BANKNOTE TECHNOLOGY REPORT

2023

DeLaRue

CURRENCY

Currency: View

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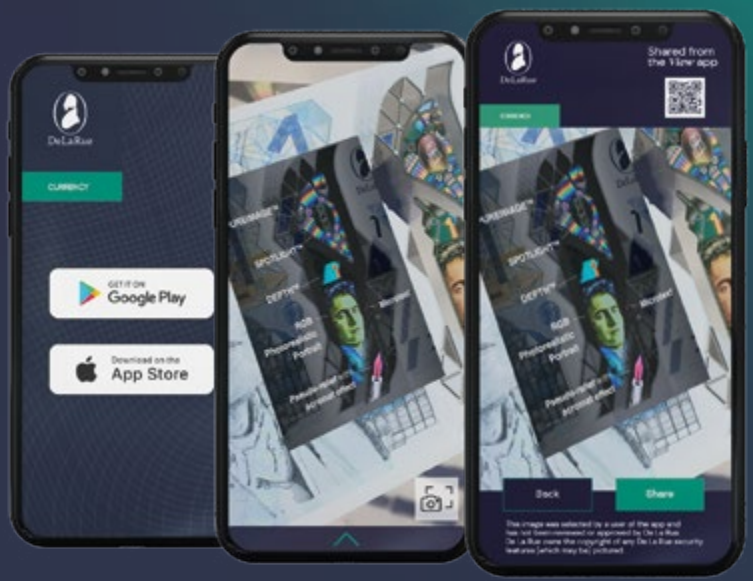
Look for the 'AR ICON' and scan the trigger image or object to see our products come to life.

1 Download the app to experience our *Augmented Reality*

2 Scan *our brochures* and see our *security features and designs* come to life

3 See how our products make *distinct, memorable and secure* banknotes

4 *Share* your experience



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The Banknote Technology Report is a platform where the latest technological developments and features are centralized on a regular basis.

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Banknote Industry News GmbH
Am Sportplatz 1 | 82041 Oberhaching / Munich
Germany

info@banknote-industry-news.com
www.banknote-industry-news.com

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CONTACT US

Philipp Greulich | Managing Director
philipp.greulich@banknote-industry-news.com

Donald Scholz | Managing Director
donald.scholz@banknote-industry-news.com

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LEONHARD KURZ Stiftung & Co. KG
Schwabacher Str. 482
90763 Fuerth/Germany
E-Mail: banknote.security@kurz.de
Internet: www.kurz-banknotes.com

KURZ

KURZ Technology – The Essential Element

FEATURES

THE BANK OF SCOTLAND £100, FEATURING AN INTEGRATED FOIL STRIPE THAT INCLUDES DEPTH™ AND PUREIMAGE™ EFFECTS

DE LA RUE

INNOVATION 2.0: SURFACE-RELIEF MICRO-STRUCTURES AND DESIGN-LED INTEGRATION

Innovation 2.0: Surface-Relief Micro-Structures and Design-Led Integration

DE LA RUE

Confidence in currency is essential for the monetary stability of a country. Technically advanced banknotes deter counterfeiters by making simulations more expensive to produce and easier to spot. It is therefore vital that the science and design that underpins banknotes stays ahead of criminals and what is available commercially.

Central banks typically launch a new series every 7 to 10 years and this is empirically known to keep global counterfeiting rates low. Security feature selection is important in ensuring banknotes are easy to authenticate and hard to simulate. However, integration of new features and the overall design of the banknote also play an essential role. For instance, if you consider a counterfeit of a polymer note with a poorly cut window it will act as a simple trigger that something is wrong.

This article examines why it's important to think holistically about security features and banknote design. The next wave of innovation is design-driven, based on the latest thinking around integration and technology. It includes security features with advanced materials science. However, it also optimises the overall banknote, using enhanced integration approaches and incorporating existing platforms in original ways.

INTEGRATION-DRIVEN INNOVATION

Security threads are an early example of integration-driven innovation. The thread itself provides some security which is then further enhanced by the integration of the thread into the banknote. A thread that is simply stuck onto the banknote would improve the banknote security but not to the same extent as one that is embedded. Today, threads are ubiquitous as a paper security feature, with every banknote paper mill having thread capability and 96% of all circulating paper banknote designs containing a security thread.

The micro-optics embedded stripe NEXUS™ is a more evolved example of integration-driven innovation. NEXUS™ was developed due to a desire for a security thread where a larger area of the effect was visible. This innovation led to an 18mm-wide embedded stripe that is visible along the entire height of the banknote. NEXUS™ required creativity and progression, beginning with integration-led thinking that was different to what would have been achieved by focussing only on the technology.

Today NEXUS™ is available with multiple colours and effects such as depth, inversion and three-dimensional contouring. The large width of NEXUS™ allows for the stripe to be shaped into non-linear designs, without loss of the effect impact, thus enabling more fluid aesthetics than the straight lines associated with standard threads. The States of Guernsey became the latest issuing authority to issue a banknote containing NEXUS™, with a £20 that entered circulation earlier this year..

UPDATED GUERNSEY BANKNOTES, FEATURING NEXUS™, IGNITE® AND PUREIMAGE™

TECHNOLOGY-LED INNOVATION

The authentication response of standard windowed threads is viewed in a relatively small area compared to a stripe. This means any optically variable effects (i.e. an effect created by colour shift, micro-optics and holographics) need to be particularly strong in a thread. Colour shifting threads meet this need via an obvious and binary authentication response that is easy for the public to remember (i.e. the colour changes when you tilt the banknote). Increasingly though the next generation of security features are driven by surface-relief micro-structures, either in isolation or combination.

TRANSMISSIVE SURFACE-RELIEF MICRO-STRUCTURES

IGNITE® is an example of a combinational next generation of security feature. It has an obvious colour shift but enhances this technology by combining it with a type of transmissive surface-relief micro-structure (i.e. a micro-structure that refracts light that travels through it). The combination of the two technologies creates strong colours that also incorporate high impact movement effects. Since it was first launched in 2019 the transmissive surface-relief microstructures used in IGNITE® have advanced. De La Rue has commissioned and installed proprietary equipment of our own design, allowing us to manufacture unique micro-structures that are <3 μm in size. These micro-structures are much smaller than standard micro-mirrors. They are optically engineered to exact shapes that deliver new and sharper effects, compared to the original version of IGNITE®. The latest generation of IGNITE® threads appear in the Uzbekistan 50,000 Som and the Guernsey £10. They contain novel geometric and rotational effects, along with "contoured" effects that move around a customised image.

EXAMPLES OF IGNITE®, FEATURING IN NOTES ISSUED BY THE CENTRAL BANKS OF UZBEKISTAN, BANGLADESH AND QATAR

REFLECTIVE SURFACE-RELIEF MICRO-STRUCTURES

Reflective surface-relief micro-structures (i.e. everything from micro-mirrors and holograms through to plasmonic structures) tend to be embedded in a foil. They have been waiting for polymer banknotes to realise their full potential.

The ultra-smooth and durable polymer substrate provides the ideal base for the next wave of striking optically variable effects. The large area of the foil stripe enables different types of surface-relief micro-structure to be incorporated simultaneously, with periodic relief structures that range from above 5 μm to below 0.4 μm.

TRUE "CLASSICAL" HOLOGRAMS

Our true holographic technology is a highly evolved form of Benton (H1-H2) holography (called "classical" holography here) and a type of reflective surface-relief micro-structure. It is the recording of an interference pattern between two coherent beams of light, one of which has been reflected or transmitted from an object. Advanced and high quality "classical" holography (with appropriate registration and precision) is based on proprietary techniques and leverages specific feature effects that are protected by IP extending into the late 2030s. It is also based on scientific expertise that only a tiny proportion of people possess and available at a very limited number of facilities globally. "Classical" holograms have become more secure over recent years as the commercial focus in this area has dropped, allowing the gap between De La Rue's secure holograms and commercially available equivalents to increase.

"Classical" holograms lend themselves to strong depth effects, parallax, photorealism, and discrete animations. Our DEPTH™ effect demonstrates full parallax movement, which means it creates objects that appear to move at different speeds, dependent upon their perceived depth in the hologram (the holographic equivalent to how trees in the distance appear to move more slowly than those nearby when looking out of a moving train window). Our stereographic effect TrueImage™ creates a single, three-dimensional image with depth and spatial relationships with the capacity for animation – perfect for capturing a three-dimensional person of significance. One De La Rue housenote includes a three-dimensional owl that turns its head and winks.

"Classical" depth effects such as DEPTH™ and TRUEIMAGE™ have never been simulated, with criminals often defaulting to a simple two-dimensional image. All perception of depth and parallax is lost at the point where a simulation is attempted. When detailed and memorable images are captured in three-dimensions they are particularly challenging

ADVANCED FOIL STRIPES IN THE WINDOWS OF THE BANK OF SCOTLAND £100 AND BARBADOS £50 BANKNOTES. SPOTLIGHT™ FEATURES FOR THE FIRST TIME IN THE BARBADOS SERIES.

to counterfeit. To date we are not even aware of any attempt to try to simulate a TRUEIMAGE™ effect.

OTHER REFLECTIVE SURFACE-RELIEF MICRO-STRUCTURES

Nowadays it is rare for a De La Rue "hologram" to be comprised of grating structures originated solely by Benton / "classical" hologram because we increasingly use additional surface-relief micro-structures that fall outside of the range that can be reached classically. These non-holographic surface-relief micro-structures are produced with advanced digital techniques creating novel effects as well as iridescent colours, saturated iridescent colours and non-iridescent invariant colour. They are precisely controlled structures that are well suited to the creation of animated graphics that can be clearly viewed over wide angles, complex image switches and engaging kinetic effects.

De La Rue's reflective surface-relief micro-structures and how they are organised is fundamentally different to those that are used in commercial holograms. Commercial effects tend to be based on low resolution "graphic arts" materials (low resolution contact mask lithography) or low-resolution fixed pixel originations ("dot matrix"). Commercially available methods lend themselves to simpler switching and more standard graphical animation.

Two of our newer effects are SPOTLIGHT™, which has two icons moving intuitively around a pivot point above or below the surface of the foil, and PUREIMAGE™, which offers dynamic movement that is striking at every angle. Scottish and Northern Irish banknotes were early adopters of PUREIMAGE™ effects for polymer holographic stripes whilst the top three denominations of the new Barbados series, became the first banknotes to feature SPOTLIGHT™. SPOTLIGHT™ also interacts with smartphones, with the effect becoming sharper under the torch of a smartphone then more diffuse under normal lighting. This means, in the event of a suspect counterfeit, the note can be validated virtually via two photos, without even having to tilt the feature..

DESIGN-DRIVEN INNOVATION AT THE INTERSECTION OF ART AND SCIENCE

Configuring a foil stripe to contain different surface-relief micro-structures raises the counterfeiting barrier and cost of simulation. Our foils are frequently protected with surface-relief micro-structures that require

IGNITE® SECURITY THREAD.

THE JAMAICAN SERIES OF BANKNOTES, ENTERING CIRCULATION IN 2023.

different types of proprietary technology. When "classical" holograms are combined with other surface-relief micro-structures the foil stripe requires at least two different sets of equipment, materials, expertise, and knowledge.

Foils with a range of surface-relief micro-structures are increasing in popularity as a security feature for polymer banknotes - in the past four years the number of polymer banknote denominations containing a foil stripe have more than doubled. The popularity of foils derives from counterfeit resiliency as well as the memorable and attractive designs possible. In June 2023 the new Jamaica series of banknotes will become the latest series to be issued on SAFEGUARD® polymer substrate. Their foil stripes will be the first in the world to incorporate a photorealistic double portrait. Integration also pays a role in the engagement and security of foil stripes with polymer banknotes..

IT'S ALL ABOUT THE WINDOWS

For SAFEGUARD® polymer it is all about the windows, with the integration of security features into the window being the polymer equivalent to a paper security feature being embedded into the paper.

When a foil-based security feature is applied to a SAFEGUARD® polymer window its effects become visible on both sides of the banknote, meaning that a single foil or other feature can help protect the entire banknote. Reflective surface-relief micro-structures in polymer windows adopt intricate shapes and are carefully registered to the detail of the window. In contrast counterfeit foils are typically a sticker with noticeable edges or are applied by tape with some discolouration and haze.

Polymer substrate contains multiple layers that combine with the banknote print, which means there are multiple layers and points of interaction to push the boundaries of design thinking and security feature integration.

SAFEGUARD® polymer banknote design is moving towards banknotes with multiple windows and security features distributed across and connected with those windows. A large range of surface-relief micro-structures will increasingly contribute effects to an overall design, being incorporated into more fluid, customisable and complex shapes that offer stronger visual cues to support authentication.

The design and integration potential of polymer is significant. We're only just starting to unlock what's possible with SAFEGUARD® polymer windows and surface-relief micro-structures. Central banks and banknote issuing authorities should expect to see security features and windows combining to create imagery and effects far beyond what a standard polymer banknote looks like today.

DE LA RUE

Mr. Mark Spencer
Email: mark.spencer@delarue.com
Website: www.delarue.com

TECHNICAL FACT SHEET

- IGNITE® is now available with sharper and more precise transmissive surface-relief microstructures, which enables new geometric, rotational and contoured effects.
- SPOTLIGHT™ provides intuitive and obvious movement above or below the plane of the foil. It also interacts with a smart phone to become sharper under its torch light.
- Combining effects such as DEPTH™, TRUEIMAGE™, PUREIMAGE™ or SPOTLIGHT™ requires entirely different advanced surface-relief micro-structures, making banknotes more secure.
- The next wave of innovation will be based on the design-led integration of advanced surface-relief micro-structures into SAFEGUARD® polymer windows.


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LEONHARD KURZ
STIFTUNG & CO. KG

MAKING SECURITY HAPPEN

KURZ Technology in Application - Know-How that speaks for itself

MAKING SECURITY HAPPEN

LEONHARD KURZ STIFTUNG & CO. KG

There is a constant demand for security features to go above and beyond in their visual appearance – but before all else, it is experience and know-how that get the job done.

Security features can be selected based on many different criteria. Two aspects are often overlooked, yet crucial for the ultimate performance of a feature and the banknote it is applied to:

Will this feature effortlessly fit into the production process?
Will the feature do its job throughout the entire banknote life cycle?

It is one thing to design a beautiful product with eye-catching, secure, and easy-to-use visual effects – however, making sure that it will work on the banknote is another story altogether. There is no shortage of bigger and smaller troubles that banknote printers and currency issuers can experience with security features that do not live up to expectations. Not all suppliers can confidently promise efficient operation in the printing plant, full compatibility with any and all production conditions, or optimal performance of their features under a broad range of circulation and note handling conditions. This article will shed light on how to avoid problems, and will elaborate on how skills and expertise of the supplier are the prerequisites for a truly successful security feature.

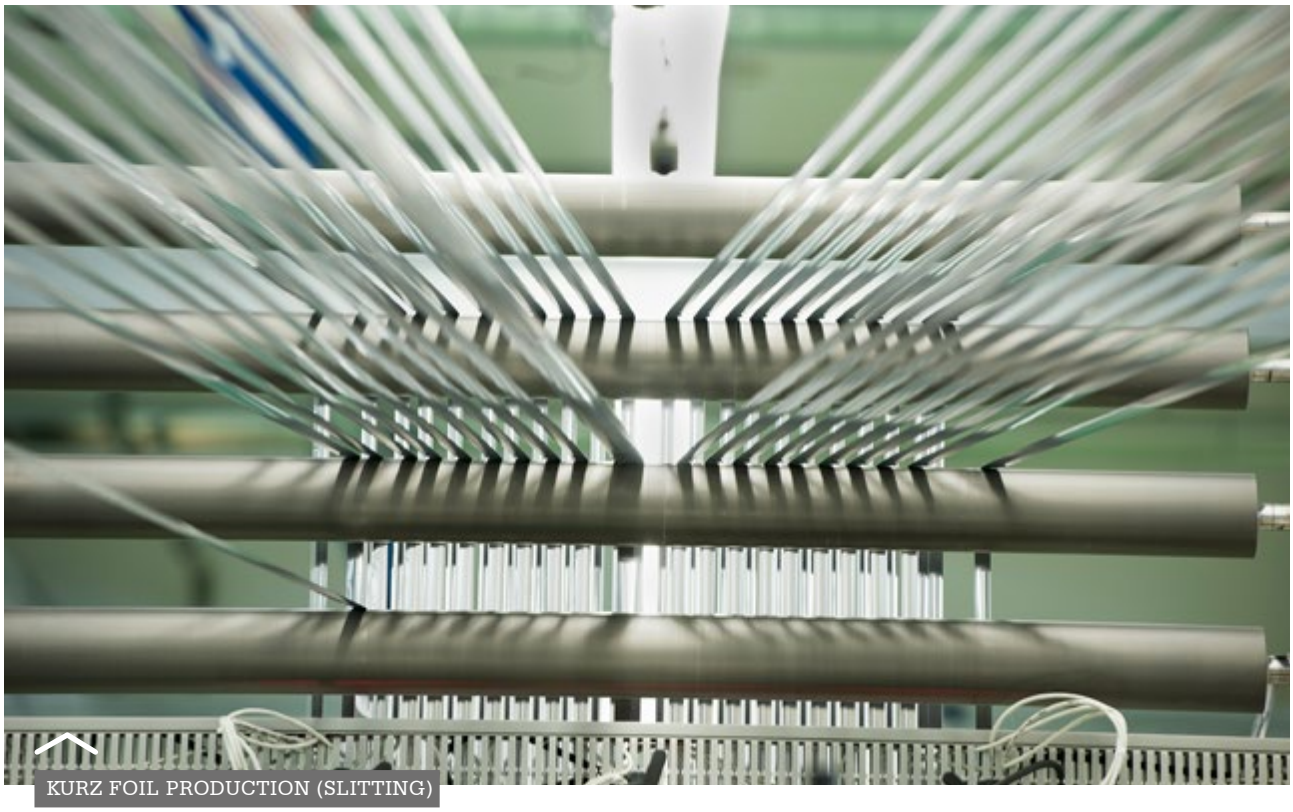
SECURITY FOILS FOR BANKNOTES

Contrary to certain insinuations, foil is not an obstacle. It is rather THE most elaborate, versatile, and flexible security feature that a central bank can choose for their banknotes – particularly if combined with an advanced optical technology such as the KINEGRAM®, which allows the creation of truly unique features that are appreciated around the world for their security and visual appearance. What's true is that the application of protective foil features onto banknotes is a sophisticated process and as such, requires extensive experience and know-how from the supplier.

From the perspective of a central bank, a printer or substrate supplier, this translates to reliability and competence – and these characteristics can best be assessed by examining a supplier's track record, i.e., the number, quality, and characteristics of its references in live banknote projects, as well as the production capacity and supply chain resilience. From the very first use of a surface-applied foil on a banknote in 1988 until this day, KURZ is the industry´s most experienced provider of such features and pioneered all important advancements in this area, such as the development of window features for paper notes or the first foil application onto polymer substrates. KURZ is the preferred foil supplier for many important banknote series such as the Euro, the Swiss Franc, and the English Pound, and has a track record of successfully producing high quantities of foil in reliable quality and within tight schedules.

IMPACT ON BANKNOTE PRODUCTION PROCESS

Most of the work to ensure a smooth and speedy application process happens behind the scenes, and long before the actual banknote production. KURZ constantly develops



KURZ FOIL PRODUCTION (SLITTING)

MEMBERS OF KURZ R&D TEAM

KURZ FOIL PRODUCTION

and adapts chemical foil formulations and adhesives and chooses specific formulations for each and every customer and banknote project. Extensive in-house testing on industry-standard application machines validates the perfect workability of the foil during the production process. In fact, KURZ tests have become an industry standard for many Central Banks. The effortless and stable application of the foil ensures timely banknote production. The preliminary research and testing helps to minimize disruptions and decrease customer churn. If issues do occur, KURZ helps to solve these quickly and easily thanks to the wealth of know-how gained from live projects, but also from being ourselves a supplier of hot-stamping application machines to the banknote industry. As such, KURZ provides full technical support to central banks, banknote printers, and substrate manufacturers. A team of highly experienced application technicians are at the customer´s service, especially if that customer implements foil application for the first time or works with changed application equipment or substrate.

OPTICAL SECURITY EFFECTS AT THEIR BEST

The optical structures within a foil feature are quite delicate. Their visibility and brilliance are dependent on successful and smooth banknote printing and foil application processes. Cutting corners at these stages can result in a less-than-perfect security feature – the same is obviously true also for other features. Every security element must be properly printed or applied in order to fulfil its purpose. KURZ strives to ensure maximum security and functionality of a foil's visual effects by close collaboration with the customer and banknote printer already in the design phase of a project, i.e., by suggesting appropriate optical effects within the foil and working towards optimal design and process integration of the foil. This is complemented by proposing an optimal foil formulation and application parameters.

A recent example is the 10 Egyptian Pound note, where KURZ's material scientists developed a perfectly transparent foil which can be applied in patch format at high speed and low temperatures onto the heat-sensitive polymer material. It fulfils all the resistances typically required for circulating banknotes.

DIFFERENT KURZ REFERENCES IN CIRCULATION

CIRCULATION PERFORMANCE

KURZ foils are engineered to ensure that they will last at least as long as the circulation life of the banknotes. Where the factors limiting circulation periods are typically dirt and soiling, mechanical damage such as tears, or the wear and fading of printing inks or machine-readable features, surface-applied foil from KURZ is engineered for maximum resistance against all impacts in circulation. Robustness in circulation in turn leads to a reduced need for re-prints and consequently is a substantial contribution to the sustainability of banknotes.

KURZ foils are renowned for their ease of application on all industry-standard application machines. This is achieved by investing significant efforts in R&D to determine the optimal formulation for each and every project, or in other words, making sure that foil and banknote will be a perfect match. Particular attention is also paid to minimizing tolerances and deviations in foil production, which in turn ensures the highest precision and speed during application, positively impacting the banknote production. KURZ developed a saving system for exact positioning of the foil which enables maximum efficiency in the use of space and machine layout, while at the same time minimizing waste, again contributing to sustainable production.

TAPE TEST FOR THE FOIL

CONCLUSION

Smooth, successful foil application is ensured by a supplier´s experience and know-how. Central banks can assess the expertise, competence, and reliability of a supplier by examining the number, quality, and characteristics of its references in live banknote projects, as well as the production capacity and supply chain resilience. As global leader in the design, manufacturing, delivery, and successful application of foil-based features for banknotes, KURZ is an expert in making security features

work while minimizing customers´ efforts. Patches, stripes, and threads from KURZ bear ample testimony to our strong competence in R&D, deep knowledge of every type of application process and machine, and – as a fully independent company – our excellent relations with all relevant machine suppliers and other industry partners. The unique portfolio of security solutions for banknotes allows a myriad of combinations of application formats, optical technologies and security effects. Customers benefit from over 35 years´ worth of experience gathered in scores of projects around the globe, or in other words, the reliable competence to ensure strong and well-performing banknotes.

