in 2000.

Today, X-ray inspection is also essential to ensure integrity of metallic castings from small truck axles to the huge aircraft-carrier steam valves used to propel airplanes from a flight deck. Of all the inspection techniques, it is the image on a silver halide x-ray film that provides the clearest indication of flaws deep within metallic components.

Non-destructive x-ray testing is a critical element in product approval, ensuring the safety of all types of transportation conveyances from ships to aircraft. It remains the most effective way to reveal flaws in metallic components. The continuing requirement for the specially-sensitized silver halide film in which metallic flaws leave their identifiable signatures that can be compared with standard photographs will assure silver's continued preeminence for this essential quality control technique.

Silver plays an additional role in the x-ray tube itself. The x-ray generator is encased in a glass envelope sealed to its metallic base with a silver-alloy braze. Silver securely wets both the glass and the metallic base, providing a secure hermetic seal which will withstand rapid heating and cooling of the tube during exposures which may range from 30 seconds to 15 minutes.

Solar Energy

Silver paste is used in 90 percent of all crystalline silicon photovoltaic cells, which are the most common solar cell, says Jeffrey Mazur, a semiconductor engineer in the Photovoltaic Technology Division of the U.S. Department of Energy. And all silicon cells used in space to power satellites use silver in the form of evaporated metal to make the electrical contact.

The electricity generated by photovoltaic cells is highly reliable. As soon as sunlight strikes, power begins to flow. Sunlight striking silicon cells generates electrons, which the silver conductors collect to become a useful electric current. The conductive silver, which also enhances reflection of the sunlight, is applied in the form of a glass paste with a minimum of 90 percent silver along the top and across the bottom of the silicon crystal. When fired, the silver forms a complete circuit collecting solar energy and conducting it to the power supply line. A group of roofing-tile solar cells can generate sufficient power to provide a house and also fill batteries to supply power after dark.

Silver plays yet another role in the collection of solar energy: efficient reflection of solar heat. Silver is the best reflector of thermal energy (after gold).

Near Barstow, California, 1,926 silver-coated mirrors reflect solar heat onto black-coated stainless steel tubes atop a 300-foot tower. This heats the tubes and the nitrate salt inside them to over 1050^{o}F. The scalding hot salt is then piped to boilers turning water to steam which drives steam turbines geared to electric generators. They now generate sufficient electricity to power 10,000 homes.

Designated Solar Two, it is the most advanced solar power plant in the world. It incorporates the research into solar reflective technology conducted since 1982 by the Sandia National Laboratories, DOE, Sandia, NM, and the Southern California Edison Company, Irwindale, CA.

Water Purification

Silver is employed as a bactericide and algaecide in an ever increasing number of water purification systems in hospitals, remote communities and, more recently, domestic households.

Silver ions have been used to purify drinking water and swimming pool water for generations. New research into silver compounds is providing physicians with powerful, clinically effective treatments against which bacteria cannot develop resistance.

An increasing trend is the millions of on-the-counter and under-the-counter water purifiers that are sold each year in the United States to rid drinking water of bacteria, chlorine, trihalomethanes, lead, particulates, and odor. Here silver is used to prevent the buildup of bacteria and algae in the filters. Of the over $3.5 billion spent yearly in the U.S. for drinking water purification systems, over half make advantageous use of the bactericidal properties of silver. New research has shown that the catalytic action of silver, in concert with oxygen, provides a powerful sanitizer, virtually eliminating the need for the use of corrosive chlorine.

New Uses of Silver

A critical issue for silver moving forward is that it must maintain and, in fact, increase its competitive position in industrial applications. At present, one quarter of annual silver consumption is in photography, and this is of course being threatened by the growth in digital technology.

On the industrial front, several potential growth areas exist for silver. They are based on silver's strengths as a catalyst, as a biocide and for conducting and storing electricity.

Fuel cells offer a medium to long-term option for power generation, particularly in motor vehicles. At present, the fuel cell development path for use in vehicles is centered on proton exchange membrane (PEM) cells and alkaline-based cells. The latter are of interest because they have various technical and cost advantages over PEM cells, including being able to use non-platinum catalysts such as silver. It should be noted thought that the most promising research is currently focused on platinum based fuel cells. However, the US government has recently proposed legislation that provides for a federally funded three year study into the use of silver and gold as catalysts for automotive and industrial uses.

