MINT NEWS QUARTERLY™

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12th Technical Forum of the World Money Fair

The Royal Mint presented its new masterpiece, the Phoenix Ascendant.

The Technical Forum of the World Money Fair has grown into a showcase displaying the latest developments of the various mints. Hosted and organised by Dieter Merkle of Schuler Pressen and Thomas Hogenkamp of Spaleck, this event has become a 'must' in the numismatic year. This time, 340 applications for participation were received by Barbara Balz and her World Money Fair team.

12 speakers talked about their latest production solutions. Michael Groves of the Royal Canadian Mint impressed with swift progress in matters of colour applications on commemorative coins.

Ralf Freiberger of Mühlbauer Group illustrated how effectively counterfeits can be withdrawn from circulation when optical methods are combined.

Two speakers re-defined the existing practical limits for coin pressing. First was Gordon Summers, The Royal Mint's Chief Engraver, who presented his newly developed 'masterpiece'.

Virtually every modern technical method has been applied to create this medal that is a unique work of art. Only two examples of this creation will be available on the market.

Second, Alexander Aminidis of ACSYS Lasertechnik introduced a coin produced by the use of state-of-the-art laser technology. Every security feature currently possible has been implemented in this coin. The dies were used by the Staatliche Münze Baden-Württemberg to mint actual specimens.

Other new developments will be presented in this issue.

Summaries of all the presentations can be found at the CoinsWeekly website at:

www.coinsweekly.com/en/News/News-from-the-world-of-minting-technology--Part-1/4?&id=3907

www.coinsweekly.com/en/News/News-from-the-world-of-minting-technology--Part-2/4?&id=3920

Mint Perceptions

In the context of the Technical Forum at the World Money Fair, Royal Mint Chief Engraver Gordon Summers raised an interesting question: how to deal with the fact that our products are achieved by a modern high-performance industry, whereas our customers perceive us as craftsmen like those that created coins in the 19th century?

The minting industry faces the same problem as other sectors. While we grant, or rather expect from, car manufacturers state-of-the-art technology, other sectors such as the food industry promote their products with advertising texts featuring terms such as 'homemade'. How about the minting industry? Does it want to sell its products under the label 'high-tech' or rather as 'craft'?

When we ask the customers, we see that the decision has already been made. Despite the boom of modern art, there is no market for art medals carefully handmade by artists. Commemorative coins, on the other hand, are sold out immediately if they are produced using some new technology.

Why can't the minting industry get rid of its image as a traditional manufacturer? Is it because of the widening gap between marketing and the coin technician? Marketing places the emphasis on a growth in sales and, therefore, on the promotion of the issue whose design very often refers to an event in the distant past. The image of the Mint, in contrast, is only rarely promoted consistently. Even if it is, the focus is more on the past than on the present.

Will this cause damage in the long run? The food industry has experienced a loss of credibility in recent decades, partly because advertising claims no longer bear any relation to reality.

We should therefore make it our goal to ensure that public perception doesn't deviate from our self-perception too much.

Ursula Kampmann, Editor

Direct Precious Metal 3D Printing

By David Fletcher, CooksonGold

Cooksongold, the precious metal supplier based in the UK and part of the Heimerle + Meule Group, has collaborated with the machine manufacturer EOS to create the *M 080* system and the advanced metal powders required for direct metal 3D. This has resulted in the production of designs which cannot be achieved by traditional coin presses. So what is this technology and how can it be used by mints around the world?

Direct precious metal 3D printing is an additive manufacturing technology that produces high quality, ready to finish, dense parts directly from 3D CAD data.

The process uses a laser to selectively melt and fuse together precious metal powder, using a layer by layer build process until the required geometry has been created.

The technology provides the following benefits opening up new possibilities for the numismatic industry:

- Freedom of design
- Complex shapes, impossible to produce by machining
- Articulating parts
- Thin walls and shapes which are impossible to produce by casting
- Lightweight parts with hollow or lattice inner structures
- Flexibility in design change
- Simple customisation
- Produce parts in different colours
- Printing directly onto existing products and coins
- No tooling, masters or wax/resins required
- Short production time (a few hours)
- Removal of production steps

Cooksongold showed two case studies at the World Money Fair.

In the first case study, they created a CAD file containing a crown, lettering, beading and coin rim. Then, they fixed an 18 carat yellow gold coin blank into the build platform and printed the CAD file in 18 carat white gold directly onto the obverse of the blank.