LEONHARD KURZ STIFTUNG & CO. KG

KURZ Banknote Security
Email: banknote.security@kurz.de
Website: www.kurz-banknotes.com

CLICK OR SCAN

TECHNICAL FACT SHEET

KURZ TECHNOLOGY IN APPLICATION

Effortless fit into the production process - Excellent performance throughout the banknote life cycle

- World leading state-of-the-art security elements
- Foil for any application format, machine, and substrate
- Full extent of application support
- Highly robust, resilient supply chain
- Maximized application speed - Minimized waste and down time in production
- Consistent circulation quality and reliability
- Optimized total cost of banknote production

META MATERIALS INC. (META®)

KOLOUROPTIK® STRIPE– NEXT-GENERATION PLASMONIC BANKNOTE SECURITY FEATURE

DELIVERING AN UNRIVALED COMBINATION OF MULTICOLOUR, 3D STEREOSCOPIC DEPTH, AND MOTION EFFECTS

KolourOptik® Stripe– Next-generation Plasmonic Banknote Security Feature Delivering an Unrivaled Combination of Multicolour, 3D Stereoscopic Depth, and Motion Effects

META MATERIALS INC.
(META®)

Renowned for its time-tested, innovative security solutions for currency validation and government document authentication, Meta Materials Inc.(META®) now offers KolourOptik® Stripe (KOS)–a next-generation plasmonic banknote security feature based on its award-winning nano-optic display technology. Exclusive to governments and central banks, the KOS delivers a unique combination of omnidirectional ("always-on") multicolour, 3D stereoscopic depth, and motion effects in an ultrathin form factor. While easy to authenticate, these complementary visual cues are extremely difficult to replicate, creating a significant barrier to counterfeiting. Limitless in design options, the KOS is readily integrated into banknotes with industry-standard processes and tools, providing an unprecedented, indelible, and engaging validation experience.

KolourOptik®, a pioneering plasmonic nano-optic display technology developed at Meta Materials Inc.(META®), incorporates three visual effects crucial to banknote security—colour, depth, and movement—into a single feature in a synergetic fashion. Recognized by the International Association of Currency Affairs for its exceptional capabilities, this technology now enables META® to manufacture a next-generation optical variable device (OVD), termed KolourOptik® Stripe (KOS), that delivers a compelling banknote authentication solution.

Featuring dazzling, parallactic, and multifaceted optical security indicators in a form factor less than 10 microns (μm) in thickness, the KOS offers appreciable advantages over conventional technologies in many aspects, including visibility, user engagement, counterfeit resilience, graphic design freedom, and durability.

LEGACY SOLUTIONS

Most conventional OVDs feature either holograms or microlenses, with the latter dominating the banknote security industry in the past decade.

First introduced as an authentication feature in the 1980s, holograms create desired visual effects based on the principle of optical diffraction. Advanced fabrication techniques, such as direct-write lasers and electron-beam lithography (EBL), now enable the manufacture of holograms that produce true-colour images with kinematic motion effects.

Despite their optical efficacy and durability, holograms are innately restricted by their dependence on diffraction that is extremely sensitive to incident light angle and quality—their effects become visible only at certain angles and in bright conditions. This limitation translates to an often underwhelming, and frustrating, user experience.

Taking advantage of optical Moiré and lenticular effects, such as three-dimensional (3D) stereoscopic depth (stereo-depth) and animation, microlens-based features represent another type of OVD that has enjoyed widespread popularity in recent years. A typical microlens-based OVD comprises a microembossed image layer filled with a contrasting medium (e.g., an ink or dye) and a microlens functioning as an image magnifier, separated by a spacer matching the focal length of the microlens.

This multilayer stack generally ranges from 20 to 130 μm in thickness, significantly exceeding the ideal limit (approximately 10 μm) for surface security features applied to banknotes. The considerable thickness difference between the sides with and without a microlens-based feature becomes a prominent issue that complicates the handling and transportation of stacks of banknotes. Thick microlens devices are also susceptible to delamination, compromising their longevity and creating a harvesting opportunity for counterfeiters.

Besides its thickness, the structure of the multilayer stack also gives rise to several drawbacks.

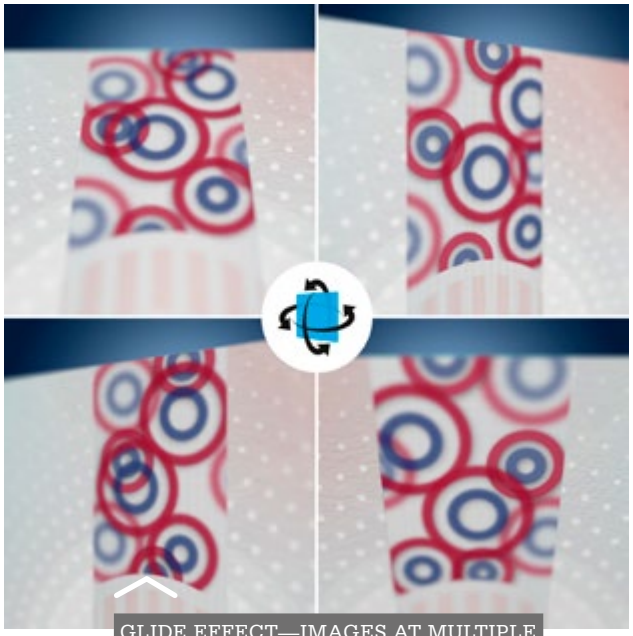
Producing a microlens-based device requires a time-consuming procedure that involves multiple casting or embossing steps as well as printing, vacuum-coating, lamination, and other assembly processes. It also requires different types of materials, which contribute to a large environmental footprint compared to surface-relief holograms. Vulnerable to separation from the other components, the microlens may be relatively easily harvested and gathered for counterfeiting purposes.

Finally, ink flood coating in conjunction with doctor blading currently constitutes the primary option for creating microimages in the embossed layer. Because this technique does not permit the application of more than one colour of ink, microlens-based OVDs are only capable of exhibiting monochromatic imagery.

KOLOUROPTIK® TECHNOLOGY

Inspired by the iridescent structural colours found in the wings of the blue morpho butterfly, KolourOptik® creates a unique combination of multicolour, 3D stereo-depth, and motion effects by harnessing light at both quantum and classical levels. Such unprecedented optical manipulation is attained through the agency of a single-layer architecture composed of a precisely engineered array of subwavelength plasmonic nanostructures seamlessly superimposed on the surface of

multifaceted microstructures. This biomimetic technology provides a powerful platform for fabricating easily authenticable—and yet extremely difficult to replicate—banknote security features that deliver an interactive and captivating validation experience.



GLIDE EFFECT—IMAGES AT MULTIPLE LAYERS OF DEPTH THAT MOVE IN OPPOSITE DIRECTIONS

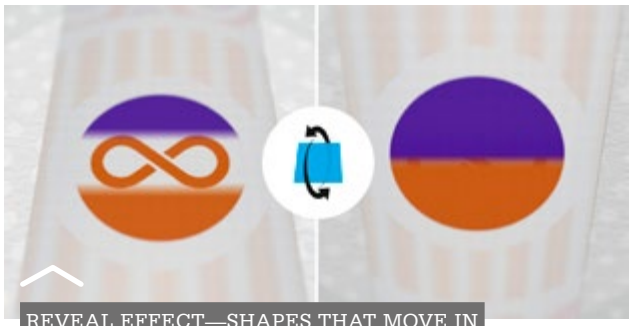
A simple way to understand KolourOptik® is to imagine the microstructures collectively as a 3D canvas upon which nanostructures are used to construct a plasmonic "paint" that colours in the desired image.

Surface plasmonic resonance is a natural phenomenon in which subwavelength nanostructures alter the colour of a metal surface by selectively absorbing, reflecting, and transmitting light. This electron-dependent mechanism underpins the structural colouration effect of the nanostructure, metal, and dielectric combination. Micro- and nanostructures can be merged to produce a parallactic effect that is responsible for 3D stereo-depth and motion.

As a highly customizable technology, KolourOptik® can be employed to fabricate OVDs of various dimensions and form factors. Of them, the KOS is the latest product launched by META®. This stripe-shaped security feature is readily integrated into paper-based banknote substrates using industry-standard tools and processes.

ADVANTAGES OF THE KOS

The KOS outperforms its conventional counterparts (e.g., holographic and lenticular features) in many areas. Unlike holograms, the KOS produces optical effects that are perceptible in every direction and independent of the light quality.



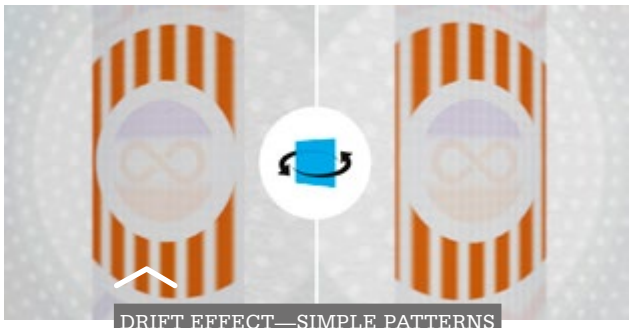
REVEAL EFFECT—SHAPES THAT MOVE IN OPPOSITE DIRECTIONS TO REVEAL AND CONCEAL AN IMAGE

These effects are even visible from a long (a metre or more) distance away. This exceptional visibility is instrumental in a fast and easy authentication process. While tilting is generally not required for the KOS to manifest its 3D visual cues, tilt-specific effects (e.g. image switching and movement) can be introduced to further enhance motion authentication.

Featuring colours in tune with those found in most banknotes currently in circulation, the KOS offers best-in-class image quality at a resolution as high as 25,400 pixels per inch.

The colour effect of the KOS can be tuned based on the nanostructures, specifically their metallic nature, shape, location, and thickness.

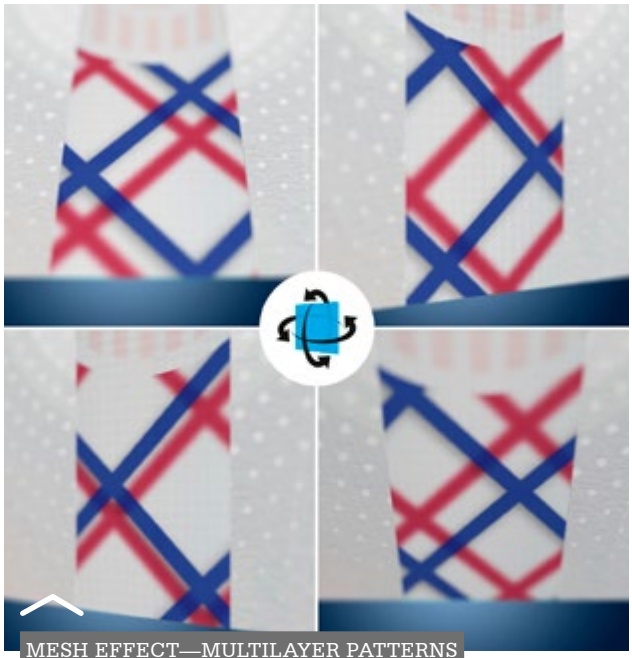
Only one metal is requisite for producing plasmonic effects. Aluminum is the metal of choice for fabricating the nanostructures in the KOS. Such a preference is ascribable to several factors.



DRIFT EFFECT—SIMPLE PATTERNS THAT MOVE IN A SINGLE DIRECTION

The high electron density endows aluminum with a marked colour-generating plasmonic response. As the third most abundant element in the Earth's crust, aluminum is also inexpensive, highly recyclable, nontoxic, and nonpolluting—unlike the inks used in microlens-based features—and has been employed in surface-relief holograms for decades. Besides the nanostructures, aluminum is also used to manufacture the microstructural component of the KOS. This monometallic composition substantially reduces the number of production variables, while improving durability, consistency, and application compatibility.

The remaining three parameters of the nanostructures—shape, location, and thickness—are readily modifiable for customizing the colour palette. A careful arrangement of nanostructures with varied parameters allows the KOS to display multicolour imagery.



MESH EFFECT—MULTILAYER PATTERNS THAT MOVE IN ALL DIRECTIONS

Moreover, the ultrathin single-layer construction of the KOS drastically reduces the risk of delamination, which in turn leads to robust durability. The absence of separable layers also poses a considerable challenge for counterfeiters to decompose and reverse-engineer the KOS, setting a new bar in security.

KOS MANUFACTURING WORKFLOW

The easy and intuitive authentication experience afforded by the KOS belies its multistage manufacturing process so sophisticated that any attempt of mimicry would likely prove futile.

KOS fabrication begins with the creation of a two-dimensional vector image with any number of colours (e.g., orange and blue) selected from a tried-and-true plasmonic palette in accordance with the customer's request. Graphic elements are designed with the consideration of their depth and spatial relation to one another at every possible viewing angle. Optimization of these positional parameters allows the user authenticating the feature to control the animation effects.

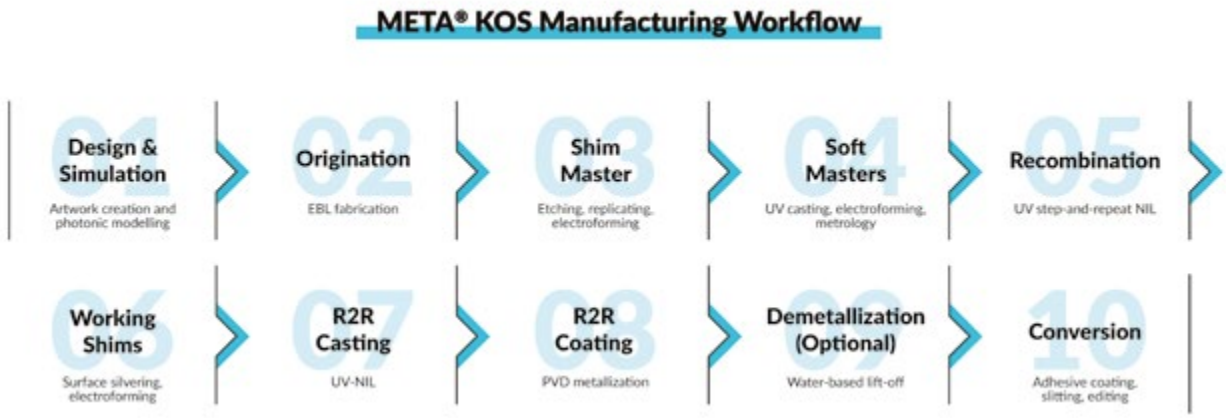
The animation and depth are evaluated through a two-step simulation process to ensure that the prescribed parallactic effects will display accurately in real-world conditions. Specifically, an animated simulation is first performed in the absence of ambient lighting conditions to inspect compositional and motional accuracy. The image is then rasterized into a bitmap format and modeled using a ray-tracing program developed in-house under spot and diffuse illumination that mimic ideal and less favourable lighting conditions, respectively. The effects at each viewing angle are rendered to determine the parameters of the nanostructures that ultimately provide multicolour pixels. Based on the feedback, the position and depth of the graphic elements are adjusted to optimize motion, edge clarity, and aliasing.

Upon approval of the artwork design, the bitmap files are converted to a lithography layout file that defines the shapes and locations of the nanostructures mapped onto the surface of microstructures. Next, both types of structures are originated using a 100-keV EBL system on a silicon wafer, followed by the production of a hard nickel duplication master through electroforming. Proprietary processes are in place to achieve suitable shim material characteristics while retaining the fidelity of the nanostructures.

Soft masters are fabricated from the initial nickel shim using an ultraviolet (UV) casting system and used in the subsequent step-and-repeat nanoimprint lithography (NIL), or recombination, process to scale up the size of the master. Further processes, such as surface silvering and electroforming, ensue, creating working nickel shims. After cleaning and drying, these masters are installed on a high-throughput, roll-to-roll (R2R) UV casting system to transfer the micro- and nanostructural details to a roll of polyethylene terephthalate (PET) coated with UV-curable resin that is up to one metre wide and thousands of metres long.

The PET substrate is then metallized with an ultrathin layer of aluminum on the cast side through physical vapor deposition (PVD) in a vacuum chamber. After application of an adhesive coating to the metal side, the obtained foil is processed into a stripe format, yielding the KOS product that is ready for integration into a paper-based banknote substrate.

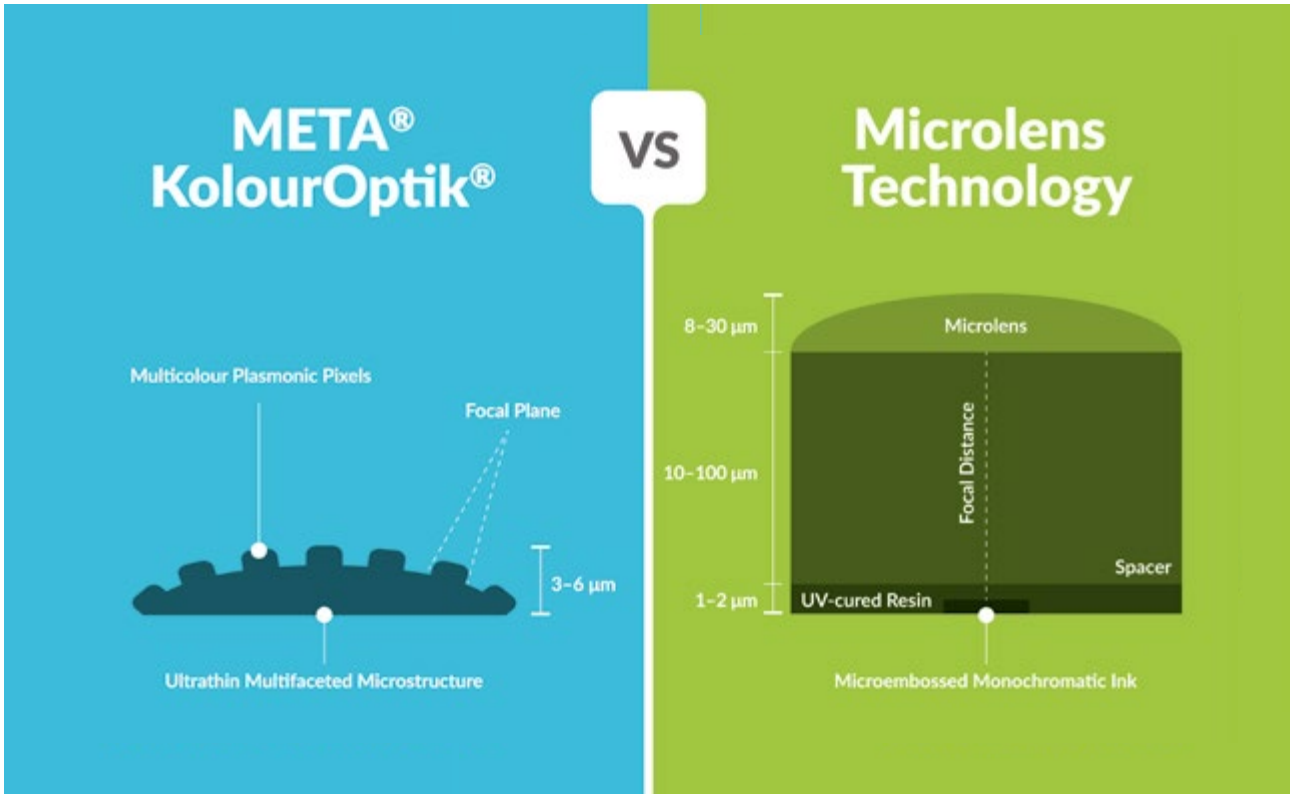
Compared to hard and soft embossing, the UV casting approach adopted in KOS



production enables high-fidelity replication of nanoscale features that are crucial to the desired plasmonic effects while ensuring high throughput. The workflow can also be customized to introduce additional features. For example, windows can be created in the KOS through an additional demetallization step to reveal banknote information (e.g., serial numbers) that would otherwise be covered. META® has developed a water-based lift-off process specifically for this purpose. While delivering an environmentally sustainable solution without the introduction of undesired materials and harsh chemicals, this process produces higher accuracy with more defined edges than many alternative demetallization methods. Instead of a rectangular shape, the foil can be tailored through demetallization to accommodate layout designs that require more space to conspicuously display important information.

DURABILITY OF THE KOS

The KOS is an exceptionally durable security feature, as evidenced by rigorous solvent, physical, and harvesting testing of samples adhered to a banknote paper substrate. The KOS performs exceedingly well in terms of substrate adhesion and optical functionality—two metrics that measure the durability of OVDs in banknotes—when exposed to a variety of solvents (e.g., sodium hypochlorite, gasoline, and hot water) and external forces (e.g., crumpling and ironing). In addition, the KOS is impervious to harvesting by common counterfeiting tools (e.g., microtools and tweezers) following subjection to treatment in household cleaning solvents (e.g., bleach and laundry detergent). Such resistance precludes the KOS from unlawful repurposing or transferring.



CONCLUSION

The KOS offers a unique banknote security solution equipped with a combination of multicolour, 3D stereo-depth, and motion effects that provides an easy and interactive authentication experience. Its single-layer metallic structure ensures durability while inhibiting counterfeiting. Central banks and industry partners are welcome to contact the META® Sales Team to request samples or for further information.

META MATERIALS INC. (META®)

Mr. Brian Donnelly and Mr. Igi LeRoux
Email: sales@metamaterial.com
Website: www.metamaterial.com

TECHNICAL FACT SHEET

- Maximum resolution: 25,400 ppi
- Applied foil thickness: < 10 μm
- Feature thickness: 3–6 μm
- Durability: Fully compliant with established chemical, physical, and harvesting resistance standards
- Standard dimension: Up to 30 mm × 70 mm
- Perceived depth range: Up to 1 cm
- Colour palette: Pastel colour palette that covers the full visible spectrum
- Colour type: Plasmonic colours produced by pure meta-structures that require no dyes, inks, microlenses, or diffraction

SUPPLIER INSIGHTS

CRANE CURRENCY

THE INTELLIGENT EVOLUTION HOUSE NOTE WITH RAPID® VISION DETECT

In March, Crane Currency introduced a new class of micro-optic security thread during ‚Public First' a central bank knowledge sharing event held in its Malta printing works. The new feature leverages breakthrough innovations in micro-optics to achieve fully sychronized multicolor movement. This results in new effects that are attractive and easy to verify in spite of the thread's increased technical complexity.

RAPID® Vision Detect ('RAPID® Vision') is offered with secure machine readability via Crane's Detect IR additive and uses the knowledge, equipment and materials mastered by Crane to produce micro-optics since 2005. A new method to write ultra-microprinting as synchronized multicolor designs allows for a placement of colors that are exact. RAPID® Vision security threads harness the precision of a sealed lens layer to decode these multicolor designs to project ehanced and attractive movement effects that are even easier to verify.

RAPID® Vision has the same fundamental construction as RAPID® HD, launched in 2020, i.e., it is thinner, has high definition imagery and a broad color palette. RAPID® Vision therefore has the same performance in the paper machine, and equivalent high durability and resistance to soiling in banknotes. RAPID® Vision can be overvarnished.