The anti-bacterial properties of silver are well documented. However, it is only recently that improvement in nano-particle research and production techniques have enabled more widespread use of silver as a biocide and anti-bacterial agent. For instance, Samsung announced in March this year that it has introduced a "silver sterilization clothes washing machine", targeted for domestic use. The machines incorporate nano-silver particles that kill 99.9% of bacteria without having to boil the water, thus providing both health and power efficiency benefits. Also, silver biocides may be able to replace arsenic and other chemical based preservatives in wood as well as being incorporated into marine anti-fouling coatings.

Gold use in electronics (bonding wires, plating) has been and is continuing to be replaced on grounds of cost and silver is often the main candidate to act as a substitute. This will become more prevalent as lower cost, mass-produced consumer products Incorporate some sort of logic control and data storage. Of course, other materials such as copper, aluminum and ceramics are also in competition with silver.

High temperature superconductor wires, combining a ceramic core with a silver sheath, have been developed for use in new power generation plants and distribution grids. The wires are very efficient in carrying electricity and widespread usage could see many millions of ounces used in this application alone.

Annexure – 5

Statistics

Table 11: Silver Producing Countries in 2002
Top 20 (millions of ounces)

Mexico	91.7
Peru	88.8
Australia	66.8
United States	46.4
China	44.9
Canada	44.0
Poland	38.9
Chile	34.9
Russia	25.0
Kazakhstan	24.9
Bolivia	14.5
Sweden	9.4
Morocco	8.5
Indonesia	8.2
Argentina	4.3
South Africa	3.7
Turkey	3.7
Japan	2.6
Iran	2.5
Greece	2.4

Table 12: Leading Primary Silver Mines

Rank	Mine	Country	2001 Moz	2002 Moz
1	Cannington	Australia	29.99	38.18
2	Proano	Mexico	28.74	31.25
3	Greenscreek	United States	11.00	10.91
4	Uchucchacua	Peru	9.78	9.39
5	Tizapa	Mexico	8.13	7.99
6	Imiter	Morocco	7.65	7.06
7	Rochester	United States	6.35	6.42
8	Galena	United States	4.51	5.30
9	Huaron	Peru	2.90	4.53
10	San Sebastian	Mexico	0.95	3.43
11	Arcata	Peru	4.44	2.86
12	Cayllona	Peru	2.25	2.86
13	Quiruvilca	Peru	3.26	2.51
14	San Martin	Mexico	2.39	2.40
15	Lucky Friday	United States	3.22	2.00

Table 13: Silver Mine Production by Source Metal
Million ounces

	1999	2000	2001	2002
Primary				
Mexico	35.5	43.2	47.7	50.3
Australia	26.5	33.6	30	38.2
United States	30	28.9	25.6	24.6
Other	56.3	39	45.3	47.9
Total	148.3	144.7	148.6	161
Gold				
Chile	8.7	22.6	22.2	15.8
Canada	15.2	17.5	20.1	23.1
United States	12.1	15.8	9.5	4.5
Other	34.7	36.7	36.6	36.1
Total	70.7	92.6	88.4	79.5
Copper				
Poland	35.1	36	37.4	38.3
CIS	20.8	25.4	28.7	29.3
Chile	16.5	17.2	20.7	16.5
Other	57.5	60.9	62.9	64
Total	129.9	139.5	149.7	148.1
Lead/Zinc				
Peru	40	43.7	43.7	45.5
Mexico	27.6	32.1	30.9	29.7
Australia	28.3	31.6	31.8	27.6
Other	91.2	92.1	88.7	86.7
Total	187.1	199.5	195.1	189.5
Other	7	6.5	7.5	7.9
Total	**542.9**	**582.8**	**589.2**	**585.9**

© Multi Commodity Exchange of India Ltd.