The process enables a true 3D image to be produced directly onto the face of the coin. The resulting coin (see below) has undercuts and intricate detail that cannot be achieved through pressing. They could of course, print the crown in the same alloy as the coin, but wanted to demonstrate the possibility of producing coins containing different metals and colours.

In the second case study, they once again used the crown CAD file. but this time printed it on both sides in platinum on to a fine gold coin blank (see right). These coins were completely unique and were the first truly 3D coins.

It's clear that other possible applications for the technology are to effectively pad print precious metal in selected areas of the coin blank that then goes on to be struck in the usual way – giving colour and contrast to commemorative coins that could not be achieved until now.

Cooksongold will continue to develop the technology adding new alloys to their current portfolio of 18y, 18w, 18r, 925 silver and 950 platinum.

More information is available at **www.cooksongold-emanufacturing.com** or email **lasersintering@cooksongold.com**

End shot of the world's first truly 3D coin.

Intricate effects produced by 3D printing.

Anti-Tarnishing-Technology at the Mint of Poland

by Siemowit Kalukiewicz

At the beginning of 2014, the Mint of Poland implemented an effective technology protecting coins against corrosion. Today, this method is applied over all of our products, with the emphasis put on the silver coins.

Silver is very sensitive to airborne sulphur. High humidity and air pollution accelerate the tarnishing process. As we all know, tarnishing has always been a worldwide problem concerning silver and other alloys. It is caused by a thin layer of corrosion (ie. silver sulphide).

Thickness of the silver sulphide layer produced on the product's surface depends on the alloy. The finer the alloy, the thinner the silver sulfide layer. In normal conditions of use, silver and its alloys get progressively covered with a yellowish, brown or black coating. If coins are manufactured with the use of various advanced minting techniques, the process of tarnishing can be accelerated.

There are different methods used to protect silver from tarnishing: placing coins in special capsules; inorganic coating (chromating); organic coatings, including cataphoretic painting (e-coating); or corrosion-resistant metal coating with a thin layer of another, more corrosion-resistant metal (rhodium, palladium, gold, platinum). However, none of these methods have 100% anti-tarnish properties. What is more, every method to some extent changes our product.

The Mint of Poland, in cooperation with BENEQ, implemented an ALD (Atomic Layer Deposition) anti-tarnish coating – *nSilver*. This method, patented by a Finnish company, seems to be the most appropriate one in comparison with the PVD (Physical Vapour Deposition) and CVD (Chemical Vapour Deposition) methods.

The new method

In the ALD method, the coating layer is applied over the entire surface of the product, regardless of its origin and the relief height. Its anti-tarnish property is based on coating silver with a fully transparent and ultrathin (10-90μm) protective film of inorganic oxides (aluminum oxide/titanium dioxide).

First, the coin is struck and washed. Next, it undergoes a process of coating with a nano-layer. During 4.5 hours, in a nitrogen protective atmosphere, coins are heated to a temperature of 100°C. Then, during a 5-hour process applicable to a vacuum with the use of suitable precursors, including TMA (Tri-Methyl Aluminum), water and titanium tetrachloride, they are covered with the nSilver protective layer.

We obtain the first 45μm layer of aluminum oxide with applying TMA (Tri-Methyl Aluminum) precursors and water in repeated cycles. The side effect is methane. A 45μm layer of titanium dioxide is formed of titanium tetrachloride and water in the corresponding cycle, and the side effect is hydrochloric acid.

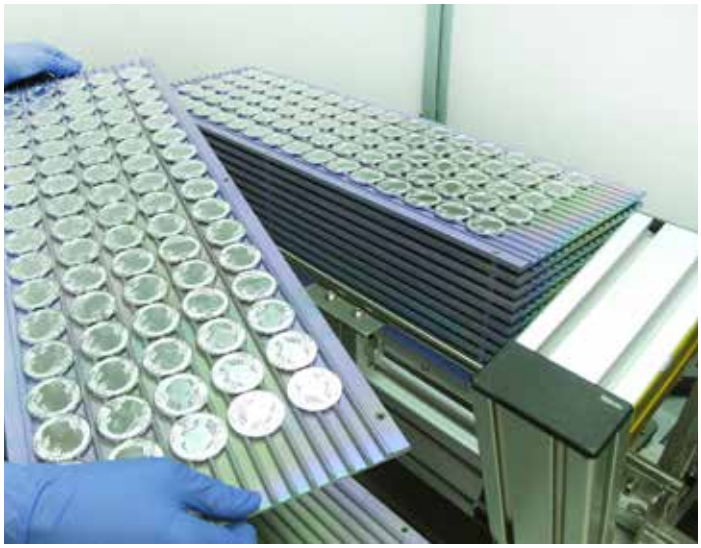
"In our tests, the protective layer remains unchanged 4,000 times longer when compared with the reference coin."