When designing a banknote, whether it is for a house note or central bank, it is important to utilize a theme. In the case of the Intelligent Evolution house note its theme of adaptation centers on a giant Pacific octopus. Crane Banknote Designer and Intaglio Engraver Nazan Tanyu created the portrait and used the octopus' famous defense mechanism, a jet of ink, to anchor the note's reverse. That creative process illustrates how modern, customizable security features increase security by making intuitive connections to a banknote's theme. In this case, the note's designers created a multicolor RAPID® Vision security thread evocative of the octopus' ability to change color and texture.

The micro-optic design software used to achieve that effect will be familiar to many central banks and banknote designers (scan the QR-Code above and see BTR-8 for a description). Upgraded for the addition of multicolor effects, the micro-optic design software is used directly in the creation of customer digital animations, physical protoypes and the manufacturing tooling used in scale prodution. The software produces accurate digital animations quickly encouraging customer input and an iterative process of optimization in keeping with the predictable and transparent steps used for the customization of all Crane micro-optic features.

Crane Banknote Designer Malin Lindgren is credited with selecting the theme and portrait for the Intelligent Evolution house note. This provided Crane's design team with the perfect foundation on which to build a banknote of security, function and beauty. Malin elaborated on the ability of theme to communicate a story for BTR readers.

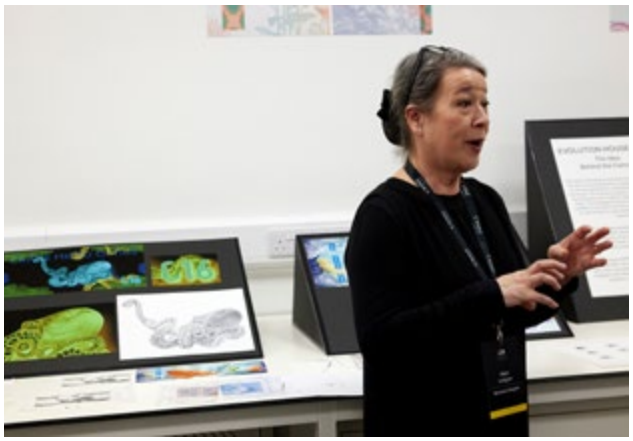
The story of the Intelligent Evolution house note is about the greatest designer on Earth - Mother Nature. One of her most amazing creatures is the Octopus, and we have made a connection between it and one of our more amazing security features, RAPID® Vision.

The evolutionary design process in nature, in which the best functions of all living things are passed on to future generations, creates better and stronger species. With this need for functionality, all the beauty of the natural world is created.

For the banknote design team responsible for the Intelligent Evolution house hote, it is a great lesson, as functionality and beauty are both key to designing a successful banknote.

When we think about 'great design', we don´t usually think about the millions of years of evolution. But in fact, many of the best functional inventions made by humans are directly inspired from nature: We build cars and airplanes using the strength of the spider's silk, we make textiles to keep us dry by mimicking the surface of leaves and feathers, AND… we created a super cool new security thread RAPID® Vision, with the ability to project color moving patterns - just like the Octopus.

SUPPLIER INSIGHTS



In nature, colors and patterns always come with an engaging message. It can say: "Eat me, I´m tasty" or "Don't eat me, I'm poisonous", "Stay away, I'm dangerous" or "Come closer, so I can eat you."

The multicolor movement of RAPID® Vision speaks the same language to the public: "See me, here I am! I am your most valuable security feature!"

And to the counterfeiters the message is: "Stay away and don't even try!"

CRANE CURRENCY

Mr. Tod Niedeck
Email: info@cranecurrency.com
Website: www.cranecurrency.com

TECHNICAL FACT SHEET

Facts about RAPID® Vision Detect

- Micro-optic windowed security thread, 4 – 6 mm wide
- High-speed moving color effects that are bold and beautiful
- Real time synchronization of color and movement; never before seen, and proven easier to use
- Fully customizable color, movement and graphic combinations
- Like RAPID® HD, RAPID® Vision is highly durable and virtually impervious to soiling
- RAPID® Vision Detect provides high security machine-readability
- RAPID® Vision can be overvarnished

the Banknote Conference

FORT WORTH, TEXAS MAY 13-15 2024

Banknote Conference is the industry's premier technology-focused event and has a long and rich history of hosting the worlds technology experts from central banks, printing works and industry suppliers and providing unparallelled opportunity to discuss emergying trends, technologies and innovation.

See you there.

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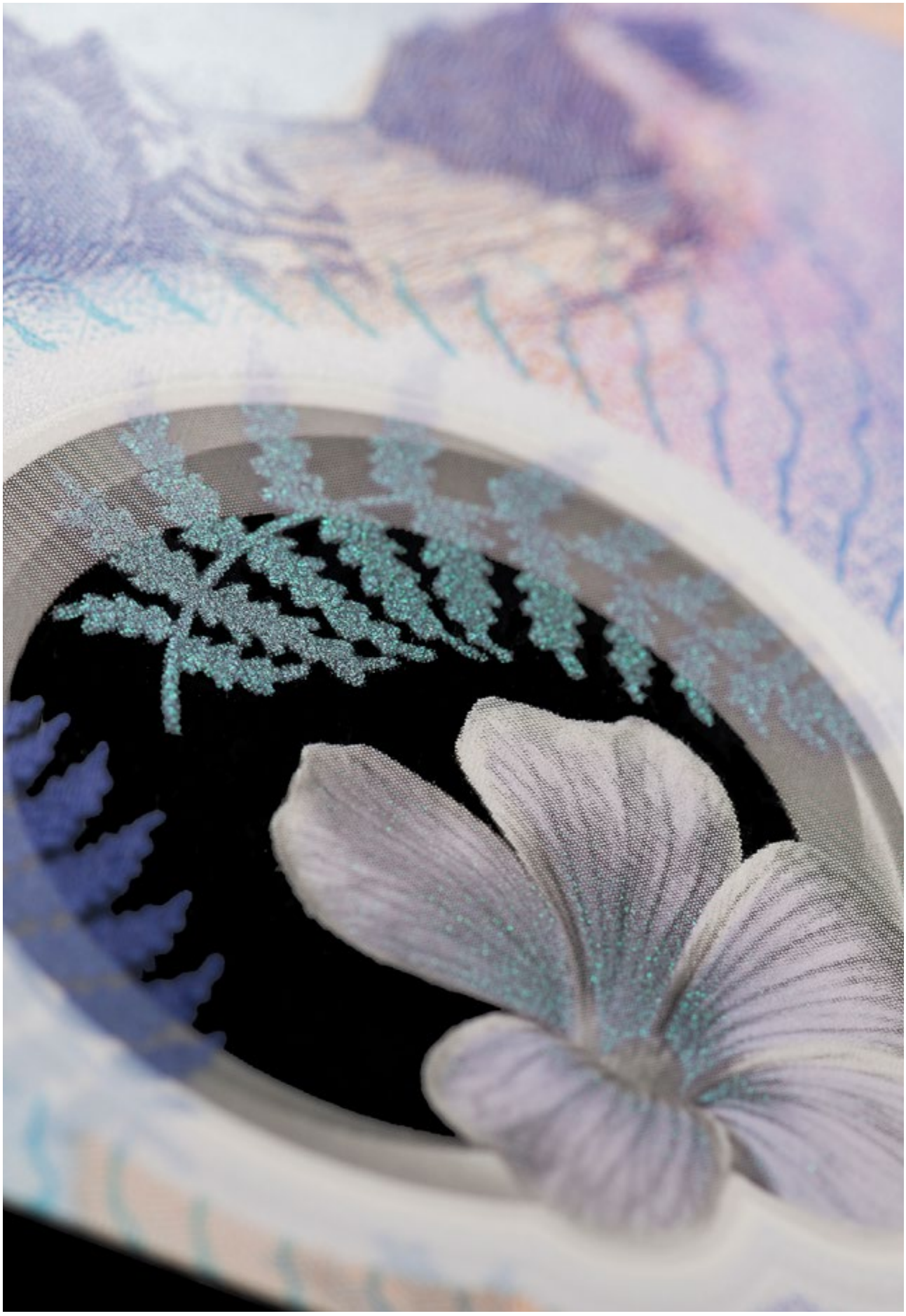


CCL SECURE

A WINDOW INTO BANKNOTE SECURITY

A window into banknote security

CCL SECURE

The iconic feature of polymer banknotes is the clear window, which has gone through a remarkable journey over recent decades. The clear window has developed from a relatively simple feature to the platform for some of the most advanced security technology in the market.

A well designed clear window on polymer houses several security features in that small space. The integration of Guardian™ and third party features increases the complexity and counterfeiting resilience of the banknote.

What started out as solid white vignettes are bold intaglio embosses, quickly evolved into tonal print, metallic and colour shifting inks and spot colours. With the addition of Cameo Portraits, holographic features and SPARK, the portfolio of window features continues to grow.

EVOLUTION OF THE CLEAR WINDOW: AUSTRALIAN BANKNOTES IN THE NEW NOTE SERIES (NNS) AND THE NEXT GENERATION BANKNOTE (NGB) SERIES.

EFFECT INKS ON POLYMER BANKNOTES

Polymer banknotes' smooth surface allows metallic and colour-shifting inks to be applied directly onto the substrate with stunning visual results. Hong Kong's 10 Dollar note is an example of colour – shifting ink taking on organic forms. A purple to pink G-Switch ribbon hugs the window, circles around an intaglio emboss, overlaps with a stylised image of a bauhinia flower and becomes solid pink where it bleeds under the white opacification layers.

Three different metallic effect inks form a complex frame around the window of Canada's 150th anniversary commemorative banknote. Metalix Purple on the front takes the shape of maple leaves, numbers and lines, complimented by a purple spot colour and silver maple leaves applied with foil. On the back, Metalix Green and Copper flow around the window.

A COLOUR SHIFTING RIBBON INTEGRATES THE WINDOW INTO THE BANKNOTE ON THE HKD 10

METALIX PURPLE FRAMING THE WINDOW OF THE CAD 10 ON THE FRONT AND GREEN AND COPPER ON THE BACK

Effect inks on Guardian™ have redefined banknote design, allowing the integration of major structural design elements covering significant parts of the note.

Banco de Mexico's new 50 peso banknote is the latest in a series of Guardian™ polymer banknotes issued in the bank's G-family notes. Recognised as the most beautiful note in the world the 50 peso is designed and produced in vertical format.

The new design of the 50 – peso incorporates a large, complex transparent window that features G-Switch and Metalix inks. The G-Switch security feature changes colour when a note is moved, or seen from a different angle. On the new 50 pesos note, the G-Switch ink changes from blue to gold, while the Metalix ink is copper coloured.

Other features include an integrated magnetic thread with the denomination of the note and pre-Hispanics based design.

PROVIDING FAMILIARITY ON POLYMER

Saudi Arabia's first circulating Guardian™ banknote integrates a Metalix Silver windowed security feature thread into the polymer design to maintain the familiar feel of the preceding paper series.

The introduction of silver-metallic thread into polymer with windowed security thread is a canvas for a plethora of designs. The layered

G-SWITCH CHANGES COLOUR WHEN THE NOTE IS MOVED FROM BLUE TO GOLD IN THE MEXICAN 50-PESO BANKNOTE

COMMON DESIGN TEMPLATE: THE POLYMERISED VERSION (LOWER LEFT) OF THE PAPER SAR 5 (UPPER LEFT) INCLUDES A METALIX SILVER WINDOWED SECURITY THREAD (RIGHT)

structure of polymer substrate enables the development of complex threads, such as threads with windows on the front and back, or even full see-through windows combined with colour shifting and metallic effect inks.

ILLUMINATING WINDOWS TO THE NEXT LEVEL

Casa de Moneda in Chile used Guardian™ polymer banknotes to commemorate a historic milestone.

Marking its 279th anniversary, the Casa de Moneda launched a housenote on a Guardian™ polymer that embeds next-generation security features in the polymer substrate to demonstrate the country's capabilities and celebrate its unique cultural heritage.

VIVID and VIVID White are used in multiple areas of the housenote to boost its security.

Invisible except when viewed under UV, VIVID White appears in several aspects of the note's reverse side – including the striking representations of the native Andean Condor, the largest flying bird in the world, and a logo of Casa de Moneda. On both sides of the note, VIVID is also contained within a blue spot ink that only fluoresces a bright yellow under UV. This effect enhances the main window, which is adorned with the design of local flora; oje de agua flower and the fragile fern.

Along the embedded features, Guardian™ polymer substrate is proven to integrate with third party features for greater design and security possibilities, such as foils.

The eye – catching nature and complexity of holographic foils make them a cornerstone of banknote security, adopted by central banks all over the world.

CCL Secure was the first to apply foils to polymer during the substrate production stage – and this set a benchmark for applying foils to polymer ever since. The Central Bank of Egypt (CBE) issued its first Guardian™ polymer banknote in 2022, featuring an innovative combination of stunning cultural aesthetics and advanced security features. The new Le10 pound note is adorned by the famous Al-Fattah Al-Alim Mosque, and a depiction of Hatshepsut, of Egypt's first female pharaohs. A third party KINEGRAM® patch by KURZ brings added vibrancy and security to the images on both sides of the note.

Contained in a large transparent window, the finely detailed hologram takes the shape of the Fattah Al-Alim mosque. It appears silver on the front of the note and gold on the back. When tilted, the foil patch displays contrasting colours in striking optical display. Egypt's cash centre is only the second printer after New Zealand to apply foil as a single patch, rather than a continuous stripe along the length of a banknote.

Security feature innovations on Guardian™ polymer are designed to support central banknotes with their comprehensive strategies to combat counterfeiting. As research and development continuous to evolve, the design and security possibilities for polymer banknotes will be endless.

CCL SECURE

Mr. Tim Berridge
Email: tberridge@cclsecure.com
Website: www.cclsecure.com

VIVID WHITE APPEARS ON THE NOTE'S REVERSE SIDE – INCLUDING THE STRIKING REPRESENTATIONS OF THE NATIVE ANDEAN CONDOR, THE LARGEST FLYING BIRD IN THE WORLD, AND A LOGO OF CASA DE MONEDA

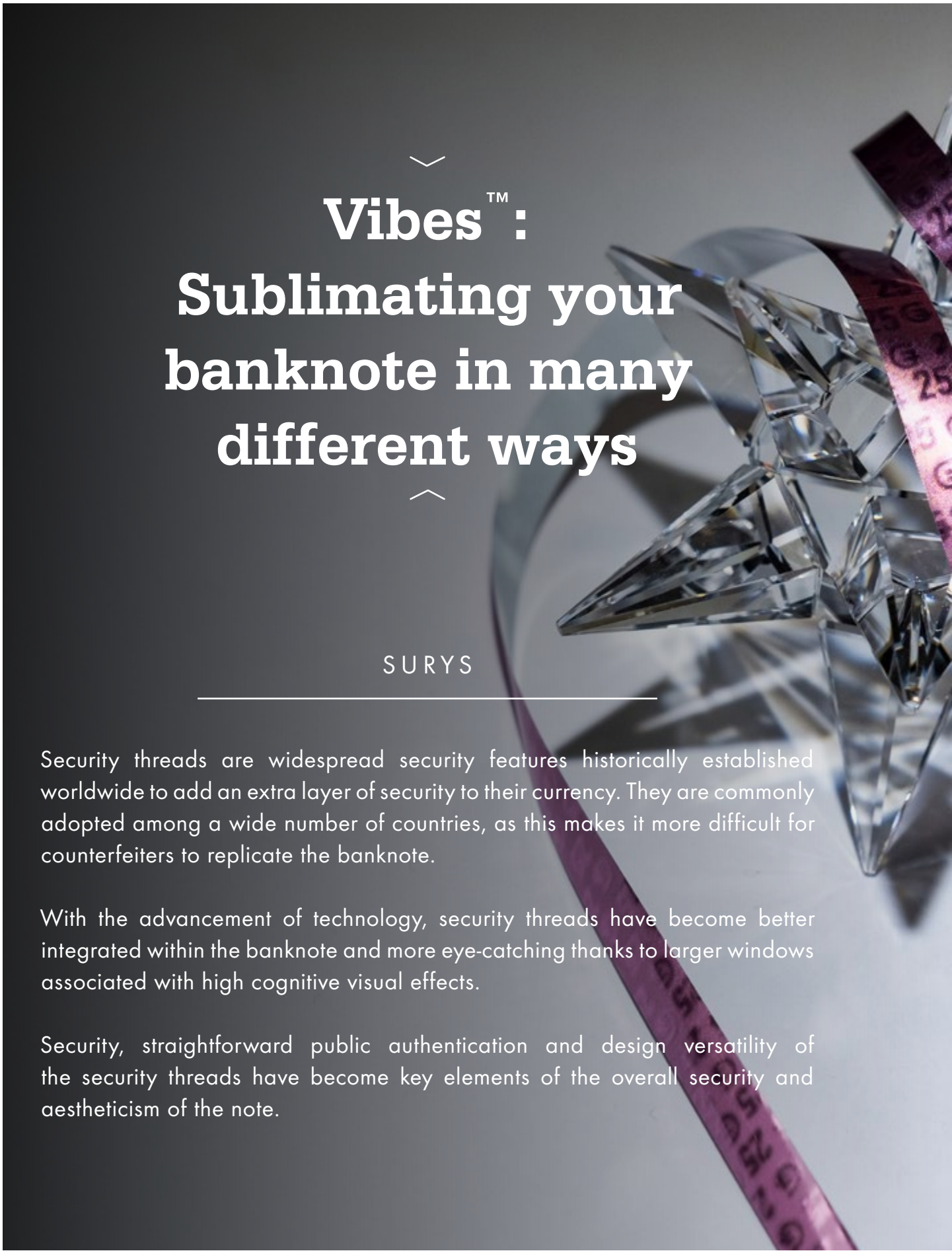
TECHNICAL FACT SHEET

- Guardian™ by CCL Secure is the #1 polymer banknote substrate with banknotes in circulation for more than 40 Countries worldwide
- 'Window' as a security feature for polymer based banknotes offer a huge range of anti-counterfeiting technology.
- 'Window' itself is a security feature, but can be also overprinted - applied with a Patch or foil stripe (e.g. Kinegram, Motion Surface etc.)
- VIVID™ is a range of coloured visible inks that fluoresce in a contrasting colour when illuminated under UV
- VIVID™ Colour in ambient light, the image appears opaque, but under ultraviolet light a high resolution full colour image comes to life
- Security feature innovations on Guardian™ polymer substrate by CCL Secure are designed to support central banks with their comprehensive strategies to combat counterfeiting


25 OK

SURYS

VIBES™: SUBLIMATING YOUR BANKNOTE IN MANY DIFFERENT WAYS



Vibes™: Sublimating your banknote in many different ways

SURYS

Security threads are widespread security features historically established worldwide to add an extra layer of security to their currency. They are commonly adopted among a wide number of countries, as this makes it more difficult for counterfeiters to replicate the banknote.

With the advancement of technology, security threads have become better integrated within the banknote and more eye-catching thanks to larger windows associated with high cognitive visual effects.

Security, straightforward public authentication and design versatility of the security threads have become key elements of the overall security and aestheticism of the note.

Vibes™ brings a new striking security thread that meets Central Banks requirements within a fast-moving and challenging environment, combining: moving effects, brilliancy, colors adapted to the banknote design and all the other attributes required for a security thread.

Based on vibrating designs created deep in the structure of the security thread, images appear to be in motion or "vibrating" when the banknote is in movement. It creates an optical effect that immediately draws public attention.

VIBES™: A SOPHISTICATED TECHNOLOGY BASED ON OPTICAL MICRO CELLS TO CREATE DYNAMIC OPTICAL MOVEMENTS

Vibes™ is a reflective security device based on an innovative micro optics technology. Its optical effect is created by a matrix of micro optics device called Optical Micro Cell (OMC).

Each OMC has unique optical characteristics and will interact with light in a specific way. Indeed, each cell carries a fraction of the optically variable image to be obtained and will contribute to the final effect.

Arranged in a matrix, the Optical Micro Cells work altogether to enable the complete reconstruction of the graphical image and its movements upon various angles of vision.

Vibes™ displays images, movements, animations that are visible in reflexion upon a slight tilt at a normal transaction distance. Moreover, it does not require a complex multi-layered optical structure, since all the optical information are gathered within one layer. This makes Vibes™ as durable and convenient as standard window threads.

DESIGN WITH INTUITIVE SYMBOLS AND ANIMATIONS

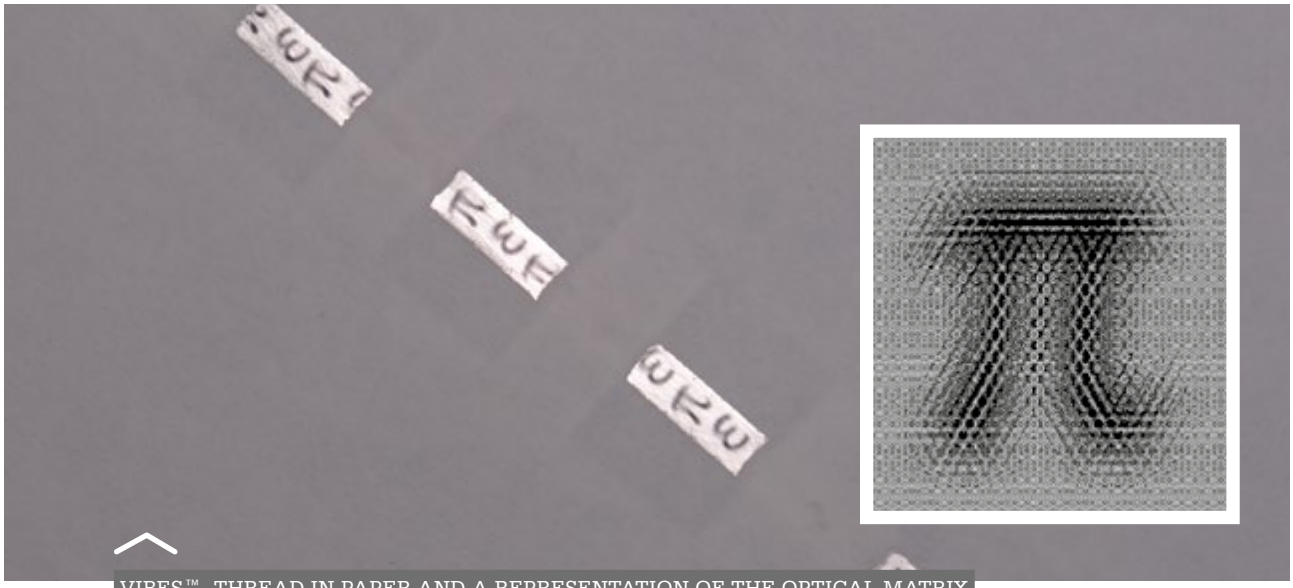
Simple designs for a better recognition

Window threads are key security features for banknotes but bring few challenges for an optimum visual performance. Indeed, most of the window threads measure 4mm width and the typical windows in the banknote are between 6 and 12mm in height.

In fact, the visible surface of a thread is about 120 mm^2. Moreover, threads are not in registration with the banknote windows, so it is required to use repeatable and redundant graphical elements.

Vibes™ takes up these challenges using simple patterns combined with animations with the objective to be easy to recognize and to remember.