Table 14: Silver Mine Production by Main Region and Source Metal
Million ounces

	1999	2000	2001	2002
North America				
Primary	65.5	72	73.3	74.9
Lead/Zinc	45.9	47.2	45.2	43.6
Copper	25.8	25.9	24.9	25.2
Gold	36.3	43.9	38.8	36.5
Other	1.9	1.7	1.8	1.8
Total	175.4	190.8	184	182.1
Central & South America				
Primary	39.7	21.4	27.9	28.8
Lead/Zinc	55.7	59.9	59.8	62
Copper	22.8	24.7	31	28.3
Gold	16.9	31.5	31.9	25.6
Other	0.1	0.1	0.1	0.1
Total	135.3	137.5	150.8	144.8
China & CIS				
Primary	6.4	6.8	6.6	9.1
Lead/Zinc	37	39	38.4	37.2
Copper	32.8	38.5	41.8	41.7
Gold	5.7	6	6.4	8.4
Other	2.4	2.7	2.6	2.6
Total	85.2	93.7	96.5	99.3
Rest of the World				
Primary	36.6	44.5	40.8	48.2
Lead/Zinc	48.6	53.4	51.7	46.7
Copper	48.3	50.4	52.1	52.9
Gold	11.8	11.1	11.1	9
Other	1.6	1.3	2.3	2.7
Total	147	160.8	157.9	159.7
Total	**542.9**	**582.8**	**589.2**	**585.9**

© Multi Commodity Exchange of India Ltd.

Table 15: Indian Silver Imports

(in million ounces)

	1998	1999	2000	2001	2002
OGL	93.3	108.9	121.9	145.5	109.2
NRI	0.1	0.1	0.1	1.1	0.1
SIL	1.4	1.4	0.1	0	0
Replenishment**	0.3	3	0.9	1.7	4.8
Sub – Total	95.1	113.3	123	148.3	114.1
Unofficial	5.8	1.2	0.8	0.4	0
Total Imports	100.9	114.5	123.8	148.7	114.1
Local premium*	9%	11%	12%	12%	10%

*percent above London price at the official exchange rate

**imports of silver bullion for manufacture and export

Table 16: World Silver Fabrication (including the use of scrap)

(in million ounces)

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Europe										
Italy	56.7	52.1	50.1	52.2	56.5	56.3	62.1	65.4	55.7	52.8
UK & Ireland	28.4	31.2	32.3	34.4	35.5	39.2	39.9	43.2	46.5	44.1
Germany	50.1	54.4	47.6	47.2	47.6	48.4	42.1	40.6	40.5	35.5
Belgium	20.7	21.1	23.4	25.3	27.2	33.8	37.5	35.3	32.1	30.8
France	30.2	28.2	31.1	27.2	28.7	28.7	26.9	29.1	29.2	27.7
Spain	6.1	10.7	9.9	9.3	8.7	8.8	7.5	6.7	5.5	5.2
Switzerland	6.2	7.1	7.3	7.8	9.6	10.7	11.1	9	3.5	3.4
Poland	2.3	2.6	3.1	3	3.4	3.6	3.7	3.9	3.4	3.2
Greece	3.7	3.9	3.8	4.3	4.5	4.1	4.1	3.3	3	2.8
Netherlands	2.1	2.4	3	2.5	2.4	2.2	2.8	1.9	1.8	2.1
Norway	1.9	1.6	1.6	1.4	1.5	1.5	3	2.9	2.3	1.9
Portugal	2.5	2	2.4	2.8	2.9	3.1	3.2	3.5	2.6	1.7
Austria	1.5	1.5	1.6	1.5	1.3	1.4	1.2	1.1	1.1	1.2
Sweden	1.6	1.5	1.4	1.5	1.7	1.4	1.4	1.3	1	1
Denmark	1	1	1	1	1.1	1	1	1	0.9	0.8
Czech & Slovak Republics	0.7	0.6	0.8	0.7	0.8	0.9	0.8	0.8	1	0.7
Finland	0.9	1	0.9	1	0.9	0.7	0.7	0.6	0.5	0.5
Romania	0.5	0.4	0.3	0.4	0.4	0.5	0.4	0.4	0.4	0.4
Cyprus & Malta	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.3
Other	1.1	0.9	0.9	0.9	0.8	0.8	0.8	0.9	0.7	0.7
Total Europe	218.2	224.4	222.9	224.7	235.7	247.3	250.5	251.2	232	216.7
North America										
United States	129.9	138.4	148.2	149.5	158.9	169.2	184.2	193.4	169.6	177.1
Mexico	32	27.6	17.5	20.8	23.5	21.9	22.7	18.3	17.9	19
Canada	2.8	3.1	2.7	2.7	2.8	3.4	3.5	3	2.9	3.1
Total North America	164.7	169.1	168.4	173	185.2	194.5	210.4	214.7	190.4	199.2