There is a great variety of testing methods available on the market. However, we opted for the most reliable ones that are conducted in an atmosphere of thioacetamide and immersion in a sodium sulphide solution. In the latter method, the sample is immersed in a 1-3% sodium sulphide solution for 30 minutes. If the sample does not change after 30 minutes, then the protection is sufficient. The nSilver protective layer should remain unchanged 100 times longer in comparison to the unprotected reference coin.

In our tests, the protective layer remains unchanged 4,000 times longer when compared with the reference coin. This should provide 50-year protection period.

The process has been in use for two years already, and I can say without hesitation that the tarnishing problem at the Mint of Poland is removed forever. Our coins are protected for years to come.

https://en.mennica.com.pl



Examples of anti-tarnish treated coins.

Loading the coins into Beneq equipment for ALD process.

Polishing of Coining Dies

By Rüdiger Böhm, Rösler

Key to producing high quality coins are perfectly made coining dies. It is not surprising that even in today's manufacturing environment the precision surface grinding and polishing of the raw dies is still done by hand.

In close cooperation with a German mint, Rösler was able to develop a mechanical grinding and polishing process with astonishing finishing results.

After embossing of the coin motif and annealing, the raw die is firmly clamped to a fixture located in the processing bowl of a special rotary vibrator. The actual finishing process begins with a pre-grinding phase: small surface imperfections on the coin motive stemming from previous production stages are removed with grinding media set in motion by vibration.

During this step, the initial surface reading of Rz = 2.0µm is reduced to Rz = 0.13µm. The intricate contours of the coin motifs are not affected but are perfectly maintained.

Mechanical grinding and polishing process.

The objective of the second process step, the 'polishing' phase, is the creation of a mirror image surface finish. After this step, the motif on the coin die shows an immaculate, high gloss appearance without any mechanical imperfections whatsoever. A surface reading of Rz = 0.08µm underlines the enormous smoothness, which is essential for impeccable coining results.

Depending on the condition of the raw dies, the entire process for finishing the surface of coining dies requires between five and eight hours. The system allows the simultaneous processing of multiple dies.

Nevertheless, prior production stages are important. Because of the complex manufacturing process and the stringent quality requirements, mints are usually making their coining dies in-house.

The process starts with the production of raw slugs. In their soft (pre-annealing) condition, these cylindrical pieces are then turned to receive a cone shaped surface profile. In a grinding step the turning lines are removed as preparation for the subsequent embossing of the coin motive.

This is extremely important, for any surface impurities would result in a less than perfect quality of the motive on the coining die.

To date, this grinding step, which must not change any of the motif contours, has been done by hand. Our process engineers succeeded in replacing this manual operation with a specifically adapted drag finishing process.

After turning, the raw dies are mounted to special workpiece fixtures. This prevents any scratching or nicking by part-on-part contact.

Production of raw slugs.

The fixtures with the mounted raw dies are then fastened to the workstations of a drag finishing machine. Depending on the machine type, up to 18 dies can be processed simultaneously.

The finishing process is divided into two steps: During the initial fine grinding operation the turning lines, with surface readings between Ra = 0.5 and 1.9µm, must be removed. The clearly visible turning lines are transformed into a smooth isotropic surface.

Depending on the respective customer, in a second step the surface can then be polished. This operation takes place in the same machine, but with a different medium. Either porcelain polishing media or a dry polishing process can be used. The result is a high gloss polish on the surface of the die, which is now ready for embossing the coin motive. The excellent surface smoothness of Ra = 0.08µm is the ideal precondition for a perfect coining die.

www.rosler.com

Royal Canadian Mint Brings Bullion DNA To Europe

After the North American launch, the Royal Canadian Mint has introduced its *Bullion DNA* anti-counterfeiting technology to the European market.

The Mint's Bullion DNA counter-top device, which now allows genuine Gold Maple Leaf (GML) and Silver Maple Leaf (SML) bullion coins to be certified in-store, was unveiled before European bullion dealers and distributors at the 2016 World Money Fair.