A wide variety of design elements can be implemented according to the wishes of the Central Bank: logo, geometric shapes, numbers, letters, abstract designs, emblems and currency symbols may be included. In term of design, Vibes™ exhibits endless possibilities.



VIBES™ THREAD IN PAPER AND A REPRESENTATION OF THE OPTICAL MATRIX

To guarantee a coherent banknote design and to make the thread self-explanatory, Vibes™ design can for instance match watermark design or a pattern present in the banknote print to give to the full banknote harmony and ease public authentication.

A wide range of elegant animations

With Vibes™, we combine a basic graphical element to a simple animation in order to keep a homogeneous look and to ensure relevance in terms of control.

The attractive designs visually associated to simple animation effects simplify the message and therefore create a prompt engagement of the public thanks to a strong visual message backed by easy information to remember.

The strength of Vibes™ also relies on dynamic and attractive optical effects including different types of image movements:

- Multi-directions movements in which graphical elements are moving in all directions,
- Switch: where two distinctive images switch together,
- Morphing: where an image morphs into another,
- Scale up: showing graphical elements sizes change and
- finally Dancing where elements have some lateral movements

These animations are all reveiled when the banknote is controlled by tilting it up and down but also from left to right.

The association of simple designs and these optical effects on Vibes™ opens up unexpected design possibilities to banknote designers, enabling them to convey their inspiration and emotions through the creation of visual and tangible objects.

COLOR AND CONTRAST

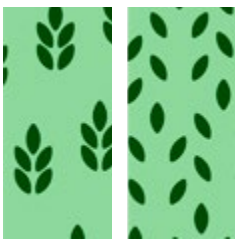
At the same time, Vibes™ exhibits a black moving image associated with a bright metallic background that creates contrasted effects.

Vibes™ is available in different colors that can be adapted and fine tuned to suit the banknote design and to attract public attention.

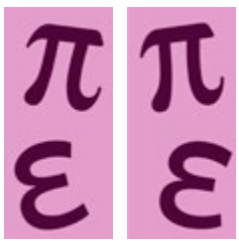
In the example in the next page, we illustrate how it can be integrated into a complete banknote series keeping the same optical design but with various colors.
Colors have been chosen to maximize the contrast between the threads and the banknote backgrounds.

Vibes™ movement

Vibes™ morphing



Vibes™ dancing



Vibes™ switching

Vibes™ scale up

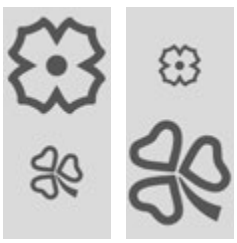


ILLUSTRATION OF A COMPLETE FAMILY WITH VIBES™ THREADS WITH THE SAME DESIGN AND MAXIMIZED CONTRAST BETWEEN PRINTED DESIGN AND THREAD COLORS

VIBES™ COMBINED WITH A VARIETY OF OTHER OPTICAL EFFECTS

Based on a new and unique mastering technology, many other optical features can be advantageously added to the design for instance, bas-relief features can be combined to the design and adapted to the countries coat of arms, emblems or denomination at a glance.

Another alternative would be to combine Vibes™ to achromatic waves to bring additional security, movement and visibility.

VIBES™: A COMPLETE CUSTOMIZATION RESISTANT TO CIRCULATION CONDITIONS

Vibes™ can be customized in many ways.

- A clear text can be added as a Level 1 feature thanks to demetallization
- Several Level 2 features are available: like micro elements integrated in the optical design and UV fluorescence features
- Level 3 features like nano elements for forensic analysis with a microscope and machine readable features like magnetism can be implemented.

Vibes™ is highly resistant to wear and tear and can withstand difficult circulation conditions. Vibes™ will last as long as the banknotes themselves with a unique resistance.

We offer tailor-made solutions with the widest range of technologies for high-security features for banknotes, ID documents and tax stamps with a wide range of overt to covert and forensic properties. High security threads, foils and laminates with premium physical and chemical resistance are entirely developed from design to production under one roof.

We have always strongly invested in Research & Development, leading to development of new innovative optical effects bringing to the market a new portfolio of products.

Our experience and know how combined to the highest security certifications by international organizations, turns us into an essential partner in the banknote industry.

ABOUT SURYS

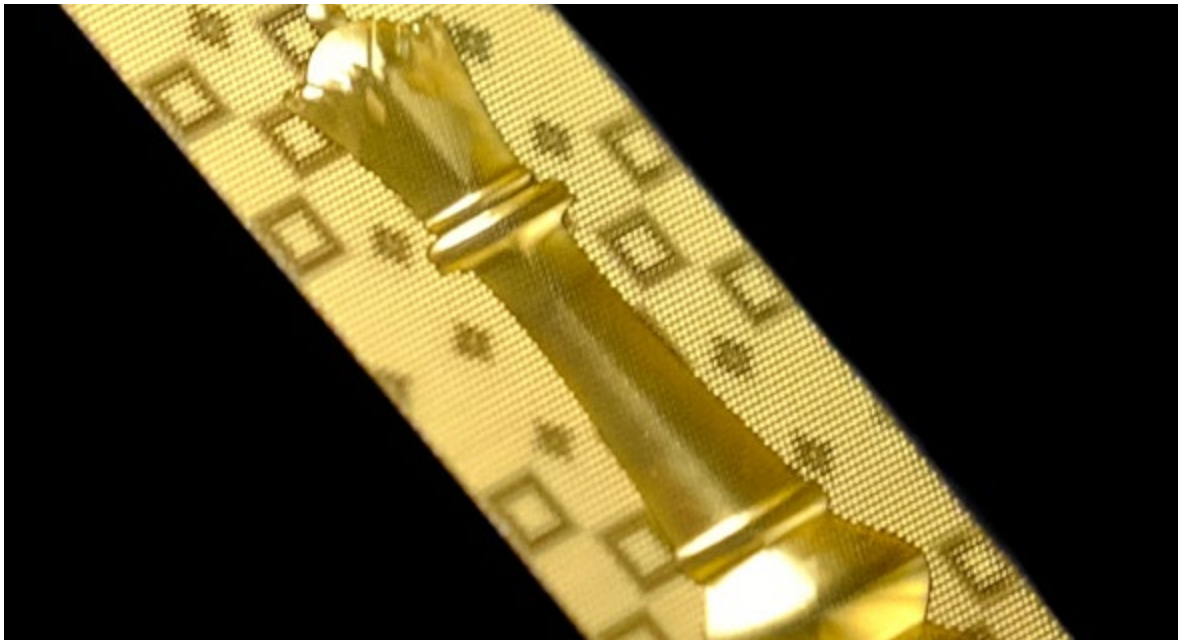
Since 2019, SURYS has joined IN Groupe, the National Printing House of France, wholly owned by the French government dedicated to sovereign security technologies, products and services. SURYS, a secure components brand of IN Groupe, is a French optical technology leader providing anti-counterfeiting solutions. SURYS offers solutions to ensure that identity documents, banknotes and fiduciary documents are easy to authenticate and hard to counterfeit. SURYS, from its premises based in Bussy Saint-Georges, in the Paris area, manages two manufacturing facilities in France and in the US, and holds R&D facilities in Germany. SURYS solutions have been adopted by over 130 countries alongside renowned major corporations.

TECHNICAL FACT SHEET

- A clear and rapid verification
- Vibrating customized image with numerous animations
- A wide range of possible colors
- Contrasting effects
- Metallic thread attributes (structure, conductivity and durability)
- Width from 4mm
- Options: Bas relief, Cleartext, fluorescence and magnetism

SURYS A BRAND OF IN GROUPE

Ms. Nathalie Vast
Email: Nathalie.vast@ingroupe.com
Website: www.ingroupe.com



SUPPLIER INSIGHTS

HUECK FOLIEN

TRILUMIC® - A JOURNEY OF HOLOGRAPHIC STRIPES FROM THE REEF TO THE AUSTRIAN ALPS

Dive into "The Reef": Holographic stripe with TRILUMIC® level 2 feature

The impressive success story of TRILUMIC® started four years ago, when we first presented the TRILUMIC® holographic stripe. Meanwhile the product is placed in the market and proven in circulation. The National Bank of Cambodia has decided as first Central Bank to put our TRILUMIC® stripe on the Commemorative Banknote 15.000 Riel in 2019. Although it is a commemorative banknote the volume was quite high, the banknote is officially used by the people and circulating in the country. The stripe was integrated in the banknote concept and applied on LANDQART's Durasafe substrate. The uniqueness of TRILUMIC® on a holographic stripe is the UV print in a full colour halftone image in a very precise detail, much higher than ever seen in a banknote print. The National Bank of Cambodia has launched the second banknote with a 15 mm TRILUMIC® stripe, the 30.000 Riel, which is also now successfully circulating.

The new sample stripe "The Reef" shows the combination of the latest holographic features together with an attractive, even improved UV print for TRILUMIC®. The unique aspect of our TRILUMIC® inks let the corals and fish shine in extremely brilliant colors under UV light. What makes the TRILUMIC® UV printing on banknotes so special? Up to now, regular UV inks for printing on banknote paper or on the plastic substrate for high security threads were used. This is well-know, proven in billions of banknotes and in production since decades.

UV printing with TRILUMIC® changes this situation largely and makes it much more difficult for the counterfeiters. We use a special software to generate the print pattern and print all TRILUMIC® colors by three unique inks in different graduation. The three

DIVE INTO "THE REEF": NEW SAMPLE STRIPE, UNDER DAYLIGHT AND UNDER UV-LIGHT

FASCINATING EFFECTS: THE SPIRIT OF GIZEH SAMPLE

inks were specially developed in sense of brightness and light fastness, to make this UV feature more durable over the lifetime of the banknote and to separate it from regular UV printed features.

In regard of the holographic features "The Reef" stripe shows a combination of classical hologram together with color-relief holograms. Join us for a dive into „The Reef" design: discover the color-relief structure of the corals in direct contrast to the achromatic white bas-relief of the diver. If you switch on the UV light you will find luminous fishes and corals in front and behind the metal layer. The UV colors are so strong that you can see them through the paper from the backside of the banknote.

TRILUMIC® is a trademark resulting from cooperation between Hueck Folien and Banque de France

Explore the Spirit of Gizeh: Holographic effects and nano-gravure technology

Inspired by the mysticism and history of Egypt, Hueck Folien presents an ingenious design of Tut Ankh Amun in fascinating 3D holographic effects which include nano-gravure technology for finest details as well. The sarcophagus in multi-color bas-relief as a direct contrast includes a full-3D keyhole effect for the interior. The elements in the middle of the sarcophagus seem to be moving on a second level. Furthermore, the stripe shows the Pyramids of Gizeh in scenic perspective with white 3D bas-relief in nano-gravure and a rotating kinetic effect for the sun.

Austrian Alps in a nanoengineered hologram

As reference to the heart of Europe, where Hueck Folien is located, we present the Austrian Alps stripe as a nanoengineered security feature. The sample stripe shows a combination of state-of-the-art-effects: a white 3D bas-relief in opposition to a Rainbow 3D bas-relief, the full-3D keyhole effect, a full-3D magnifying lens effect and the movement in the Swap Parallax effect. Finally the combination with Hueck Folien's TRILUMIC® UV printing on the both sides of the stripe, raises the holographic stripe from a public level 1 feature to a level 2 security feature on the banknote.

SUPPLIER INSIGHTS

AUSTRIAN ALPS:
NANOENGINEERED SECURITY FEATURE
UNDER DAYLIGHT VS. UNDER UV-LIGHT

The unique aspect of TRILUMIC® in this sample is the impressive contrast between the bright white and decent colors showing the sunset over the mountains. White UV is normally impossible to print in this intensity by a UV white ink.

With the technolgy of TRILUMIC intensive UV white becomes possible and provides high counterfeit protection.

Austrian Alps is designed together with our hologram-origination partner IQ Structures.

High Security at its best

Since more than 35 years, Hueck Folien is strategic partner for highest security - we have been lending identity to banknotes through our security threads since 1987. As a recognized technology leader in the field of first-class coatings, we secure tailor-made product advantages for our customers through stable quality and reliable service. These highest quality and service standards are reached by a team which feels responsible to create originality and continue to guarantee it in years to come. As a family-owned enterprise we have implicit trust in the abilities of our employees, who contribute actively to the ongoing further development of Hueck Folien to the benefit of our customers.

HUECK FOLIEN GMBH

Mr. Jan Hofmann
Email: j.hofmann@hueck-folien.at
Website: hueck-folien.com

TECHNICAL FACT SHEET

- TRILUMIC® is a trademark resulting from cooperation between Hueck Folien and Banque de France
- Hueck Folien uses a special software to generate the print pattern and print all TRILUMIC® colors by three unique inks in different graduation
- The TRILUMIC feature can be used for holographic stripes or security threads
- TRILUMIC® can be over varnished or over printed
- "The Reef" stripe shows a combination of classic hologram together with color relief holograms

since 1892

The Future needs Tradition

Gietz stands for reliability in the security industry

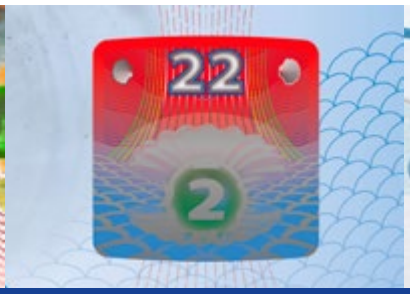
FSA 1060 Foil Commander NOTA

State-of-the-art machine for application of security foil features

The Gietz FSA 1060 Foil Commander NOTA delivers top quality and demonstrates its versatility in the application of security features on to banknotes, government and secured documents. It is reliable for all types of substrates; hybrid, cotton-based and polymer.

With the newly developed application process, Gietz has succeeded in setting a milestone by using a release technique for the security features applied by heat transfer from the carrier medium.

Since the beginning until today: Gietz - your partner for hologram patches and stripes on banknotes.



Gietz AG
Mooswiesstrasse 20 | 9200 Gossau | Switzerland
+41 71 388 22 22 | info@gietz.ch | www.gietz.ch

More Information

SUPPLIER INSIGHTS

PURA GROUP

PURA GROUP - TOTAL SECURITY SYSTEM DIVISION

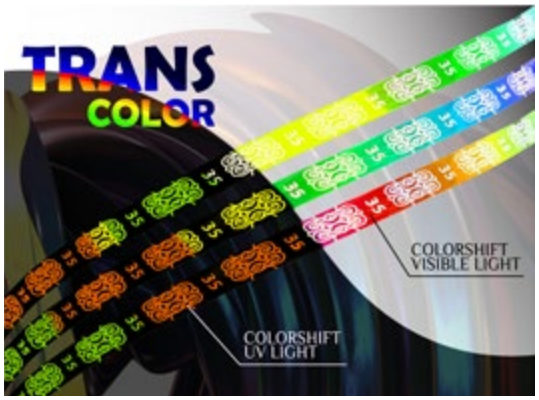
Pura Group is recognized as the largest integrated banknote and security products manufacturer in Southeast Asia. Pura Group offers a one stop solution of every variety for customized banknotes with personalized security banknote paper and security thread for customer requirements.

Pura Group had a long-standing reputa-tion since 1908 with the philosophy of producing special innovative products and security products until today, Pura Group has established 30 divisions that produced banknote papers, security papers, security threads, security foils, passports, ID cards, holograms, security packagings and many more for various companies and gover-ments around the world.

Total Security System Division is one of Pura Group's division which produces high security products.

TRANS-COLOR™ Features

TRANS-COLOR™ is our newest product with advanced features to be applied on security market, especially banknotes. TRANS-COLOR™ security thread can be used as a window thread on banknotes as well as other security document.



In addition, Pura Group Paper Mill division located in the same complex, this enabling completely secure and cost-efficient for application of TRANS-COLOR™ security threads and other security features on Pura banknote and security paper.

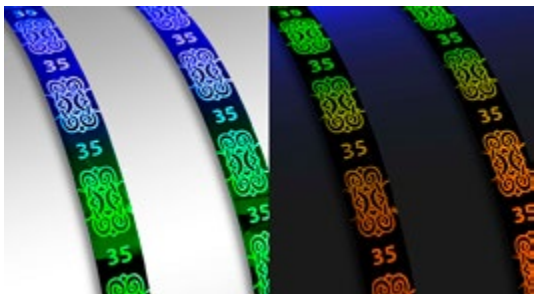
Futhermore, in 2022-2023 Pura Group's Total Security System Division has become the main supplier of Indonesian banknote security threads for four denominations, namely 1,000, 2,000, 10,000, and 20,000 Rupiah with more than 462,000 Km capacity. Since 2000, Pura Group Paper Mill also had been producing banknotes for Indonesia and for many other countries as well.

TRANS-COLOR™ Threads:

"Optical effects threads from multilayer thin coating and optical fluorescent shifting technology that deliver colors changes BOTH on visible and under UV light spectrum"

TRANS-COLOR™ is created with authentica-tion features that are sophisticated but still look simple so people can easily identify them. TRANS-COLOR™ security thread has been applied with 3 levels of security in accordance with banknote security needs. TRANS-COLOR™ does not only have a contrasting color change feature on visible light spectrum at level 1, but also has a color change feature on UV light spectrum which can only be seen with UV light at level 2. In addition, TRANS-COLOR™ can be combined with magnetic and IR features at level 3 which can increase the security value of a banknote.

TRANS-COLOR™ combines color changes both on visible and UV light spectrum combined with a striking color changing effect.



This combination enables more convenient, swift, and precise authentication process of the banknote.

TRANS-COLOR™ color change is available in Copper-Green, Green-Blue, and Gold -Green for visible light and Blue-Green, Green-Yellow, and Gold-Green for UV light spectrum.

PURA GROUP
EXPORT MANAGER:

Mr. Gunawan Kristianto
Email: gunawan@kudus.puragroup.com
Website: www.puragroup.com

TECHNICAL FACT SHEET

- Pura Group is the largest integrated banknote manufacturer in SE-Asia offering high security banknote paper and state of the art security thread technologies.
- Pura is the Main supplier for banknote paper and security threads for the Bank of Indonesia
- TRANS-COLOR™ security thread to be used as window threads on banknotes and combines color changes both on visible / UV light spectrum with a striking color changing effect.
- TRANS-COLOR™ is available in Copper-Green, Green-Blue, and Gold-Green for visible light and Blue-Green, Green-Yellow, and Gold-Green for UV light spectrum.

SUPPLIER INSIGHTS

IQ STRUCTURES

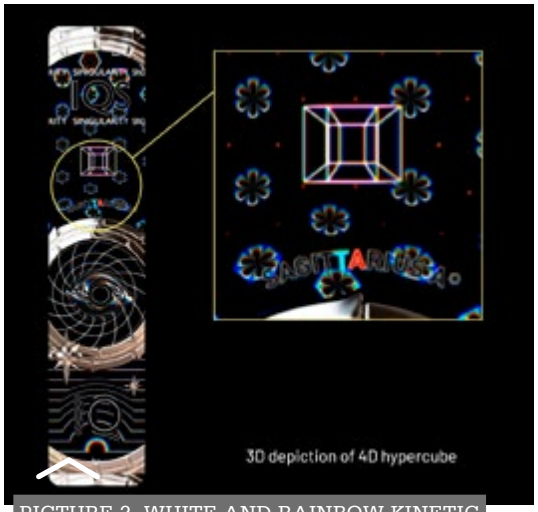
SINGULARITY – A COMPLEX OF NOVEL AWARD WINNING VISUAL EFFECTS

Sagittarius A* is a massive black hole in the centre of our galaxy. Its existence had been known for a long time, but it was first detected on 20 May 2022. That day in May, a team of scientist reconstructed and visualised the signals coming from the centre of the Milky Way. The visual embodiment of Sagittarius A*, also known as the Singularity, was finally uncovered. To pay tribute to such a technological and intellectual achievement, the mastering team of IQ Structures decided to mimic the visual behaviour of the black hole using the means of advanced diffractive optics. The idea of a complex optical security element called Singularity was born.

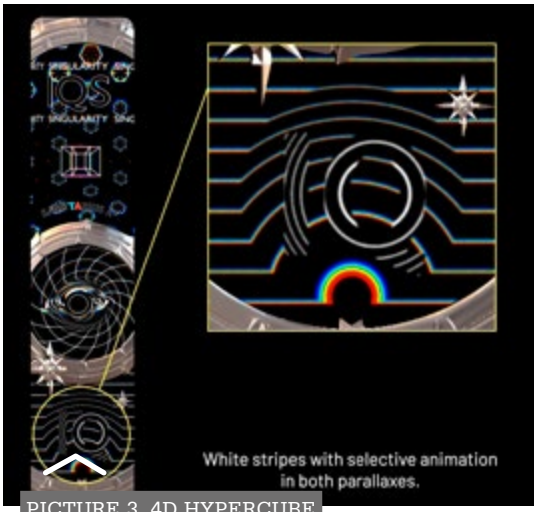
"*The singularity can be explained to us laypersons as a place where all the things that apply around it don't apply. Figuratively, then, like a waterfall in a desert, a tulip in an ice field, or a black hole in the middle of the Milky Way. And it is this symbolism that our hologram evokes. We wanted to create an optical security element that would be completely different in nature from all conventional, albeit cutting-edge solutions, qualitatively different, visually different and unique,*" stated Senior Designer of IQ Structures Jan Dřevíkovský.

The sophisticated mathematical algorithms together with advanced fabrication made it possible to move the boundaries of diffractive optics beyond the known visual patterning. Translation, rotation, morphing either discreet or animated in a non-chromatic 3D appearance. Such effects are far beyond the classical approach of diffractive optics. Based on massive computational power and the fabrication of functional easy-to-recognise nanoelements, distinctive features capturing user´s attention are created. The particular effects may be used as standalone security elements (see pictures 1, 2 and 3) or as synthetic all-in-one features (see picture 4). You can reveal the animation of the Singularity by scanning the QR code below.

PICTURE 1, MOVING OBJECTS COVERING THE BACKGROUND - THIS IS AN INNOVATIVE TECHNOLOGICAL CONTRIBUTION

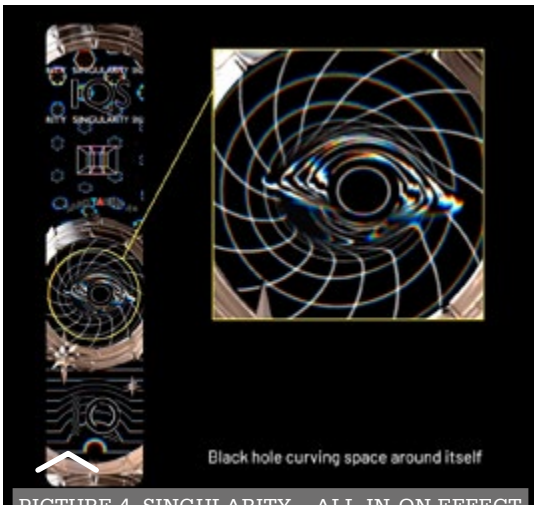


PICTURE 2, WHITE AND RAINBOW KINETIC EFFECTS ON 3D ANIMATED OBJECTS – IQ STRUCTURES BRINGS STANDARD 2D EFFECTS INTO 3D PERCEPTION



PICTURE 3, 4D HYPERCUBE
(2-AXIS ANIMATED 3D PROJECTION)

„Combining the bright visual imagination of our designers, sophisticated mathematical algorithms and the advanced technology of nanofabrication, we have created a new level of diffraction-based optical security features. Interactive features that are simple to be unambiguously authenticated and, due to their nature of diffraction optics, subtle enough for easy and seamless integration in any banknote substrate. Our novel features offer the customers serious protection of their currency based on a scientific approach and the latest origination technologies", commented Robert Dvořák, Managing Director.