Central & South America										
Brazil	6.9	8.3	9.4	8.4	8.4	8.1	7.7	6.8	6.6	6.4
Argentina	4.1	4.1	3.9	3.8	3.8	3.1	2.7	2.3	1.8	1.9
Peru	0.8	0.9	1	1.1	1.1	1.1	1	1	1	1
Colombia	1.1	1.1	1.1	1.1	1.1	1.1	0.9	0.8	0.7	0.7
Ecuador	0.5	0.7	0.7	0.7	0.7	0.7	0.5	0.5	0.5	0.5
Chile	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.4	0.4	0.4
Other	0.6	0.5	0.6	0.9	1.3	1.6	1.8	1.1	0.9	0.7
Total Central&South America	14.5	15.9	17.1	16.4	16.8	16.2	15.1	12.8	11.8	11.6
Middle East										
Turkey	6.2	5.4	6.4	6.7	6.9	6.6	6	7.4	5.5	7.8
Israel	2.8	3.1	3.4	3.7	4	3.9	3.9	3.6	3.3	3.3
Egypt	1.9	2.5	2.2	2.3	2.1	1.9	2	2	1.8	1.6
Saudi Arabia	0.4	0.3	0.4	0.4	0.6	0.5	0.6	0.6	0.6	0.6
Other	1.9	2.5	2.4	2.6	2.5	2.4	2.5	2.4	2.5	2.4
Total Middle East	13.5	13.8	14.8	15.7	16.2	15.3	15	16.3	13.8	15.8
Indian Sub- Continent										
Indian	108.8	93.9	101.3	122.2	122.9	114.7	121.5	131	154	118.5
Bangladesh & Nepal	3.9	4.6	5.2	5.8	6.4	5.1	5.8	6	6	4.8
Other	3.4	2.8	3.8	2.7	4.1	2.8	3.4	3.2	2.1	2.1
Total Indian Sub-Continent	116	101.2	110.2	130.7	133.5	122.6	130.6	140.2	162.1	125.4
East Asia										
Japan	107.9	108.4	112.7	112.1	127.2	112.8	122.5	135	119.3	118.6
Thailand	38.7	29.1	27.7	27.6	27.1	24.2	26.7	30.2	32.6	35.8
South Korea	15.6	16.4	18.6	18.5	18.6	13.8	16.7	20.6	18.1	19.1
Taiwan	4.8	5.3	5.7	6.4	6.9	6.8	6.7	9.4	8.5	9
Indonesia	1.8	2.7	3.1	3.4	4.1	2.7	3.2	3.9	4.3	4.8
Hong Kong	2.6	3.4	3.4	3.7	4.4	3.6	3.9	4.4	3.2	3.4
Myanmar, Laos & Cambodia	1	1	1.1	1.1	1	0.8	0.9	0.8	0.9	1
Vietnam	0.4	0.5	0.6	0.7	0.7	0.6	0.7	0.7	0.7	0.8
Malaysia	0.5	0.4	0.4	0.4	0.4	0.4	0.5	0.6	0.6	0.6
Other	0.4	0.4	0.4	0.3	0.3	0.3	0.4	0.4	0.5	0.5
Total East Asia	173.7	167.5	173.7	174.2	190.6	165.9	182.1	206.1	188.6	193.5
Africa										
Moracco	0.5	0.5	0.5	0.6	0.6	0.6	0.5	0.6	0.6	0.6
Tunisia	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
South Africa	0.6	0.4	0.5	0.3	0.3	0.3	0.3	0.3	0.2	0.2
Algeria	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2
Other	0.5	0.5	0.5	0.4	0.3	0.4	0.4	0.4	0.4	0.4
Total Africa	2	1.9	2	1.8	1.8	1.7	1.7	1.8	1.7	1.7
Oceania										
Australia	7	6.3	5.3	5.2	5.2	5.6	5.8	7	5.9	5.8
New Zealand	0	0	0	0	0	0	0	0	0	0

© Multi Commodity Exchange of India Ltd.