The Bullion DNA device works by reading a micro-engraved security mark appearing on the reverse of every GML bullion dated 2014 and later, as well as every SML coin dated 2015 and beyond. The mark, consisting of a textured maple leaf and the last two numerals of the coin's production year, visible only under magnification, is laser-engraved on the dies which are used to strike these coins.

The Mint's digital non-destructive activation (DNA) technology, developed in partnership with ArjoSolutions, captures images of the mark encrypted with a string of code, and stores these in the Royal Canadian Mint's secure database. When a GML or SML coin is placed in the Bullion DNA device, it communicates with the Mint's secure servers to decode the encrypted signature and search for a match registered during coin production.

Rebranding the South African Mint

The South African Mint revealed a new corporate identity at the World Money Fair. According to Managing Director Tumi Tsehlo, 'the rebranding of our identity is an outward declaration of who we are internally.

We are a first-class mint with an enviable track record in coin minting and huge growth aspirations. We want the industry and the public to see this new look as a reclaiming of our rightful place in the global mint industry.'

The design of the South African Mint's new logo and corporate identity involved a stringent development process to ensure that key criteria were met.

Among these were to denote the organisation's South African origin and its identity as a premium coin manufacturer. The new logo also had to convey a sense of gravitas and officialdom as well as serve as an affirmation of attributes ranging from artistic integrity to technical excellence. In addition, given the timelessness of the South African Mint's products, it was essential that the identity remain stylistically relevant in future and also scalable.

SOUTH AFRICAN MINT

Vienna Philharmonic Bullion Coin

The Austrian Mint unveiled at the World Money Fair their first platinum bullion coin. Produced from 999.5 pure platinum, the new Vienna Philharmonic coin shares the famous design with the gold and silver Vienna Philharmonic Bullion Coin.

Gerhard Starsich, CEO and Chairman of the Executive Board of the Austrian Mint said: 'expanding into platinum is a natural step for us.'

The new platinum coin will initially be available in 1 ounce denominations, and will be sold throughout Europe and in overseas markets, including Japan and the US.

New Centrifugal Finishing Machine for the Treatment of Circulation Blanks

By Ingo Löken , Spaleck Oberflächentechnik

At the Technical Forum, Spaleck presented a completely new technology for polishing circulating coin blanks, combining the advantages of hot air drying technology with the linear textile dryer. The *Z44* is able to run up to 1,600kg blanks per hour.

The new generation of centrifugal finishing machines for the polishing of circulating coin blanks last December. The new generation is remarkable because, compared to the existing smaller sister model *Z33BFC* with a capacity of about 800kh/hour, the Z44 finisher is now capable of running up to 1,600kg circulation coin blanks/hour.

Along these lines of increased capacity, there have been various technical improvements implemented into this new generation. The blanks are loaded from the operator into the storage hopper with a capacity of about 4 tonnes. This gives the operator the opportunity to focus on other tasks for about 2.5 hours fully automatic operation of the machine.

From the storage hopper, the blanks are loaded into the working tub. Here, a batch of about 400kg blanks are treated with 400kg of stainless steel media.

During the treatment, the pickling phase and polishing process takes place. Spaleck has optimised the treatment conditions using just mild acids, so we generate bright surfaces without the use of sulphuric acid or peroxide. The mild acid can be recycled by the system and re-used in the next treatment cycle. These efforts were made to achieve the most effective and environmental friendly system; we are proud to claim that the water consumption per hour is about 1,000 litres.

After the treatment process, the mix of media and blanks are unloaded onto a storage hopper from which the separation process is started. For the benefit of the operator, the separation conditions are controlled by weight cells.

That means that the operator tells the PLC a dedicated volume to be separated in a certain period of time (eg. 80kg/minute).

From there the blanks go to a rinsing and separation area, where the blanks are separated from the stainless steel media. Before the blanks go into the dryer, an air knife arrangement pre-dries blanks from obvious water sitting on the blank's surface. This elimination of macro humidity brings the blanks into the perfect conditions to be dried with a worldwide new drying technology.

Due to the advanced challenges in the marketplace, Spaleck walked away from the well-established hot air drying technology. Spaleck has combined the benefits from the hot air drying technology with the well-established linear textile dryer, which is very successfully working for gold and silver blanks. The technical result is the creation of blanks with proof quality.