PICTURE 4, SINGULARITY – ALL-IN-ON EFFECT MIMICKING THE BLACK HOLE BEHAVIOUR USING ROTATION, TRANSLATION, MORPHING AND ANIMATION IN 3D SPACE

The fact these new effects are based on diffraction optics is extremely important for the banknote manufacturers. For the proper visual functionality, only submicron deep structures are required. This means the effects are supplied as a standard foil based solution in the form of a thread, stripe or patch. It provides the manufactures with an easy and plug-and-play integration of the features on or into any banknote substrate.

„From time to time, a very special ingenious moment arises, all the elements fit together in a smooth and gentle swing – a scientific discovery creates enormous enthusiasm inside your mastering team, which leads to the development of novel security features awarded the 'The Best Origination' at the Excellence in Holography awards organised by IHMA. I´m very honoured to be a part of such a moment", summarised Petr Franc, the CEO of IQ Structures.

CLICK OR SCAN

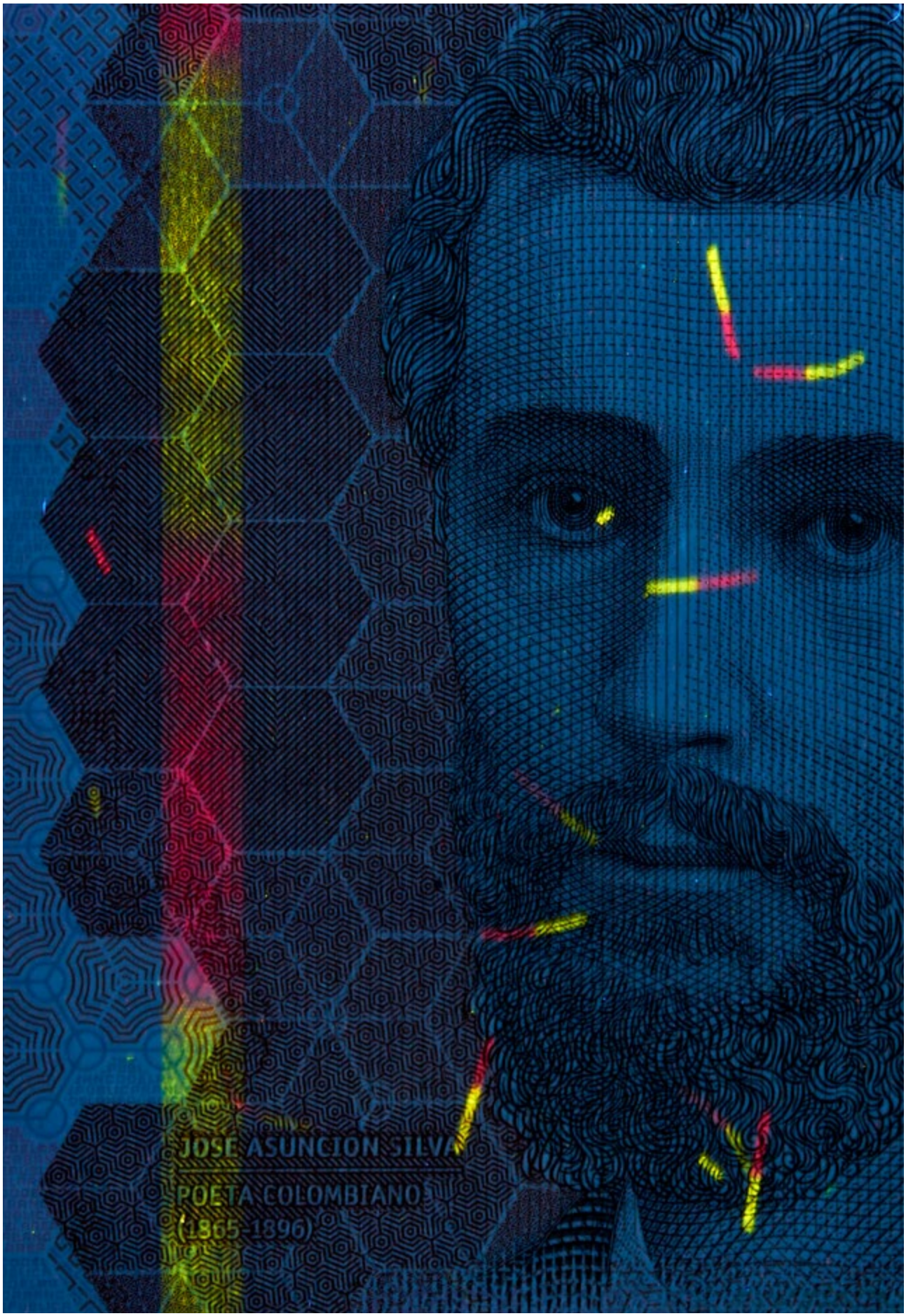
IQ STRUCTURES

Mr. Robert Dvořák
Email: robert.dvorak@iqstructures.cz
Website: www.iqstructures.cz

TECHNICAL FACT SHEET

- Colourless optical security features
- Sophisticated mathematical algorithms
- Advanced nanofabrication
- Wide range of animated non-chromatic 3D effects

SUB STRATE FIBRES


JOSE ASUNCION SILVA
POETA COLOMBIANO
(1865-1896)

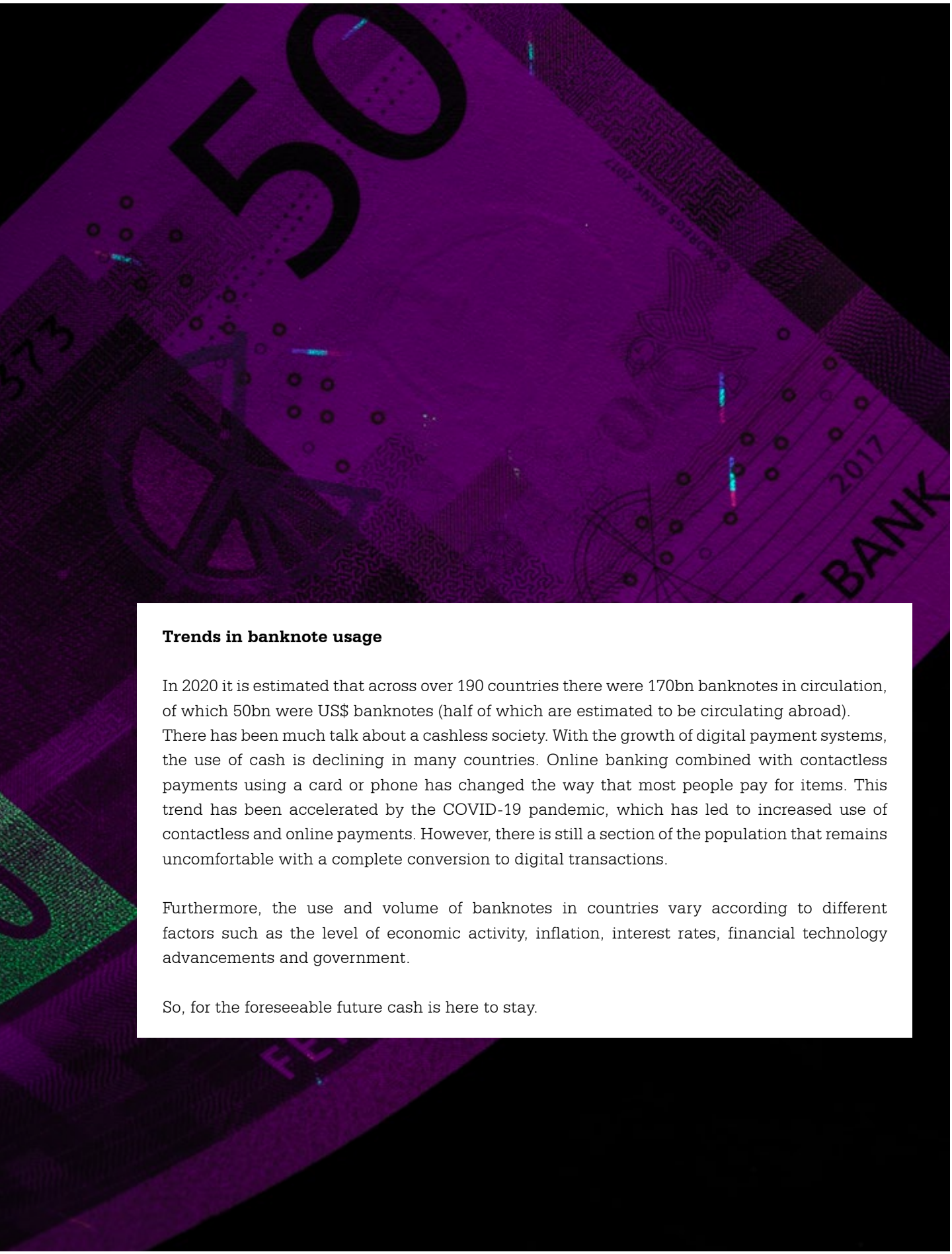
SECURITY FIBRES

BANKNOTE SUBSTRATES AND SECURITY TRENDS

Banknote substrates and security trends

SECURITY FIBRES

Banknotes are more than just currency; they represent their country and its central bank. Banknotes need to be protected against counterfeiting, be durable, and fit for purpose. Banknotes are evolving in terms of their use, substrate and security. Security needs to be incorporated into the banknote design, the substrate (paper or polymer) and the print.



Trends in banknote usage

In 2020 it is estimated that across over 190 countries there were 170bn banknotes in circulation, of which 50bn were US$ banknotes (half of which are estimated to be circulating abroad).
There has been much talk about a cashless society. With the growth of digital payment systems, the use of cash is declining in many countries. Online banking combined with contactless payments using a card or phone has changed the way that most people pay for items. This trend has been accelerated by the COVID-19 pandemic, which has led to increased use of contactless and online payments. However, there is still a section of the population that remains uncomfortable with a complete conversion to digital transactions.

Furthermore, the use and volume of banknotes in countries vary according to different factors such as the level of economic activity, inflation, interest rates, financial technology advancements and government.

So, for the foreseeable future cash is here to stay.

BANKNOTE SUBSTRATE TRENDS AND DEVELOPMENTS

Most of the world's population still uses paper banknotes.

In 1988 the Reserve bank of Australia issued the first polymer banknote made from bi-axially orientated polypropylene (BOPP). Although it has been 35 years since the first polymer banknotes were issued there is currently a relatively small proportion of the world that has converted from cotton-based notes to polymer (just approximately 20 countries, usually for high denomination or commemoration notes.)

Countries that have adopted polymer banknotes include Australia, Papua New Guinea, New Zealand, Fiji, Vanuatu, Canada, Romania, the United Kingdom, Costa Rica, Nicaragua, Mexico, Mauritania, Nigeria, Vietnam, Brunei, Maldives, Malaysia, Singapore and Thailand.

Cotton banknotes have a wider range of established security features which have evolved over time, such as. threads which are used in magnetic note sorting.

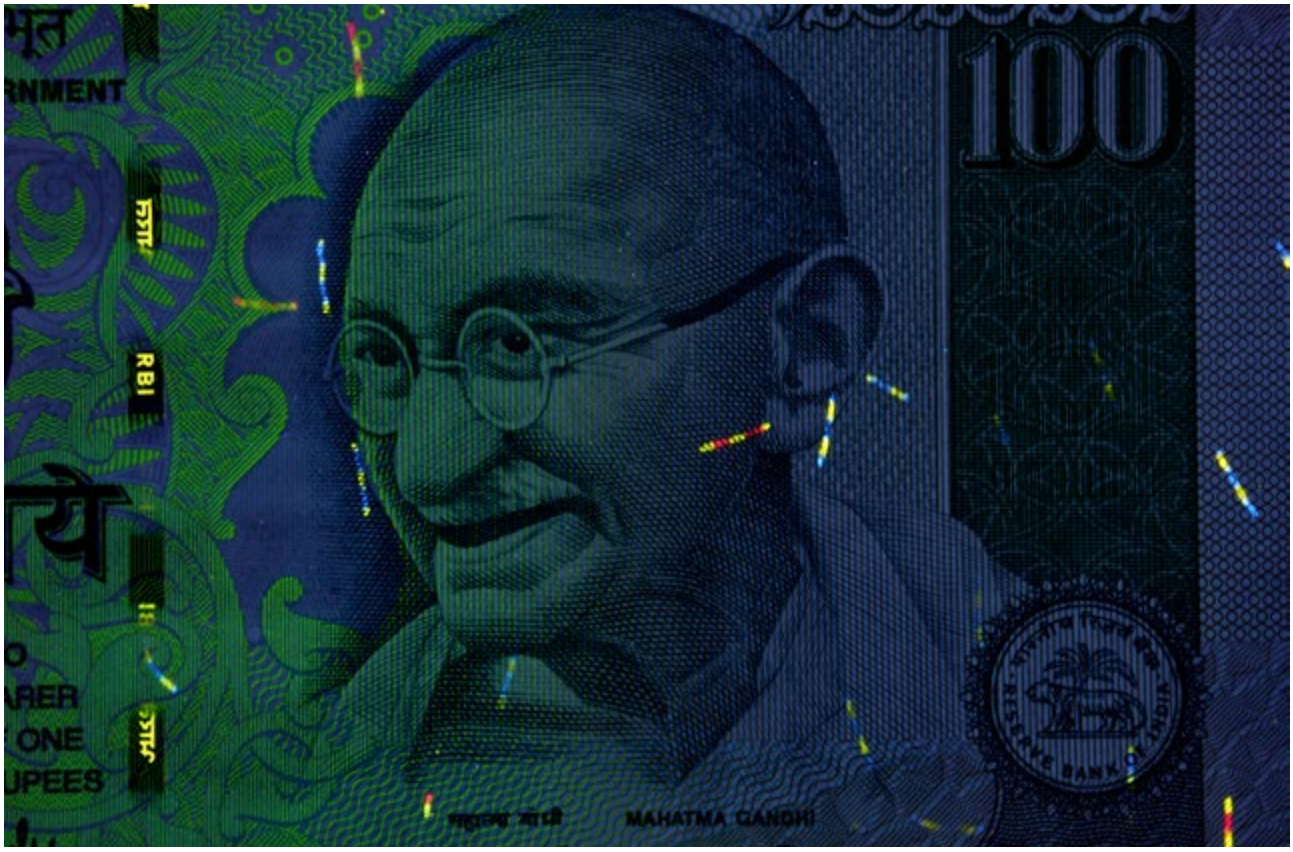
There is an argument that cotton banknotes are more sustainable as they are made from a renewable resource. While polymer notes have a higher substrate cost, they are very durable, with a lifetime of approximately 2.5 times that of cotton. They keep cleaner for longer as they have good anti-soil properties, absorbing less moisture.

A new but as yet unadopted, development involves the use of a composite substrate for banknotes. Here a polymeric core is sandwiched by two thin cotton layers.

WHY PAPER BANKNOTES CONTINUE TO DOMINATE.

There are several reasons why some countries continue to use paper banknotes rather than transitioning to polymer banknotes.

Typically it takes between 5 and 10 years for a new currency denomination to be introduced, but in the case of a substrate change to polymer notes, adaptations need to be made to note sorting equipment and procedures, as well as to ATMs and cash machines.



Furthermore, the initial cost of switching from paper to polymer banknotes can be high for central banks, as it requires new printing equipment, processes and expertise, as well as the replacement of existing paper banknotes. In addition, cultural and public acceptance can add to the inertia.

TRENDS IN BANKNOTE SECURITY FEATURES

Cotton-based substrates have evolved in the decades since their introduction to meet the challenges posed by counterfeiters. Security features for cotton-based banknotes include watermarks, windowed and embedded threads and randomly distributed security fibres, which cannot be incorporated into the polymer substrate. Holograms, intaglio, UV printing, and micro-printing are used in both cotton and polymer banknotes to prevent counterfeiting and forgery.

The main security feature specifically that differentiates polymer from cotton banknotes is the transparent window.

Current polymer notes are reported to offer improved protection against copying, but their introduction has been slow, so only time will tell if counterfeiters are deterred by their introduction.

With composite banknotes, the combined substrate has the durability of a polymer note but also can include the many security features associated with cotton-based banknotes, as well as registered holes within the paper layers, resulting in fully transparent windows.

It is interesting that one of the most innovative developments in modern security substrates is the creation of composite structures that not only shows improved

durability but also benefits from the decades of development improvements associated with cotton-based substrates.

Central banks continue to work together to develop and incorporate new security features to prevent counterfeiting and to maintain the integrity of their currencies.

HOW SECURITY FIBRES ARE USED IN BANKNOTES ALONGSIDE OTHER SECURITY FEATURES

Both security threads and security fibres provide a range of verification and anti-copy features that are constantly updated in response to threats to the integrity of the banknote. Threads and fibres have controlled dimensions, consist of overt visible features, covert spectroscopic as well as forensic level and machine-readable components.

Cotton-based banknotes have included security fibres as one of the most reliable anti-copy security features for many years. These fibres are thin, single or multi-coloured fibres embedded in paper during the papermaking process.

The fibres are typically made of a cellulose-compatible material (such as viscose or paper) that fluoresce under ultraviolet light, making them difficult to replicate. The fibres are randomly distributed and cannot be reproduced by printing. The range of security attributes incorporated in fibres is enormous including visible (overt), invisible (covert) or machine-readable features (forensic).

Fibres can be unique to an application and the colours chosen can be personalised and coordinated according to the colours in the flag of a country or its documents.

The inclusion of fibres has no effect on the performance or physical properties of the banknote paper such as durability and lightfastness, or on its security attributes.

There has been a trend towards using security fibres in combination with other paper-based security features, such as threads, magnetic

and electronic ink, and chemical markers. This creates a multi-layered, integrated security system that is difficult to compromise, making it more secure than depending on any one security feature on its own. The versatility and low cost of security fibres in cotton-based banknotes mean they are a globally accepted, integral part of any banknote substrate specification.

A small number of countries use visible fibres and visible fluorescent fibres. Several countries (approx. 150) use single-colour invisible fluorescent fibres, while a smaller number of currencies and countries use multi-colour invisible fluorescent fibres, these include the euro, Argentina, Colombia, Peru, Barbados, India, Israel, Madagascar, Moldova, Norway, Sweden, Ukraine and Albania.

However, it is also interesting to note that two of the mentioned currencies that have adopted multi-colour fibres for over ten years, namely The Reserve Bank of India and The European Central Bank, are the largest issuers of bank notes after China and the USA.

SECURITY FIBRES LTD.

Mr. Gary Spinks
Email: spinkspaper@btconnect.com
Website: www.securityfibres.com

TECHNICAL FACT SHEET

- Security fibres provide a wide range of verification and anticopy features that are constantly updated in response to countefeit threats
- Fibres can be unique to an application and the colours chosen can be customized
- Leading currencies and most circulating banknotes as the "Euro" or Indian Rupees using fibres
- Fibres have controlled dimensions, consist of overt visible features, covert spectroscopic as well as forensic level and machine-readable components
- Security fibres are one of the most reliable anti-copy security features for cotton-based banknotes

PRODUCTION


Guinea
Hundred Kina

NOTE PRINTING AUSTRALIA

QUALITY MANAGEMENT AN INTEGRAL PART OF NPA´S CUSTOMER RELATIONSHIP

QUALITY MANAGEMENT AN INTEGRAL PART OF NPA´S CUSTOMER RELATIONSHIP

NOTE PRINTING AUSTRALIA

Note Printing Australia's Quality Management Systems (QMS) are comprehensive in nature and essential to ensuring that its banknotes and passports meet the quality standard as agreed with its customers. As a wholly-owned subsidiary of the Reserve Bank of Australia responsible for the printing and production of Australia's banknotes and passports, quality standards are held to an extremely high level. These standards have translated into a culture of quality at NPA that is very much an ingrained part of staff thinking and action through the organisation.

Head of Quality, Luke Maguire, is responsible for NPA's Quality Management System. He says that one of the keys to delivering banknotes and passports of the highest quality is to ensure that all materials coming on-site are tested before being released, and that on-going end-to-end quality testing across all aspects of the manufacturing process – from product design and pre-production through to production and finishing – are rigorously maintained.

"NPA has developed an end-to-end robust quality program that's one of the major factors to ensuring we keep spoilage to agreed low levels and delivery outcomes on track. This is a capability managed by a great team of people in quality compliance, process engineering and in our QC Lab," says Luke. "After establishing with the customer the agreed quality standard, this team works closely with our Security Printers and Finishing staff to provide data, support and advice based on these customer expectations."

THE 1000-PISO BANKNOTE OF THE PHILIPPINES

The frequent testing at the centre of the quality system is characterised by a 'layered' testing approach to maintaining quality. Multiple systems are in place to ensure that manufacturing defects are minimised in the first instance and recognised in the shortest possible time when they do occur.

"The first layer of quality assurance is to ensure our people are trained in ways of working that minimise defects such as adopting and maintaining standard work practices that we know through experience is the optimal process to carry out a task," explains Luke. "The second layer is to have a different group of trained people looking at the same thing. This means we have QC Lab technicians taking product from the production floor and testing the material at a frequency that gives the team confidence that our production is stable and within specification."

The third layer is what Luke describes as a "secondary" audit in which every banknote, for example, is single-note inspected during the Finishing process using high speed processing machines. This includes proprietary quality test mechanisms that NPA has retrofitted on to the machines to test for foil defects on polymer substrate.

When you add AQL standards (Acceptable Quality Limit), strategic choices need to be made about the frequency of testing relative to the impact of the defect. A major defect could require numerous tests whereas less impactful defects don't need as many layers. Where the testing layers occur is also important and depends on where the defect sits in the process.

"Ideally, we are looking to measure critical control points in our process and every layer

INSPECTION SYSTEMS TECHNICIAN JAMIE LAMBETH EXAMINES THE SINGLE-NOTE INSPECTION DATA BEING GENERATED ON A RECENT RUN OF PHILIPPINES 1000-PISO BANKNOTES.

REAL TIME DATA AT THE PRESS HAS IMPROVED THE QUALITY OF CONVERSATIONS AND DECISION-MAKING BETWEEN SECURITY PRINTERS, ENGINEERS AND MANAGERS. NPA'S (L-R) RAJ PRASAD (CHIEF PRODUCTION OFFICER), DEAN MCGRATH (CHIEF TECHNICAL OFFICER), ALBERT DONG (PROCESS IMPROVEMENT ENGINEER) AND LUKE MAGUIRE (HEAD OF QUALITY)

reduces the chance of a quality error by magnitudes of probability," says Luke. "The high frequency checks that we conduct upfront help NPA because they minimise spoilage. This includes checking banknote properties that can't be measured at the press such as magnetics. Our single-note inspection capability is our guarantee to the customer that we have delivered to the quality standard required."