Total Oceania	7	6.3	5.3	5.2	5.2	5.7	5.8	7	6	5.8
Western World Total	709.5	700.1	714.6	741.7	785	769.2	811.2	850.1	806.3	769.6
Other Countries										
China	21.1	24.6	26	28.6	32.2	33.9	33.1	33.6	35.7	42.2
CIS	40.7	31.6	28.9	28.2	27.2	25.4	24.3	24.9	25.8	26.4
North Korea	0.2	0	0	0	0	0	0	0	0	0
Total Other Countries	62	56.2	55	56.9	59.4	59.3	57.5	58.6	62.2	68.6
World Total	771.6	756.3	769.6	798.6	844.4	828.5	868.7	908.6	868.5	838.2

Table 17: All India Monsoon Rainfall
(rainfall % of normal)

1998	1999	2000	2001	2002
106	96	92	94	81

(Source: National Informatics Centre)

Table 18: Monthly Average Price of Silver in Indian Market

	1990-91	1991-92	1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	1999-00	2000-01
April	6755.80	6710.31	8395.41	5809.41	7046.25	6896.38	7467.61	6969.38	8810.00	7793.40	8022.08
May	6734.40	6909.68	7973.09	6187.13	6980.96	7105.81	7551.72	6919.40	7989.00	8095.00	*
June	6696.77	6837.00	7255.88	6009.88	6784.88	6793.77	7211.72	6770.40	7765.00	7796.54	7958.46
July	6803.64	7018.15	7537.00	6481.48	6707.35	6683.54	7104.50	6332.20	8124.00	8007.40	7990.00
August	6939.38	6867.88	7626.14	6362.35	6661.22	6816.43	7192.08	6511.25	7864.00	8142.80	8014.17
September	6833.32	6996.86	7351.50	6071.67	6965.29	7188.17	7108.00	6857.83	7560.00	8107.62	8062.29
October	6959.24	7235.12	7196.33	5974.68	7054.56	7511.71	6974.40	7084.40	7528.00	8326.25	8076.96
November	6646.40	7277.50	6539.35	6070.13	6866.38	7353.42	6919.35	7020.91	7499.00	8112.86	7891.15
December	6391.84	7692.20	6644.71	6562.65	6430.85	7205.25	6871.20	8068.96	7360.00	8102.20	7798.20
January	6805.22	8357.96	6810.35	6746.00	6361.04	7655.88	6851.88	8285.63	7715.00	8123.70	7753.46
February	6809.22	8137.38	6056.71	6839.50	6259.95	7964.17	7307.29	8829.32	8223.00	8191.74	7621.52
March	6754.22	7948.92	5554.22	7062.58	6188.96	7471.50	7421.09	8577.61	7827.00	8003.80	7364.00
Average	6760.79	7332.41	7078.39	6348.12	6692.31	7220.50	7165.07	7352.27	7855.00	8066.94	7868.39

Source: 1. Press Trust of India. 2. Bombay Bullion Association.
* Information from the Press Trust of India is not available for the month of May 2001.

Table 19: Average Prices of Silver in Indian and U. S. Markets
(in Rs. per kg)

Year	Mumbai	New York	Spread
1990-91	6760.79	2579.21	4181.58
1991-92	7332.41	3269.89	4062.52
1992-93	7078.39	3749.87	3328.52
1993-94	6348.12	4741.09	1607.03
1994-95	6692.31	5187.33	1504.98
1995-96	7220.50	5811.03	1409.48
1996-97	7165.07	5762.65	1402.42
1997-98	7352.27	6153.96	1198.32
1998-99	7855.00	7144.00	712.00
1999-00	8066.94	7286.51	780.43
2000-01	7868.39	7110.18	758.20

© Multi Commodity Exchange of India Ltd.

Table 20: World Silver Supply from Above-ground Stocks
Million ounces

	2001	2002
Implied Net Disinvestment	-9.5	20.9
Producer Hedging	18.9	-24.8
Net Government Sales	87.2	71.3
Sub-total Bullion	96.6	67.4
Scrap	182.7	184.9
Total	279.3	252.3

Table 21: Indian Industrial Fabrication, 2002

	Percentage
Pharmacy & Chemicals	22.4
Foil	9.0
Plating	31.7
Solders & Brazing	5.4
Electrical	13.5
Photography	0.85
Jari	17.1

Disclaimer

This document is for information purpose only. Certain information herein has been acquired from various external sources believed to be reliable. While we have taken reasonable care during compilation of this document, we assume no responsibility for any error or discrepancy in the information herein. You must make appropriate judgement without any prejudice or compulsion.

Copyright

All rights reserved. No part of the newsletter can be reproduced or copied in any form by any means without the prior permission of Multi Commodity Exchange of India Ltd.

Contact Us

Multi Commodity Exchange of India Ltd.
1st Floor, Malkani Chambers, Off Nehru Road,
Vile Parle (East)
Mumbai – 400099
Tel: 91-22-26164146
Fax: 91-22-26118195

Email: info@mcxindia.com
Website: www.mcxindia.com