So a new specification for the perfect drying technology has been formulated.

The requirements are:

- Drying capacity 1,600kg/hour
- Ready for mass production which is requested in the circulation coin blank business
- No spots or damages are allowed on the blanks
- No contamination
- Low noise level
- The drying temperature has to be on a lower level, preferably less than 80°C

After an extensive study for the drying conditions and a prototype phase, Spaleck Oberflächentechnik was very proud to present this new drying technology SFT 200 during the World Money Fair 2016.

www.spaleck.biz/en/home/

Making a Mint: Holographic Coins

Using holograms to create optically variable effects on coins can be challenging. While the dream of holographic coins being used in general circulation has not yet been realised, several special or commemorative holographic coins have been produced in recent years.

Given the need for mints to innovate (particularly those that rely on commemorative coins for a large part of their output), together with the reduced number of available technologies for making coins resistant to counterfeiting compared to banknotes, holograms could provide a solution – if and when the technical issues relating to durability are overcome.

Brief history highlights

What is 'claimed' to be the world's first holographic coin was a 'Noble' for the Isle of Man (IoM), minted by Pobjoy Mint, a privately-owned company in the UK. The coin is made of platinum and depicts a Viking ship with the sail made from a patterned hologram. The design for the coin was first issued in 1983 and the IoM re-issued 10,000 in 1996, which included the hologram.

In 1999 the Royal Canadian Mint (RCM), which has a history of issuing coins featuring holograms, unveiled a holographic gold maple leaf coin to commemorate the 20th anniversary of its gold maple leaf programme. This coin received an Excellence in Holographic Product award from the International Hologram Manufacturers Association (IHMA).

In commemoration of the 100th anniversary of the birth of Dennis Gabor (the inventor of holography), the National Bank of Hungary issued a 3,000 Forint silver coin in June 2000. The obverse side, bearing the principal design of the coin, featured the holographic depiction of the initials of G.D.

Gabor coin – Hungary, 2000.

Australia's centenary

In 2001, the Royal Australian Mint (RAM) released an A$5 hologram coin to mark the end of Australia's Centenary of Federation. This is believed to be the first two-channel hologram coin. Depending on the angle of view, two separate images are visible.

One depicts the Federation Rotunda while the other is a map of Australia showing the states and territories in different colours.10,000 of these coins were produced and the hologram utilised a method pioneered and patented by Australia's Commonwealth Scientific & Industrial Research Organisation (CSIRO).

The following year, the RAM produced a further hologram coin for the 'Year of the Outback Finale'. This A$5 silver holographic coin was the first to feature three channels. With improved technology, this coin had a much larger hologram occupying almost half of one side. The three-channel hologram showed the mountain in morning, day and night lighting, and 15,000 were minted.

In 2003, the RAM issued a holographic coin as the finale to its series on Australia's Volunteers, while in 2004 it issued holographic coins for a standard issue design, albeit the holograms were only used on the proof set. These coins of kangaroos were produced using a new method developed by CSIRO, which entailed coating the hologram side of the coin with a resin, into which the hologram is embossed.

The Evolution of Holographic Coins

Over the past 20 years, the use of holograms within commemorative and collector coins has developed in sophistication.

1996

Isle of Man platinum coin, 'claimed' to be the world's first holographic coin.

2001

A$5 federation hologram finale silver coin, believed to be the first two-channel hologram coin.

Commonwealth coin

In 2004, the Pacific Ocean Commonwealth of the Northern Mariana Islands issued a non-circulating coin incorporating a stereogram image of Albert Einstein, and in the following year a coin featuring holographic images of crop circles.

Cambodia too has joined the hologram bandwagon and, in 2005-2006, the country issued a coin featuring the famous Taj Mahal as part of 'The Wonders of the World Series'. Only 3,000 of these 10,000 riel coins were issued.

Cambodia's silver coin featuring a hologram of the Taj Mahal, 2005.

In 2006, Holography Industry JV in Belarus – in cooperation with the Kazakhstan Mint – produced their first holographic coin with the theme 'cycle racing.' The image on the coin was produced using nickel matrix embossing.

To commemorate the Vancouver Olympic and Paralympic Winter Games, the RCM issued a 15-coin series in 2010, featuring winter sports with a holographic element highlighting the sporting side of the coin. 45,000 of each coin were produced.

A commemorative $25 sterling silver holographic coin celebrating the 2010 Olympics, depicting curling.