One of the major quality drivers at NPA in recent years is the installation of vision inspection systems through the manufacturing processes that enables security printers and the quality team to gain close to real-time feedback on performance and trends on the press.

"Process Engineering is supporting Production to make sure the process is in control. We have installed a large number of vision inspection systems on the machines so we can get real-time measurements," says Albert Dong, a Process Improvement Engineer who has been responsible for growing NPA's data gathering capability at the press. "When production sees a problem we can stop straight away – this is the key."

The application of SPC "Statistical Process Control" that can visually display the performance of the process using close to real time data is displayed on a dashboard that clearly shows performance and trend against specification. The dashboard provides a visual guide that shows a "control chart" with a target range and acceptable limits which require an escalating series of actions to be taken should the process start moving beyond these limits. These actions support decision making processes that start with the printer but can move to team-based consultation, and ultimately engineering consultation in order to mitigate and/or remove the defect.

One of the keys to NPA's approach to quality is to ensure there is a common understanding of defects that can occur on the press, where they occur, what they look like and what causes them. NPA's Quality Manual is a comprehensive document that provides a single source of information to streamline and condense the quality control process. It is also a great resource to help orient those new to the QC Lab. The document covers defect identification in raw materials, in-process, finished product and compliance testing for all of the printing processes.

"The development of the Quality Manual has been a turning point in the training of new Quality staff. The manual is comprehensive and presented to each new starter in the laboratory. It details our goal to provide the general public with products they can have confidence in and trust. It outlines in detail how we proactively strive to do this, while providing all-inclusive information on the critical aspects of the department in a way we never could before," says Emily Conheady, NPA's QC Laboratory Manager. "I can't overstate the value of this document in ensuring the newest members of our team are given every opportunity to understand how we operate and how critical their role is in providing the customer with the best quality products."

In developing an effective Quality Management System, NPA focuses strongly on design for manufacture which operates on the principle that while press line machine limits exist, it does not mean that the product is designed to push to the edge of these limits. The discipline of design for manufacture is a pre-production activity that can significantly assist with setting and meeting customer expectations and driving down the inherent spoilage profile of the project before the very first banknote or passport begins the printing process.

"A deep understanding of foundational manufacturing capability for printing on polymer is key to setting the project on the right path. NPA's design processes are very comprehensive, draw in customer engagement, and consult at great length with Quality and Production before a project sees a printing press," says Dean McGrath, NPA's Chief Technical Officer.

NPA'S QUALITY MANUAL HAS ACCELERATED THE LEARNING CURVE FOR STAFF TO GAIN A COMMON UNDERSTANDING AND IDENTIFICATION OF DEFECTS. NPA'S EMILY CONHEADY (QC LABORATORY MANAGER) AND MATTHEW RYLEY (QUALITY ASSURANCE TECHNICIAN)

With all these resources, tools and systems in place, it is the culture of quality at NPA, the attitudes of the individuals and the teams in their daily approach to quality, that is most striking.

"To say that people at NPA are passionate about quality would be an understatement," says Raj Prasad, Chief Production Officer. "It runs in their blood."

Operations Management undertakes a daily management review that focuses on the daily performance of Operations by considering Safety, People, Quality, Delivery, and Cost (SPQDC). The overall purpose of this work is to drive engagement with staff and to drive efficiency and spoilage improvement.

"Our days start with GEMBA walks which follows the SPQDC structure and with the management team's mindset of looking for how they can help. This enables us to both celebrate the good performances but also be immediately aware of when support is needed. This is a great way to connect with our people and our processes," says Prasad.

Informed by the GEMBA walks, management conducts a Daily Operations Review which serves as a forum to talk about issues and potential issues that have been identified with all relevant stakeholders. This is followed by the Daily Technical Review in which printers will be invited to sit with management and the technical team to root cause the issue they're experiencing on the press and to use the thinking of the group to problem solve.

"Taking this time with the printers drives a culture of constructive engagement and learning. It's an essential driver of quality in the business. It not only is a forum in which management can listen carefully, but one where we respect the fact that printers see these problems first hand and so we encourage and empower them to come up with solutions," says Prasad.

DAILY TECHNICAL REVIEWS DRAW ON THE COLLECTIVE EXPERIENCES AND PERSPECTIVES OF THE GROUP TO PROBLEM SOLVE AS ISSUES ARISE ON THE PRESS. NPA'S (L-R) AARON THECKSTON (PRINT HALL SHIFT COORDINATOR), JOHN CANTON (SECURITY PRINTER) AND STEPHEN NICHOLS (PERFORMANCE IMPROVEMENT COORDINATOR).

By focusing on the process, the results take care of themselves. Spoilage, Schedule Attainment and Overall Equipment Effectiveness (OEE) are key metrics that NPA uses to understand the impact that the Quality Management System is having in Operations, i.e. achieving target spoilage levels or below, delivering on-time and on-budget, and maximising the amount of uptime on the production line.

Another key outcome, and the most important to NPA, is that the Quality Management System serves to increase customer confidence and satisfaction. To this end, NPA willingly plays the role of customer advocate to component suppliers and strategic partner to central banks themselves.

By taking this position, NPA creates outcomes beyond banknote provision that help its central bank customers to achieve other organisational goals associated with currency management. By being willing to engage openly in its quality processes and product insights, NPA helps their central bank customers to be better informed about their own product. This in turn provides customers with their own unique experience of NPA: the provision of high-quality banknotes and passports, and the confidence of knowing that they are working with a security printer who first and foremost holds their organisational interests to heart.

NOTE PRINTING AUSTRALIA

Mr. Steve Casey
Email: steve.casey@npal.com.au
Website: www.noteprinting.com

TECHNICAL FACT SHEET

- An end-to-end robust quality program that ensures spoilage is kept to agreed low levels and delivery dates are met.
- 'Layered' testing approach to maintaining quality using multiple systems ensure that manufacturing defects are minimised.
- Single-note inspection in Finishing is NPA's guarantee to the customer that banknotes have met the agreed quality standard.
- The comprehensive installation of vision inspection systems has enabled NPA operations to track printing performance in real time.
- QMS effectiveness is measured using Spoilage, Schedule Attainment and Overall Equipment Effectiveness (OEE) data.
- Note Printing Australia is at the forefront of a state of the art Quality Management System within the printing industry.

Spartan

The answer to the note/coin boundary is here.

Scan to watch Spartan™ in production

Spartan™. The tougher, ultra-durable, cost-effective banknote.

Spartan™ is the first polymer banknote developed specifically for those denominations that sit on the cusp of the note/coin boundary.

It's manufactured by CCL Secure as a complete, finished banknote – ready for issuance – with a unique serial number and both covert and overt security features. Talk to us now to find out more.

cclsecure.com/spartan

CCL SECURE

CCL

THE ALLIER RIVER CLOSE TO EUROPAFI

BANQUE DE FRANCE

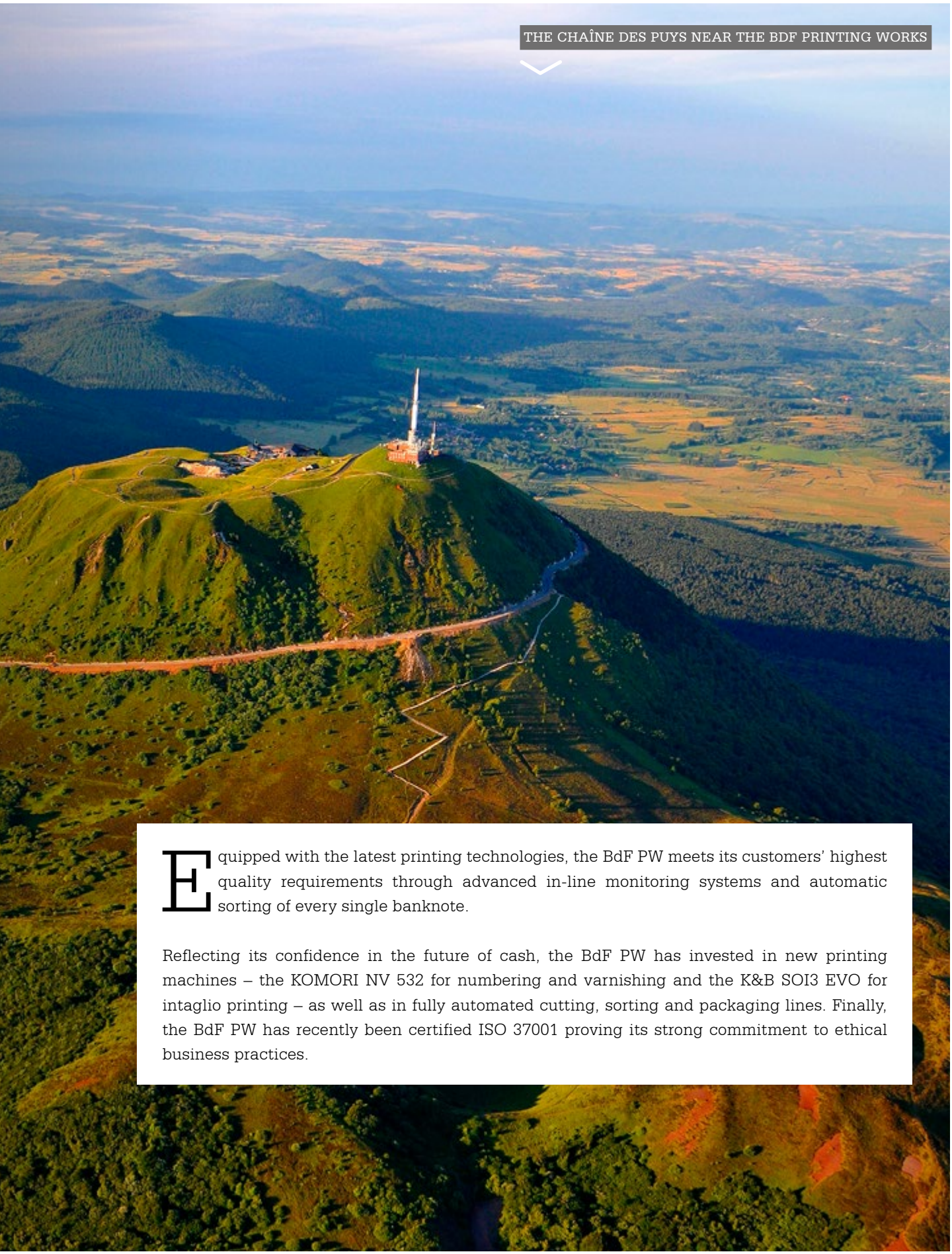
A JOURNEY THROUGH BANQUE DE FRANCE BANKNOTE MANUFACTURING

Over two centuries of know-how in banknote manufacturing

A JOURNEY THROUGH BANQUE DE FRANCE BANKNOTE MANUFACTURING

BANQUE DE FRANCE

Located in the centre of France, in Chamalières, close to the UNESCO World Heritage site of the Chaîne des Puys, the Banque de France Printing Works (BdF PW) has a production capacity of 2.8 billion banknotes per year. Half of the BdF PW production capacity is dedicated to the manufacturing of foreign banknotes circulating in more than 20 countries. In addition, BdF PW is the leading printer of Euro banknotes.



THE CHAÎNE DES PUYS NEAR THE BDF PRINTING WORKS

Equipped with the latest printing technologies, the BdF PW meets its customers' highest quality requirements through advanced in-line monitoring systems and automatic sorting of every single banknote.

Reflecting its confidence in the future of cash, the BdF PW has invested in new printing machines – the KOMORI NV 532 for numbering and varnishing and the K&B SOI3 EVO for intaglio printing – as well as in fully automated cutting, sorting and packaging lines. Finally, the BdF PW has recently been certified ISO 37001 proving its strong commitment to ethical business practices.

A few kilometres away from the BdF PW, on the Allier River in Vic-le-Comte, stands EuropaFi, the Banque de France's paper mill. With a production capacity of 4,500 tonnes a year, EuropaFi is able to integrate the most advanced security features available on the market for different applications such as banknotes or ID documents. Having been fully renovated over the past few years, EuropaFi uses the latest generation 3-sheets width paper machine, developed in collaboration with Voith and Allimand and equipped with an in-line inspection system to guarantee the highest level of quality. EuropaFi also meets the highest requirements in traceability throughout the whole paper production process; every single sheet is numbered and traced from the reel to the delivery trucks.

With a view to preserving its direct environment and the resources necessary for its production, Europafi has reduced its industrial water consumption by 30% between 2019 and 2022 per tonne of paper produced.

In addition, 90% of the water taken from the Allier River is returned to the natural environment after treatment by a site-specific treatment plant.

A COMPLETE RANGE OF DURABLE PAPERS AND BANKNOTES

The Banque de France Printing Works and the EuropaFi paper mill work together to provide the highest levels of durability for banknotes through advanced Research & Development capabilities and a long experience of banknote behaviour in the most demanding circulation environments.

Learning in the field, the Banque de France developed LongerFit®, a proprietary sizing that offers high soiling and mechanical resistance to banknote paper, while maintaining excellent print quality and supporting all security features. Protecting the substrate from external physical/mechanical and chemical attacks, this solution is currently in circulation. LongerFit® stands in between state of the art banknote paper PVOH sizing and EverFit®.

EverFit® is a printed and secured paper banknote that is laminated with a protective layer as a finishing step. It offers the highest durability for highly demanding circulation conditions by addressing the three main concerns for durability: soiling resistance; ink wear resistance; and mechanical resistance.

THE BANQUE DE FRANCE'S RANGE OF DURABLE PAPERS AND BANKNOTES

EVERFIT®, BANKNOTE MADE DURABLE

EverFit® has proven its efficiency in very harsh circulation environments over the past 5 years.

Thus, the Banque de France offers a full range of solutions with banknote papers perfectly adapted to the different types of needs and usages.

TOWARDS A MORE SUSTAINABLE BANKNOTE

The environmental footprint of a banknote lies partly in its manufacturing process but mostly in its ability to last in its circulation environment. With LongerFit® and EverFit®, the Banque de France participates in lengthening the lifetime of a banknote in circulation and therefore greatly contributes to lowering its environmental footprint. To go even further, efforts are also being made in the selection of fibres that can be used in the production of banknote paper. EuropaFi is already producing paper from cotton fibres, which come from textile industry waste. Over the past few years, we have actively investigated the use of locally sourced alternative fibres in our papers with an uncompromising quality. Such alternative fibres have a lower environmental footprint than cotton fibres in Europe and EuropaFi strongly believes them to be the future of banknote paper manufacturing in a number of countries.

FLAX, HEMP, SOME EXAMPLES OF ALTERNATIVE FIBRES

Sustainability must also be addressed at the end of a banknote's life. Through circular economy initiatives, the Banque de France has developed valorisation chains for banknote shreds. After mixing with recycled polymers (surgical masks for example), banknote shreds can be upcycled in home or industrial furniture and equipment, such as boxes and pallets. The EverFit® banknotes unique characteristics allow them to be reinvented in a second life as 100% recycled banknote-based objects.

BANQUE DE FRANCE

Mr. Emmanuel Devaux
Email:
emmanuel.devaux@banque-france.fr
Website: www.banque-france.fr

TECHNICAL FACT SHEET

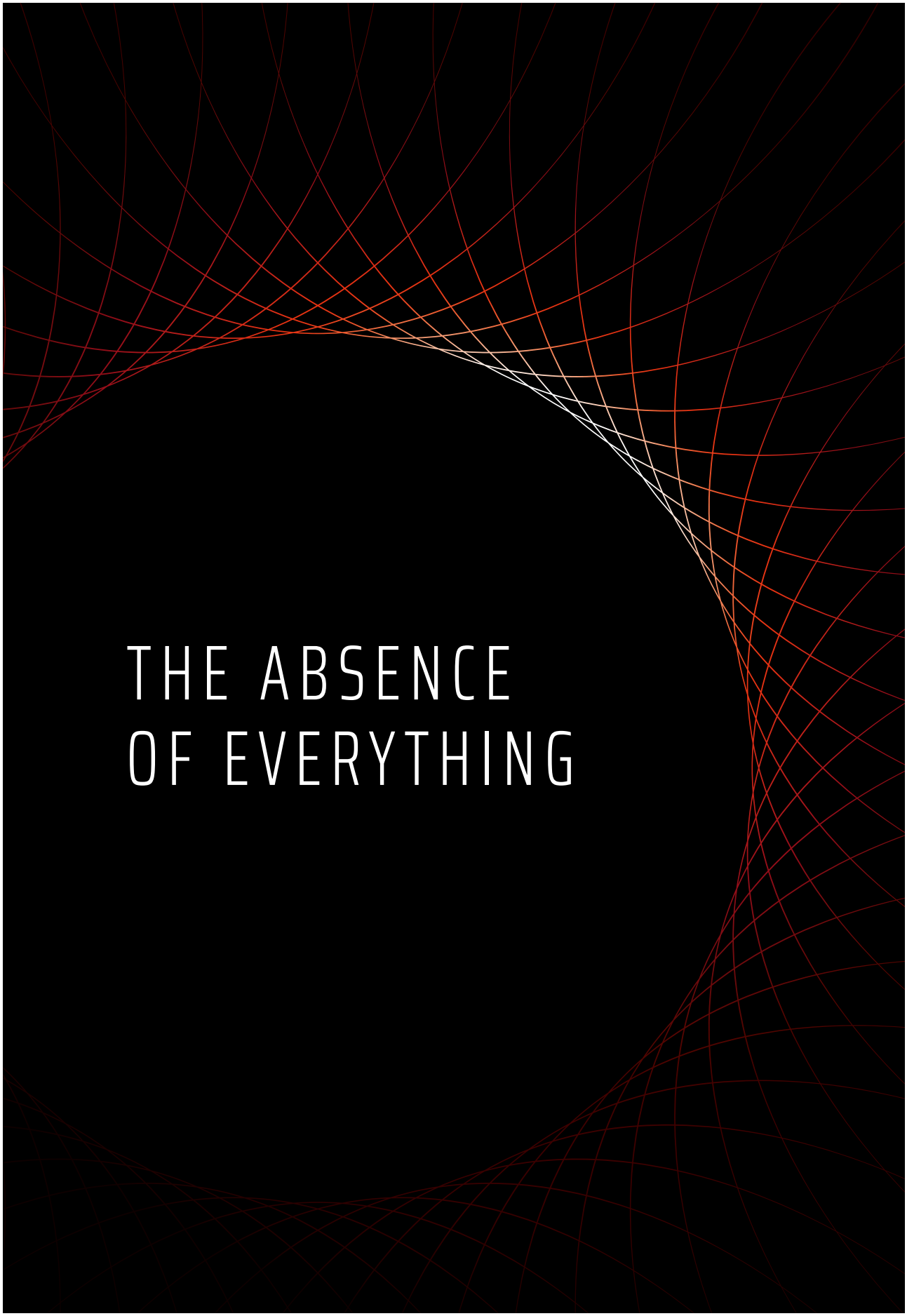
- The Banque de France Printing Works has a production printing capacity of 2.8 billion banknotes per year >50% earmarked for the export market. Latest printing equipment by Komori and Koenig & Bauer Banknote Solutions have been recently installed
- Recent ISO 37001 Certification
- EuropaFi - the Banque de France's paper mill has a production capacity of 4,500 tonnes a year incl. inline traceability and inspection system.
- LongerFit® offering high soiling and mechanical resistance to banknote paper
- EverFit® is a printed and secured paper banknote that is laminated with a protective layer on both sides as a finishing step.
- The BdF has actively investigated sourcing alternative fibres for its banknote substrates, working towards a more sustainable product.

JURA

SECURITY PRINTING

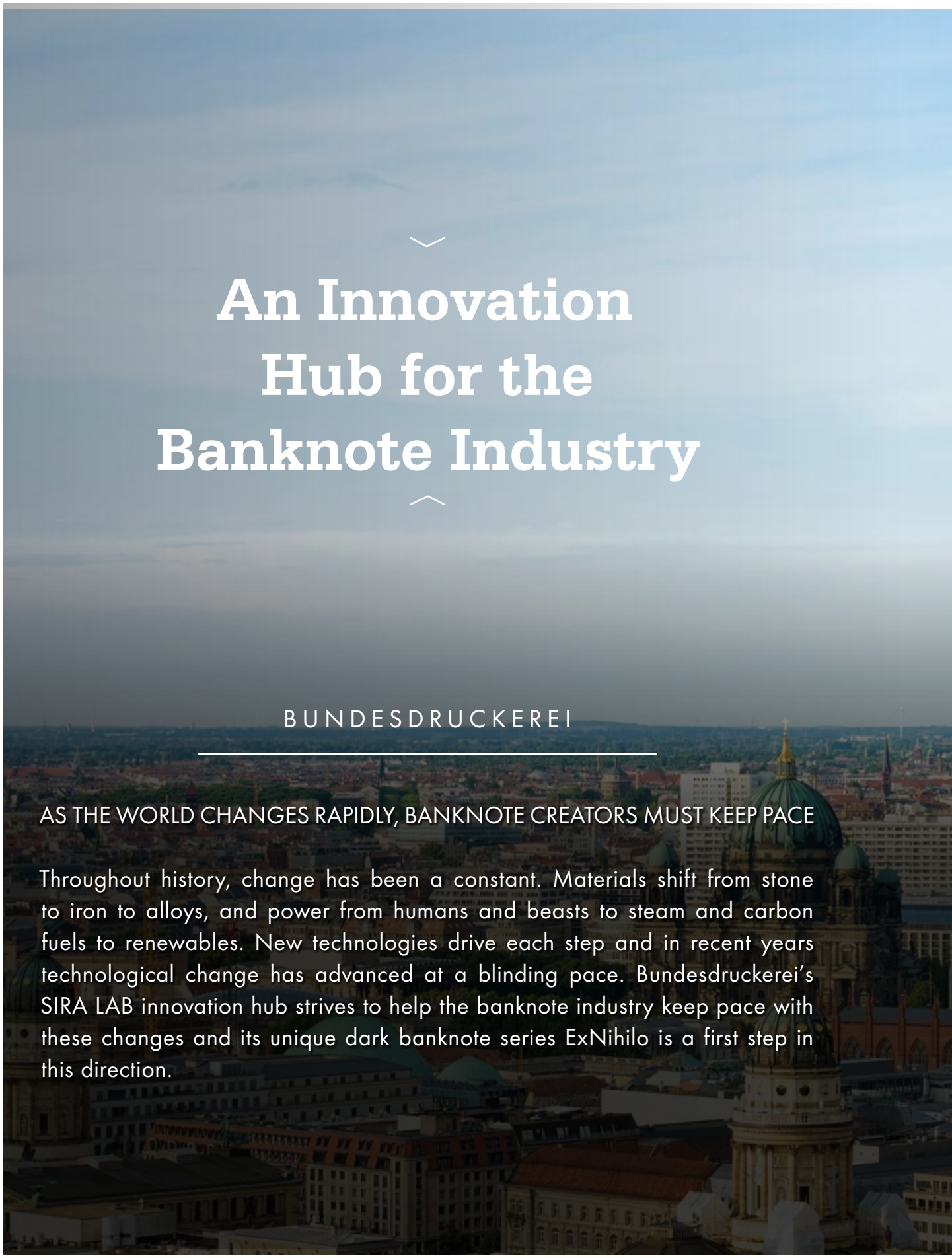
www.jura.hu

Jura's latest development
is **S-DLE®**
Direct Laser Engraved Steel
Plates for Intaglio Printing.


THE ABSENCE
OF EVERYTHING

BUNDESDRUCKEREI

AN INNOVATION HUB FOR THE BANKNOTE INDUSTRY



An Innovation Hub for the Banknote Industry

BUNDESDRUCKEREI

AS THE WORLD CHANGES RAPIDLY, BANKNOTE CREATORS MUST KEEP PACE

Throughout history, change has been a constant. Materials shift from stone to iron to alloys, and power from humans and beasts to steam and carbon fuels to renewables. New technologies drive each step and in recent years technological change has advanced at a blinding pace. Bundesdruckerei's SIRA LAB innovation hub strives to help the banknote industry keep pace with these changes and its unique dark banknote series ExNihilo is a first step in this direction.

In an economic era defined by rapid change, the common banknote – the mainstay of commerce for centuries – is facing one of its most profound transformations. The digital evolution of money is fueling rapid changes in currencies. The banknote industry needs to keep pace with these changes through innovation focused on both physical and virtual money. Bundesdruckerei's SIRA LAB innovation hub seeks to trigger creativity in banknote design and production by charting a new way forward and incorporating the two faces of today's currency.

For many organizations, innovation is often seen as a single event, a change in a specific product or service to meet a defined need. It is episodic. However, innovation is in fact a practice, an ongoing process that continually explores new ideas fundamental to the industry. This thinking led Bundesdruckerei to create the SIRA LAB innovation hub. The hub approaches innovation from a fundamental capacity perspective and aims to bring the industry closer together in facing technological change.

"Today, we are at the dawn of a new age," explains Dr. Dieter Sauter, Senior Vice President of Value Printing at Bundesdruckerei and the driving force behind the hub. "New and alternative payment methods are appearing on the horizon."

He continues, "A competition has engulfed our industry with stakeholders vying to be among the first to combine the advantages of both worlds, i.e., to rely on the security standards of a conventional banknote while benefitting from the advantages of dynamic programmable values. The SIRA LAB innovation hub is a place for industry partners to come together and collaborate, to reinvent their traditional role, and to make innovative changes to banknote technology."

DR. DIETER SAUTER

The hub is a place where innovation and expertise can thrive. The aim is to encourage collaboration and knowledge sharing across the banknote industry. Additionally, the potential for innovative banknote technology applications is immense, especially as established banknote companies form partnerships with businesses that traditionally have not yet ventured into this sector. These partners can offer diverse forms of support, shared expertise, and combined collaboration to promote the most successful innovation.

"The SIRA LAB hub serves as an R&D platform to experiment with new features, designs and ideas, of which some may be commercialized," Dr. Sauter continues.

COLLABORATING FOR INNOVATION

With novel opportunities on the horizon, the banknote industry could ignite new growth and invigorate its profitability by redefining its meaning and purpose, reinventing its traditional role, and making bold and innovative operational changes through a collaborative approach as a community.

As other industries have shown, collaboration across disciplines is a strong tool for innovation. Although new, the hub has already established partnerships with leaders in press manufacturing, ink production, and other industries, including Koenig & Bauer, SICPA, KURZ, CCL, and Landqart. These partners will use the hub to research and develop new ideas and to integrate innovative solutions in the banknote industry by combining their expertise.

"Companies regularly seek partners with complementary capabilities," Dr. Sauter says. "The more complex the business environment becomes — for instance, as new technologies emerge or as innovation cycles accelerate — the more relationships like these make sense."

The hub also convenes an alliance-management team tasked with tracking and reviewing progress made by the partners

against clearly defined metrics. This oversight helps to identify and address any obstacles that might develop and flatten any other speed bumps to progress. Under this structure, product development is expected to take eight to 24 months. "Innovation is critical to growth, but that's what makes it risky," Dr. Sauter says. "It requires bold bets and a willingness to persevere despite setbacks, criticism, and uncertainty."

'FROM NOTHING' TO DARK BANKNOTES

ExNihilo, the name of the initial banknote series from Bundesdruckerei's SIRA LAB innovation hub, describes the philosophical starting point for the effort. With roots that reach back to Melissus of Samos and Aristotle in Ancient Greece, the Latin ex nihilo nihil fit is often translated as "from nothing comes nothing". With the rise of digital payments worldwide, the concept of money becomes more and more independent of its material construct, gradually approaching nothingness. Yet, it is from this "nothing" that the banknote industry must innovate and discover new paths.

"A pure definition of true nothingness needs to be the absence of everything," says Adrian Heuberger, Senior Expert for Currency Development at Bundesdruckerei and a chief innovator behind ExNihilo. "Nothingness as the absence of everything is one of the most contradictory things to imagine. A cultural metaphor for the absence of everything is the absence of light, which leaves darkness. By removing light, we create a stage for things that were not visible before, a stage for things you can only see when the lights go out."
These ideas gave birth to the concept of the ExNihilo series in Bundesdruckerei's design lab in Berlin. From "nothingness", as it were, the SIRA LAB innovation hub would create exciting new ideas centered on new technologies.

The goal of the first collection of ExNihilo banknotes is to reach the optimal balance for those who want to continue to use physical money and also want the convenience, functionality, and other benefits of digital currency. The designs produced must be both unprecedented and provocative. They must demonstrate that banknotes are no longer chained to their traditional format.

Heuberger and his colleagues' focus at the design lab is on developing dark banknotes, a design unprecedented in modern currency. The unexplored possibilities of the banknote's unique color could be exploited for increased security. Traditionally, manufacturers have shunned dark banknotes largely because they are relatively easy to counterfeit and, because of their high carbon content, interfere with infrared security features. But with new technologies and materials, dark banknotes could harbor unknown potential for security features and usage.

"The collection is adapting to the changing context in banknote creation and charting a new course to increased value creation," Sauter says. "Four primary forces shape this new context: sustainability, innovation, action and recycling. These were all taken into consideration while working on the concept."

The first of the collection centered on sustainability, a trend within the banknote industry for many years. Banknote manufacturers have, of course, already been exploring measures to improve sustainability. Innovation in this area includes new ways to further reduce greenhouse gas emissions, including switching to low and zero-carbon raw materials.

The second of the series, to be completed in 2023, revolves around design innovation,

particularly ways to use dark coloration to create more secure banknotes and new technology to cohabitate with digital currencies. Two other banknotes in the collection are expected to be developed over the next two to three years.

EVOLUTION TOWARD A 'MORE HONEST' FORM OF MONEY

Heuberger, the lead designer at the hub, says he sees the dawn of digital currencies as an evolution toward money's core essence, value. Released from its physical form, money becomes simply value stored as electronic information on a computer chip and exchanged using apps on telephones, laptops, and desktops.

"Money is being dematerialized. Money is approaching nothingness," he says and then asks, "What has money ever been without our consent that it is valuable? Without us, money is what it always has been: a slip of paper. Almost nothing. The new payment methods are the more honest form of money. They do not pretend to be something else. They become exactly what money has always been: nothing."

The innovation hub has started its work just at the dawn of a new time when money is losing its physical form.

"We would like to dare what has never been dared before: to produce dark banknotes and to use these dark banknotes as a stage for innovative things that can only been seen in the darkness," Heuberger says.

DIGITAL LAUNCH

Bundesdruckerei will showcase the concepts behind dark banknotes, as well as the underlying technologies and benefits, at the Currency Conference 2023 in Mexico City in May during a digital presentation. The insights gained during this innovation journey will be presented to a select audience at the conference. Early indications, however, confirm that Bundesdruckerei and its partners will create substantial value as they continue to explore and develop the potential, unleashing advantages for the future of the banknote industry.

ABOUT BUNDESDRUCKEREI

Berlin's Bundesdruckerei GmbH is a leading German high-tech security company.

ADRIAN HEUBERGER

With innovative solutions, products, and technologies "Made in Germany", the company protects identities and data. By creating trust and legal certainty in our digital society, Bundesdruckerei GmbH enables governments, companies, and citizens to act with confidence in the analog and digital world. As a Bundesdruckerei Group company – with more than 250 years of experience under our belt – the company is paving the way for a secure digital age.

BUNDESDRUCKEREI GMBH

Ramona Fazeli
Head of Marketing Department,
Value Printing
Email: ramona.fazeli@bdr.de
Website: www.bundesdruckerei.de

TECHNICAL FACT SHEET

- Bundesdruckerei's SIRA LAB innovation hub seeks to trigger creativity in banknote design and production
- This SIRA LAB innovation hub includes esteemed partners such as Koenig & Bauer, SICPA, KURZ, CCL Secure and Landqart
- Latest banknote design innovations from the innovation hub particularly include ways to use dark coloration to create more secure banknotes

SUPPLIER INSIGHTS

CANADIAN BANK NOTE COMPANY LTD.

SUCCESS RELIES ON THOUGHTFUL INTEGRATION AND RIGOROUS TESTING

From design to feature integration to manufacturability testing; Canadian Bank Note Company Ltd. embraces complexity so central banks can issue their bank notes with minimal risk

Currency is an essential component of our daily lives. It is a reflection of a nation's history, culture, and heritage, and the design of a currency can tell a story that goes beyond its monetary value. However, currency is not just about aesthetics; it also plays a critical role in the economy, commerce, and global trade. As a result, the design and testing of bank notes must incorporate the latest technology and security features to ensure their integrity, durability and prevent counterfeiting.

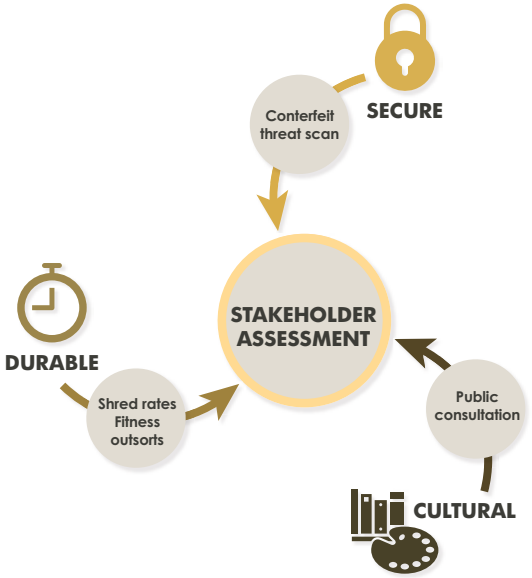
Canadian Bank Note Company Ltd. (CBN) understands the ever-evolving needs of Issuing Authorities and is committed to designing and delivering products that exceed expectations. CBN excels in executing the complex integration of features from a multitude of suppliers. We collaborate with industry suppliers and provide a measured and objective approach and the ability to integrate even the most complex features into a banknote reducing Issuing Authority risk of any new notes in the circulation environment.

CONSULTATION – TESTING THE STAKEHOLDER NEEDS & KEY PRIORITY

As a result of CBN's industry expertise and long-term customer relationships, our cross-functional teams and multi-product capabilities enable us to maximize design aesthesis while rapidly minimizing risk to deliver the most beautiful, advanced, and secure bank notes in circulation today. Circulation conditions and stakeholder are defined by the balance between three pillars:

- Culture
- Security
- Durability

CBN works closely with Issuing Authorities to achieve a balance amongst the three pillars to achieve the optimal note design and manufacturing process for each unique circulation environment.



Culturally Expressive Bank Note – A window into your culture

Nations take pride in their bank notes. For this reason, CBN's team of world-class artists extensively research the culture and history of a nation. With the understanding of the science supporting the integration of complex features into a bank note, the design process incorporates security features including optically variable effects, detailed metallic filigree and multi-colour registration to depict meaningful artifacts and indigenous patterns.

Secure Bank Notes – Certainty made easy

CBN initiates a design based on the philosophy of intuitive authentication. This approach is based on the principle that the high quality of a bank note design masterfully executed into a manufactured bank note distinguishes that note from any counterfeit. CBN certifies each bank note design for ease of authentication and high quality during manufacture.

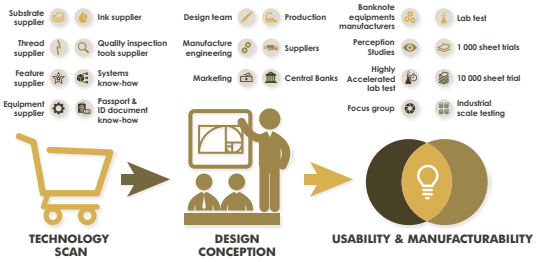
Prioritization of Durable Bank Notes – Quality is our top priority

Delivering a high-quality and durable bank note is paramount. CBN's unique in-house Highly Accelerated Lifetime Testing (HALT) helps us understand how a bank note design will behave in circulation to best assure note quality and longevity.

SUPPLIER INTEGRATION – DE-RISKING THE TECHNOLOGY

CBN has a proven record of integrating innovative technologies into bank note design. This understanding allows us to integrate state-of-the-art features in a securely manufacturable method. This proven method involves a complex orchestration of knowledgeable resources supported by leading edge technologies.

Below we briefly describe the steps we use which have led to successfully de-risking complex integrations in the past.



Design – Testing and Optimizing the Concept

Once the technology scan and design brief have been completed, the creative phase begins. A diverse team of experts, including representatives from the Issuing Authority, artists, engravers, and manufacturing, take central bank specifications, build beautiful designs and test to certify that the final design is compatible with all functional and overt public features. Machine readability is woven into the overall design to support the "general public" user and the bank note equipment manufacturers (BEMS).

SUPPLIER INSIGHTS

Usability – Bank notes designed with the user in mind

CBN gains valuable insights into usability by using a few key metrics. With machine-readable features, small design changes can significantly affect the BEMS ability to employ features such as magnetic inks or infra-red inks. CBN's in-depth understanding of the sensors, along with internal testing capabilities, means we can easily integrate functional features effectively.

Manufacturability

A key part of achieving success is team structure. Communication between designers, pre-press and manufacturing is ingrained from the very beginning. Unhindered discussions over design, feature sets and manufacturability are integral to success

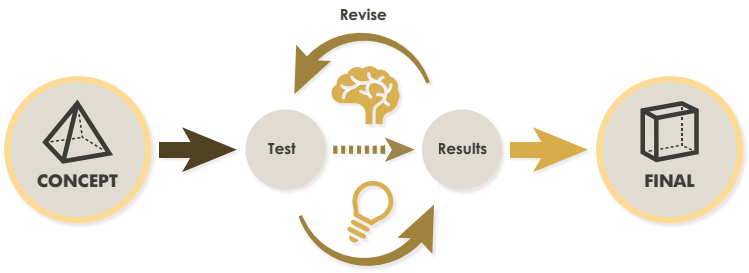
Risk – Prioritizing Testing on the impact and probability of Failure

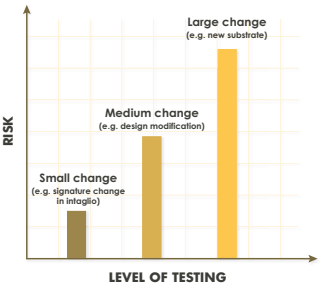
CBN estimates the risk level of any project based on the magnitude of the change from prior experience. The goal is to fail fast and with minimal investment in order to quickly discover what is achievable. The approach to push to failure quickly begins in the laboratory, which is less resource-heavy and will uncover potential issues.

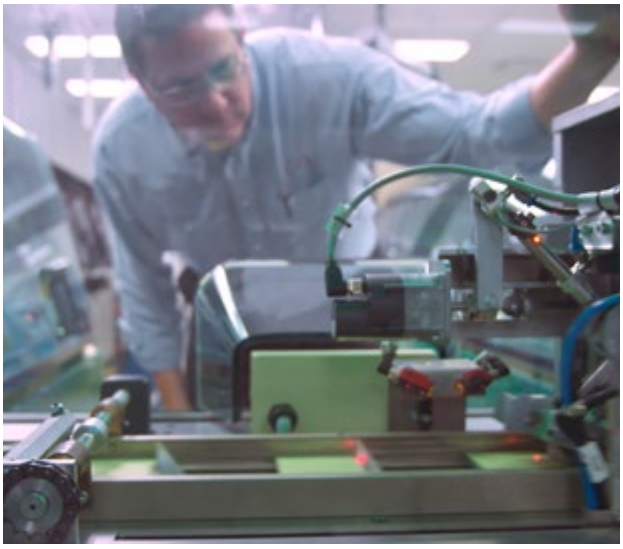
For those designs that introduce the greatest level of risk, CBN starts with testing in the laboratory to focus on the performance of the features incorporated into the note while minimizing the cost of materials and equipment operation. This will help determine if an ink will not adhere to a substrate, does not cure or results in set-off or if a foil reacts with common household products in an unacceptable way, for example.

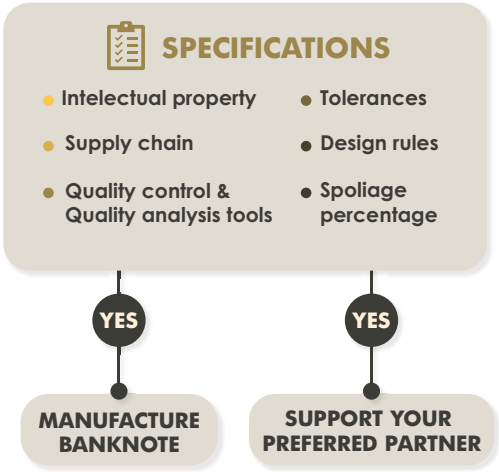
Should a design pass the laboratory testing criteria, testing can continue to full-scale equipment in low volumes. This phase focuses on the performance of the design in a manufacturing environment.

One of our key findings over the years is that the use of genuine manufacturing equipment for testing is essential for effective risk mitigation.









There is no substitution for putting work on production equipment when it comes to gaining full-scale insight.

Following small trials on production equipment, CBN will move to test with higher volumes running at realistic production speeds. This is the stage at which quality control tools such as vision systems are employed, and realistic technical specifications can be formulated to ensure reproducibility and minimize spoilage.

Results – Rigorously Tested for High Confidence

Finally, once the entire cycle of CBN testing has been completed, the result is a fully usable and securely manufacturable banknote design specification.At this stage, CBN can supply specifications, production plans, quality plans and implementations. One or all these results can be made available to support the Central Bank's preferred printer or can be implemented at our production facilities.

To learn more about the testing approaches as well as services CBN can offer to "get you your perfect banknote" please contact our Vice President & GM, Currency and Excise Control, Spencer Mandy at smandy@cbnco.com.

CANADIAN BANK NOTE COMPANY LTD.

Mr. Spencer Mandy
Email: smandy@cbnco.com
Website: www.cbnco.com

TECHNICAL FACT SHEET

- CBN has a proven record of integrating innovative technologies into bank note design
- CBN is providing in-house Highly Accelerated Lifetime Testing (HALT) simulations
- CBN has a an indepth understanding of the sensors for machine-readable features
- CBN offering service to "get a Central Bank's perfect banknote"

SUPPLIER INSIGHTS

LANDQART

LANDQART'S 150TH ANNIVERSARY HOUSENOTE

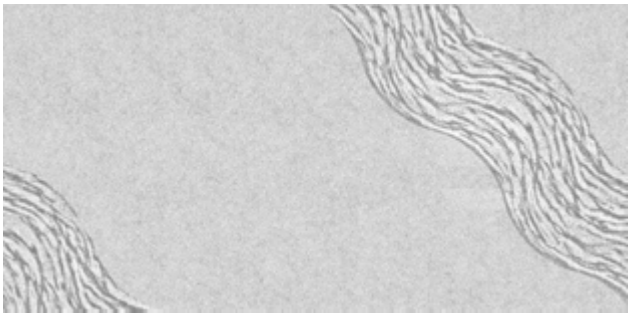
"Happy Birthday to You" is one of the most sung songs in the English language, with the melody used in many other languages; few people would fail to recognise it. "Happy Birthday to Us", however, is a much less well-known tune, but one that perfectly fit the mood in the Swiss town of Landquart in July 2022 when staff and guests celebrated the milestone that is reaching 150 years since Landqart AG was founded.

The company has gone through many changes throughout its long history, culminating perhaps with the creation of Durasafe, the paper-polymer substrate for secure documents that is currently used in banknotes issued from the Bahamas to Algeria and Kazakhstan, and from Switzerland to Malaysia and Cambodia. It's not surprising, therefore, that the company chose to celebrate the anniversary with a housenote that it could share with staff, customers, partners, and other well-wishers.

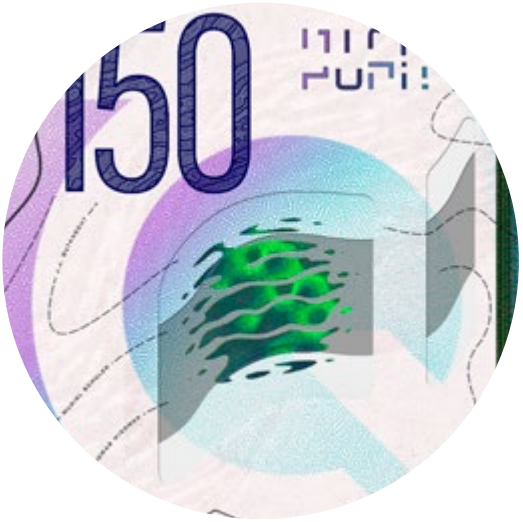
Housenotes have a long tradition in the banknote industry, acting as a way to mark an occasion and to show off the latest technologies and features to best effect, and not often in the most mainstream of ways. With that backdrop, the challenge was set: we had to push the limits of what can be achieved with the substrate (Durasafe, of course), showcase our history and future, and demonstrate how close collaboration between partner companies can achieve something out of the ordinary. With a completely blank canvas in front of us we turned to independent Swiss designer Andreas Iten to create the concept design for us. Andreas was part of the design team behind the award winning 9th Series of Swiss Franc banknotes, and had collaborated with us and the Abu Dhabi based Oumolat Security Printing to create the Chiaroscuro banknote, so we knew we were in good hands.

Andreas worked closely with the Landqart team to prepare some initial concepts that touched on the idea of a journey from the past to the present and beyond, of success built on the hard work of the past.

This was built into the watermarks that Landqart's own designers prepared, a colleague loading material into a grinder –the grinder, no longer used, still stands in the staff entrance to the paper mill – the date of foundation, and the river Rhine, symbolic of the important role that water plays in papermaking even today and the need for industry to respect its local environment. Already at this early stage the project team started pushing the boundaries, adding the watermarks to both paper layers, something that is only possible with Durasafe, and has never been done before.



In choosing the other security features for the note we turned to Kurz for its Kinegram® Cosmic stripe laminating foil, and to Sicpa for SPARK Live®. Realising a longstanding ambition the SPARK Live feature is printed on the transparent window, with the design closely following that the of the river in the watermark. Placing the feature on the transparent window allows it to be viewed from both sides of the note, with the design working well in both vertical and horizontal orientations.