Three years later RCM, official licensee of DC Comics, introduced the first achromatic hologram coin in the world, as a tribute to Superman's 75th anniversary.

More recently in 2014, the RCM released a new limited mintage (10,000) silver $20 collector coin for the 25th anniversary of the Canadian Space Agency. The silver coin featured an achromatic hologram of the International Space Station's robotic arm and a spacewalking astronaut. The hologram was originated by Optaglio. This coin was commended with an IHMA 'Best Applied Decorative or Packaging Product' award in December 2015.

In 2015 RCM, in collaboration with NovaVision and Pacific Holographics, issued a five ounce fine silver hologram coin, the first ever to feature a hologram, incorporating Canada's national symbol, the maple leaf as a hologram.

The coin was also commended in the 2015 IHMA 'Best Applied Decorative or Packaging Product' Category in December 2015 at The Holography Conference in China.

Very heavy hologram coins from Canada

In addition to the more 'regular' sized holographic coins, there are also very heavy holographic coins available.

The first Canadian $250 – 1 kilogram silver coin with a hologram – was released in 2015: The 'Maple Leaf Forever' silver coin, of which only 500 were produced, features two sugar maple leaves with crossed stems overlapping in the hologram design.

A similar but an even more expensive heavy coin is the Canadian $2,500. This 1 kilogram gold coin (Maple Leaf Forever), of which only ten were produced, was also released in 2015. The design features a hologram across the entirety of the engraved leaf's undulating surface on the coin, allowing natural light to be diffracted from different angles as it is tilted from side to side. This creates an iridescent rainbow effect which is enhanced by the use of multiple polishes.

The $250 silver and $2500 gold One-kilogram Maple Leaf Forever coins – Canada 2015.

2004

A non-circulating coin incorporating stereogram of Albert Einstein.

2014

A Canadian silver $20 coin featuring an achromatic hologram of the International Space Station.

2015

Award winning five ounce silver coin featuring a maple leaf hologram.

Commission Investigates Costs and Benefits of New US Coins

Cost savings for the state means high costs for the free economy. This is the dilemma of the conversion of material of US circulating coins, and is one that was covered by Jon Cameron of the US Mint at the Coin Conference last October, when he explained that the estimated costs to society of making changes to US coins far exceeded the savings (see MNQ December 2015).

In the light of increasing metal prices, the US Congress had requested the Treasury to reconsider the change in the metal composition of circulating coins. A report from the Treasury is still awaited.

The Congress also commissioned the GAO (Government Accountability Office) to investigate what efforts the US Mint has already taken to reduce the costs of the coin production. The GAO submitted its final report in December 2015, reaching a different conclusion than the US Mint.

In 2014, the US produced about 13 billion new coins. An alternative material was taken into consideration for three denominations: the nickel (5 cents), the dime (10 cents), and the quarter (25 cents).

These three denominations are made of different copper-nickel alloys. If the coins would be made of plated steel, the US Mint initially hoped for annual savings of up to $83 million. Given the potential savings regarding the nickel and the dime, the US Mint thinks that annual savings of between $8 million (for minor changes in the metal composition) and $39 million (with a full conversion to stainless steel) are within reach.

In the GAO's view, the Mint has not applied the best practice guidelines correctly. For example, it had not accounted for possible changes in the metals' market price. Nevertheless, the GAO deemed the estimates a useful point of departure.

The GAO investigated the costs for the industry incurred by the necessary adjusting of the vending machines. Representatives of the industry sectors concerned estimated the additional costs between $2.4 billion and $10 billion. The GAO calls these numbers into question as well.

This appraisal is based on 7 million machines whereas a 2015 industry study spoke of only 4.5 million vending machines in the US. Furthermore, machines that only accept quarters (eg. coin washing machines) should not have been considered since no material conversion is planned for this denomination.

As a matter of fact, the GAO report likewise stresses that the cost-effectiveness was linked between state and industry: while maximum savings for the state (full conversion to stainless steel) would generate highest modification costs for the industry, minimal costs for the companies (minor changes in the alloy), by contrast, would result in the lowest savings for the state.

In this context, the GAO points to a legislative specification. The 2010 Coin Modernization, Oversight, and Continuity Act stipulates that newly introduced coins in existing vending machines have to function 'to the greatest extent practicable'. Representatives of the mints stated to the GAO that this specification has to be considered when the Congress receives recommendations on the part of the Treasury.

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