The Cosmic stripe has been applied in x-and y- registration, with part of it clearly visible in reflection, and the remainder in transmission. The foil is applied to one of the paper layers at Landqart before going to the Durasafe machine, meaning that it lies safely behind the polymer layer, protecting it from damage that could occur in circulation and making it harder to harvest for fraudulent purposes. This is a characteristic of the Durasafe substrate, where threads and stripes can be placed inside the substrate. We have pioneered the use of single, very large windows to show the effects of the thread or stripe in the best possible way for the general public to see them clearly, and we have done so again in this note. Seeking to push the limits with in another world first, the design of the note shows the stripe in a diagonal orientation, something we don't believe has ever been done before.

There are many reasons why this approach to applying a stripe hasn't been done before, but what better occasion to try than when celebrating your birthday? We are grateful to the printers and designers at Orell Fussli Security Printing in Zurich who kindly took on the project despite their initial concerns about working with a diagonal stripe. The team there made an excellent job originating Andreas' concept design to bring the history of the company to life on the note.

SUPPLIER INSIGHTS

Using a horizontal orientation to represent the origins and past of the company, the historic side of the note includes many references to traditional notes: heavy Intaglio borders, and detailed vignettes of Landqart in the late 19th and early 20th centuries. The modern side of the note is vertical, with the stripe running diagonally through the middle of the note representing a reel

of paper that has just been removed from the machine, and a stylised depiction of the Durasafe machine as the "portrait". The design of this side has two noteworthy aspects, one is the litho design, which shows off the three-layer structure of the substrate being printed on the note. Remembering that this note was a celebration for all of the Landqart staff, if you look carefully you'll notice that the contour lines appear broken up in places. In truth, the designer managed to incorporate the names of Landqart staff into the note as microtext in the Intaglio print. There are too many to go on a single note, so they are spread out over the entire sheet, making it necessary for everyone to look at the note carefully and then find "their" note.

The modern side of the note is vertical, with the stripe running diagonally through the middle of the note representing a reel of paper that has just been removed from the machine, and a stylised depiction of the Durasafe machine as the "portrait". The design of this side has two noteworthy aspects, one is the litho design, which shows off the three-layer structure of the substrate. Remembering that this note was a celebration for all of the Landqart staff, if you look carefully you'll notice that the contour lines appear broken up in places. In truth, the designer managed to incorporate the names of Landqart staff into the note as microtext in the Intaglio print. There are too many to go on a single note, so they are spread out over the entire sheet, making it necessary for everyone to look at the note carefully and then find "their" note.

The note fulfilled the brief of assisting Landqart celebrate its 150th anniversary; it's a fitting memento for the occasion. More than that it served the purpose of a housenote, allowing Landqart and its partners to push the limits and explore things that are, today, a bit too adventurous to make it into a circulating note, but in a few years, who knows, maybe all the notes out there will have multiple watermarks as well as fully registered, diagonally oriented stripes?

More information about the note:
https://landqart.com/en/150-years-lq

TECHNICAL FACT SHEET

- Concept and Design: Andreas Iten (andreasiten.ch)
- Concept and Substrate: Landqart
- Laminating foil: KURZ
- Origination and Print: Orell Füssli Security Printing
- Inks and SPARK® feature: Sicpa

LANDQART AG

Mr. Richard Perera
Email: Richard.Perera@landqart.com
Website: www.landqart.com

ORELL FÜSSLI

ESCHER®: A 3D INTAGLIO REVOLUTION

ESCHER®: A 3D INTAGLIO REVOLUTION

ORELL FÜSSLI

Intaglio printing creates unique graphical elements on a banknote. The degree of realism achieved is outstanding. However, different ways to create more realistic intaglio drawings are being tested. Introducing top-notch 3D digital technologies will significantly prolong the use of iconic intaglio printing.

Intaglio printing is a traditional banknote production process that is precise, versatile, and secure. Traditionally, intaglio drawings are hand-drawn interpretations of photographs, paintings, and other two-dimensional (2D) visual references. Once the drawings are finalised, plates are produced using computer-to-plate systems and printed on banknote substrates. The resulting graphic elements are tactile and eye-catching – essential to a banknote's look and feel. Artists and central banks have been experimenting with three-dimensional (3D) intaglio elements since the mid-2000s. In 2016, the SNB introduced a 3D intaglio image of hands on the ninth series of the Swiss franc. 3D scanners and security printing software have improved vastly since then. In 2020, the Orell Füssli Design Team launched Escher®, a project dedicated to exploring different 3D intaglio workflows and methodologies within the context of banknote design and production.

FROM ENGRAVING TO 3D INTAGLIO PRINTING

The craft of copperplate engraving dates back to the Renaissance, when artists such as Albrecht Dürer dedicated their lives to mastering and developing this technology and art. While the initial purpose of intaglio was to reproduce illustrations and art, it has become an essential security element. Intaglio printing has been primarily used since the 19th century to print of valuable documents such as share certificates, stamps, and banknotes. The precision and unique look of engraved elements made it an excellent weapon against counterfeiters. The invention of multicolour intaglio by Ivan Orloff in 1890 was a significant milestone, allowing the mass production of increasingly complex banknotes. Today, intaglio engraving is primarily used for banknotes and passports.

Intaglio printing is one of the essential stages in the banknote process – a technique frequently used on both sides of banknotes. The motif to be printed is engraved on a metal plate, forming depressions or grooves. The plate is heated, and the grooves are filled with inks in several colours, usually up to four. Excess ink is wiped away, and the ink is pressed onto the substrate with pressure before drying.

The results are the unique characteristics of intaglio printing, fine lines, full coverage of the substrate, and tactility (the "feel" of the banknote).

CHOOSING A COMPLEX OBJECT

Choosing an object to scan took time. Rounds of trials led us to animal skulls. Skulls, although morbid, present exciting challenges during the scanning and modelling processes. They have many parts (large and small), different surface textures, and a complex interior that generates many shadows. We leaned into these challenges and proceeded with a skull to ensure our method would be compatible with any object. The resulting intaglio drawings are sculptural, hyper-realistic, and three-dimensional.

UNDERSTANDING THE RAM SKULL; ART STUDIES WERE DONE IN OUR DESIGN STUDIO TO GET A BETTER UNDERSTANDING OF THE SKULL'S COMPLEXITY.

TESTING THE ESCHER® WORKFLOW ON DIFFERENT 3D INTAGLIO OBJECTS AND SECURITY SCREENS; AN INTAGLIO PLATE FOR A TEST PRINT. THE COW SKULL AND SNEAKER ARE 3D MODELS. THE RAM SKULL IS A 3D SCAN.

HOW 3D TECHNOLOGY INFLUENCES THE DESIGN PROCESS

Escher® tests two kinds of 3D images: a 3D model designed by an artist and an object digitised by a 3D scanner. The resulting files consist of 3D polygon meshes and 2D photographic textures. 3D models, like traditional intaglio drawings, are highly subjective because artists create them. 3D scans, on the other hand, are precise reproductions free from any artistic styling or interpretation.

Whether to use a 3D model or a 3D scan is entirely up to the design team and the central bank. Both are equally good sources for the 3D intaglio workflow and can be handled identically during the design, origination, and production processes, although retouching is occasionally needed to optimise scans.

Traditionally, intaglio prints are hand-drawn line drawings. 3D intaglio breaks from this tradition and is compatible with multiple security screens and additional features such as latent images. The 3D intaglio workflow is almost entirely automated: designers map security screens to 3D models with state-of-the-art software, rendering every shadow and contour in the finest detail. The resulting screened 3D model can be quickly repositioned directly in the banknote design, even during origination, without rescanning or remodelling the object. Design variations are easy to generate and evaluate.

The realism is outstanding, and the results comply with the highest security printing standards. Tests are underway to apply this workflow to scans and models of buildings and people.

DESIGNING THE ESCHER® NOTE

The design of the Escher® note is inspired by 3D space. The composition has two distinct zones – the left is abstract and isometric, and the right is realistic and photographic. The color palette draws from colors found in the desert during heat spells. The entire design is filled with visual nods to the 3D intaglio workflow:

ESCHER® DESIGN A
THE TWO ESCHER® NOTES HAVE IDENTICAL OFFSET DESIGNS.
THE COW SKULL, PRINTED WITH INTAGLIO IS A 3D MODEL CREATED BY AN ARTIST.

ESCHER® DESIGN B
THE RAM SKULL, PRINTED WITH INTAGLIO IS A 3D SCAN FREE FROM
ANY ARTISTIC STYLING OR INTERPRETATION.

ESCHER® DESIGN A CLOSE-UP OF INTAGLIO SECURITY SCREEN

CLOSE-UP OF 3D-INSPIRED SECURITY SCREENS IN OFFSET (LEFT) AND INTAGLIO (RIGHT)

from the isometric offset motif to the 3D-inspired offset and intaglio security screens.

The intaglio security screens used on the skulls are designed in Corvina Plus – a high-security design and prepress software from Jura Security Printing – with a combination of lines, symbols, and text ("Orell Füssli," "Escher®," and "2022").

PRODUCTION PROCESS

The plate-making process followed the standard workflow of Orell Füssli. A König & Bauer CTIP (Computer To Intaglio Plate) laser engraving system, consisting of a high-precision etching process in special polymer plates, was used. In a subsequent galvanic process, Nickel Alto-plates were drawn from the polymer, and printing plates were produced.

The printing was carried out on a KBA Mini-Orloff Intaglio press, using inks from SICPA SA and proofing paper from Landqart AG. There were no changes or adaptations whatsoever in the plate-making or printing process with respect to standard processes at Orell Füssli.

A FLEXIBLE, NEW METHOD

The advancements in 3D software and scanning present exciting avenues for further exploration, especially regarding portraits and architecture. The flexible, precise, and automated workflow brings unrivalled realism to the design process. Repositioning portraits and buildings without rescanning or remodelling offers unprecedented flexibility to the banknote design process and benefits design teams and central banks alike.

ORELL FÜSSLI LTD. SECURITY PRINTING

Jessica Matthäus, Banknote Design
Armin Waldhauser, Design and Engraving
Dr. Daniel Schwarzbach, Director Innovation

Email: daniel.schwarzbach@orellfuessli.com
Website: www.orellfuessli.com

TECHNICAL FACT SHEET

- Intaglio is one of the essential elements of a banknote design.
- The Escher(r) method renders shadows and contours in the finest detail and is compatible with multiple security screens.
- The resulting screened 3D object can be quickly repositioned directly in the banknote design, without rescanning or remodelling the obejct.
- The realism is outstanding and the results comply with the highest security printing standards.

SUPPLIER INSIGHTS **PWPW**

A BANKNOTE FOR A NEW ERA OF SPACE EXPLORATION

Collector banknotes are a challenge for the companies producing them, providing opportunities to verify new substrates, security features and other parameters before they are used in circulating banknotes. When original artwork is added, collector banknotes gain exceptional value for numismatic enthusiasts.

The latest collector banknote produced by PWPW for the National Bank of Poland was dedicated to the figure of Nicolaus Copernicus - astronomer, physician and economist. The issue of the 9th of February is linked to the 550th anniversary of the great scientist's birth, which falls this year. The note is the result of fruitful cooperation with the substrate producer, CCL Secure. It also demonstrates that very modern and high-tech security features can be successfully implemented in traditional iconography, which in this case are mainly found in the substrate.

In this case, Guardian™ polymer substrate was used. PWPW was accredited to print on it in 2013, and although the printing technology is generally the same as on paper substrates, it requires special handling of the raw material and specific security features. Those implemented on the 'Nicolaus Copernicus' have not been present on a Polish banknote to date. The front of the banknote is dedicated to the eminent Polish astronomer - hence, on the left, there is a transparent window in the form of orbits. The central part of the banknote features the Vivid™ Colour security feature, which is visible as a transparent window in daylight, while under UV light it produces an interesting and colourful effect of the heliocentric system. Verification of the security feature is possible on both sides of the banknote. Shadow™ Image security feature consisting of leaves from an ornament of the tenement house where Nicolaus Copernicus lived in Toruń was also implemented in the substrate. This motif is repeated in different contexts, in other security features, showing new possibilities, giving new effects while achieving visual consistency.

Unique design

The banknote was designed by PWPW graphic designer Krystian Michalczuk on the basis of iconographic materials prepared by the National Bank of Poland and under the substantive supervision of its consultants. For the designer, the biggest challenge was to choose graphic motifs that would blend together, be in keeping with the era, and at the same time it would be possible to implement them in a modern substrate.

The banknote's colour scheme is mainly blue and green, symbolising the sky and the Earth. The aim was to achieve subtlety and soft colour transitions. As for the choice of a portrait of Nicolaus Copernicus, this was not an easy task due to the relatively modest iconographic base.

There are few images of him and, in addition, recent discoveries and facial reconstructions have shown that Copernicus' appearance was far from what we imagine. The image used therefore had to be generally recognisable. The portrait that was most aesthetically interesting and refined was chosen, allowing it to be placed more effectively into engraving. The quality of the source material is quite important, because when using line rather than stain, details have to be taken into account.

An intaglio portrait of Copernicus in brown and red appears on the front of the banknote. At the bottom, latent image in the form of the number "20", denoting the denomination, visible depending on the angle of view, is placed on its background. In the background, a fragment of a colour illustration from Andreas Cellarius' star atlas 'Harmonia Macrocosmica', depicting the Copernican solar system and part of the quadrant scale in white, was offset.

In the central part of the banknote, at the bottom, the inscription DWADZIEŚCIA ZŁOTYCH (TWENTY POLISH ZLOTY) in green, below it the numbering in black and in the background the large number 20. On the left-hand side at the top, the number 20 against a background of a plant motif. Below, in the background, a facsimile of Nicolaus Copernicus' signature and a plant motif also visible against the light. Along the left-hand edge, the typographic numbering is printed vertically in red.

The reverse of the banknote commemorates Nicolaus Copernicus as an economist and founder of the quantitative theory of money. This is symbolised by the following offset elements: a fragment of the obverse of Gdańsk szóstak (six grosz coin) in brown; the reverse of Gdańsk szóstak, above the obverse of Elbląg szóstak created partly from microprinting in the form of the inscriptions NBP, 20, MIKOŁAJ, KOPERNIK. In the central part at the top the name of the issuer: National Bank of Poland in black. Below the inscription: "The task of all noble sciences is to lead man away from evil and to direct his mind towards greater perfection", which is a quotation from Nicolaus Copernicus' work "On the revolutions of the heavenly spheres". Below the inscription is the obverse of the Prussian groat in brown. In the centre, as on the reverse side, at the bottom an oval-shaped transparent element with a drawing of the Solar System in white, which is visible under UV light as a coloured effect.

At the bottom of the banknote, in its background, there is a fragment of the Warmia Chapter Castle in Olsztyn. To the left of the transparent window is a plant motif forming a vertical iridescent stripe, pink in colour, visible depending on the angle of view.

Production at the highest level

The multitude of aforementioned security features was subjected to detailed manual verification by highly qualified personnel with attention to the smallest details. Validation of each piece was carried out at a separate, personalised station to ensure a product of uniform quality.

SUPPLIER INSIGHTS

During the production processes of one of the collector banknotes, also produced on behalf of the National Bank of Poland, a tool to control the correct numbering of collector banknotes was developed at PWPW and was also applied to the 'Nicolaus Copernicus'. The BankNote system consists of multimedia devices and cooperating mobile applications. The app indicates which number the next banknote should have. The two numbers on the banknote are compared and their compatibility and correctness verified. If the system detects an error, it will alert the user about the incident by displaying information such as an incorrect scan, a problem reading the number, different numbers on the banknote, a banknote with a different number than the one expected or a "duplicate". The application will then be blocked and the error information automatically forwarded to a competent person who must verify the situation.

The new collector banknote is an original design that demonstrates that very high-tech security features can be successfully implemented into traditional iconographic elements. It is a very interesting note that is of wide interest to collectors.

POLISH SECURITY PRINTING WORKS:

Ms. Iwona Burczyńska-Bogdańska
Email: I.Bogdanska@pwpw.pl
Website: www.pwpw.pl

TECHNICAL FACT SHEET

PWPW is known for its multiyear experience and competencies in the area of:

- Production of security paper (offering latest durable cotton based substrate technologies with high soiling and mechnical resistance),
- Production of banknotes, passports, IDs, visas, cards and other security prints,
- Providing IT systems in which phisical documents function. Our IT experts design author's IT solutions such as eID/ePassport, specialist software (the so-called applet) together with an operating system and dedicated microchip for biometric documents and cryptographic cards (PWPW SmartApp®), solutions for digital tachographs, elements of Track&Trace systems, Public Key Infrastructure (PKI), and provide a safe wide area network (PWPW WAN).
- Experts of PWPW, state-of-the-art machine park and innovative solutions guarantee high quality and security.

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Daylight view

Rising colour

UV-A Image

Fading colour

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www.mouve.ink

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we're on it.

SUSTAINABILITY

OBERTHUR FIDUCIAIRE

HOW BANKNOTES ARE CONNECTING PEOPLE TO THEIR NATIONAL AGRICULTURAL HERITAGE

How Oberthur Fiduciaire is creating lasting connections between people, country, and agricultural heritage

How banknotes are connecting people to their national agricultural heritage

OBERTHUR FIDUCIAIRE

The fiduciary experts at Oberthur Fiduciaire have patented new technologies that can include up to 20% of a geography's local organic vegetable fibres in the country's banknote paper substrate.

Rather than impacting the integrity and durability of the resulting banknote paper, the company's R&D team found that most local fibres strengthen and increase a paper's cohesion and wet strength.

As a result, banknotes made with a proportion of organic vegetable fibres are more resistant to soiling and contamination. They can also endure more significant mechanical wear and tear, meaning they are more durable and can stay in circulation for longer.

Oberthur Fiduciaire's long-standing relationships with central banks in geographies that produce organic vegetable fibres and the banks' openness to using their country's natural resources in their national banknote production have led to this patented technological development.

Suitable natural fibres for banknote production

Many countries worldwide produce local fibres, like sisal, jute, linen, alfa, hemp, or eucalyptus, which are highly compatible with the specific technical specification of banknote paper.

For instance, the speed at which the hardwood eucalyptus grows, its drought resistance, and its ease of cultivation already make it a popular choice for paper mills.

WHAT ARE THE BENEFITS OF USING LOCAL ORGANIC FIBRES?

Incorporating local organic fibres into a nation's banknote production enables central banks to demonstrate a sense of pride in the work of their farmers and add to the already significant contribution that farming makes to their country's economy.

It also creates a tangible and enduring connection between the people who use the banknotes in their daily lives by celebrating their national agricultural heritage.

And that's not all. Compared with 100%cotton banknotes, banknotes manufactured with local organic fibres provide a range of positive and ethical benefits.

Banknotes made with local organic fibres:

- Contribute to the local economy
- Promote ethical and sustainable farming
- Need less water and few or no inputs, making their cultivation more environmentally friendly
- Enable transparent traceability in the local supply chain
- Provide central banks with a source of positive public relations to strengthen and enhance their reputation

SISAL – A STRONG, VERSATILE, AND ECO-FRIENDLY ALTERNATIVE TO COTTON

Sisal (Agave sisalana) is a material that demonstrates the many benefits of using local organic fibres in manufacturing banknotes.

Sisal is a hardy species of flowering plant native to southern Mexico and widely cultivated and naturalised in many other countries with warm, dry climates where it grows all year round.

When stripped, the sisal plant's leaves produce robust, thick fibres valued for their high tensile

strength. This property makes sisal a versatile agent for ropes, twines, mats, and carpets and as fibre reinforcement in composite fibreglass, rubber, and concrete products.

	Mechanical reinforcement observed	Fitness benefits
Internal cohesion/Scott Bond	↗	Use of Sisal permits to improve paper cohesion and contributes to limit paper destructuration in circulation
Tearing resistance	↗	Better tearing resistance
Folding endurance	↗	Better folding endurance
Wet strength	↗	Better resistance in wet environment

ECOLOGICAL BENEFITS OF LOCAL ORGANIC FIBRE USE

While current estimates suggest that producing a kilo of cotton consumes 8,000 litres of water, sisal needs no irrigation. It can grow in the dry soil of semi-arid areas where rainfall is less than 500 litres per metre square a year and where no other plants grow.

As well as needing very little water to grow, sisal requires fewer resources like fertilisers and phytosanitary products while offering a high yield.

In addition, farmers can upcycle any waste from the sisal production process to produce biogas, pharmaceutical ingredients, construction materials, natural fertilisers, and animal food.

Rank	Country	Sisal production in 2019 (Tons)
1	Brazil	86800
2	Tanzania	32800
3	Kenya	21000
4	Madagascar	17600
5	Haiti	14100
6	China	13900
7	Mexico	12400
8	Morocco	1680
9	Venezuela	1560
10	South Africa	1120

SISAL AND BANKNOTE PRODUCTION

Like cotton, sisal pulp contains large quantities of alpha-cellulose, but sisal has other characteristics that make it an attractive material for use in banknote manufacture.

Due to their morphology, sisal fibres enhance the mechanical properties of the banknote paper mix – increasing the tensile strength, absorbency, porosity, and cohesion of the resulting banknotes and reinforcing their resistance to being folded or torn.

Once in circulation, banknotes with mixed cotton-sisal furnish are more durable than their standard cotton-furnished counterparts. In addition, mixed cotton-sisal furnish banknotes maintain their physical properties and aspect, their level of mechanical resistance, and high quality of sheet formation and watermark aspect.

ENVIRONMENTAL BENEFITS OF LOCAL ORGANIC FIBRE USE

The R&D teams at Oberthur Fiduciaire have worked to increase the percentage of sisal fibres that can be incorporated into the banknote paper mix from 5% to 20% – a significant increase of 15%.

This increase – and the resulting decrease in the need to use cotton fibres – creates a substantial positive environmental impact, reducing water consumption and the use of fertilisers and phytosanitary products. Whether a nation's local organic fibres are sisal, jute, linen, alfa, hemp, eucalyptus – or others – the R&D team at Oberthur Fiduciaire can support central banks worldwide to take a step towards producing more environmentally and ecologically friendly banknote paper.

Cotton: ca. 10000 litre/kg fibre

Hemp: ca. 2100 litre/kg fibre
(including ca. 2010 litre for grow of useful matter)

A summary of the parameters relating to water requirements for the cotton fibre and cotton goods imported annually to the United Kingdom (only including raw cotton imports)

Parameter	Estimate	Unit
Liters of water required to produce 1kg of cotton	9,788-9,958	litres
Total cotton fibre imported to the UK	1.6777x108	kg cotton fibre
Raw cotton imported to the UK	0.2688x108	kg cotton fibre
Waste cotton imported to the UK	0.1966x108	kg cotton fibre
Total cotton products imported to the UK	1.2122x108	kg cotton fibre
Cotton yield	599	kg lint.ha-1
Area required to grow imported cotton products	202,374	ha
Seasonal irrigation requirement	9.15x106	l.ha-1
Total water requirement for imported cotton products	1.8517x1012	l

A summary of the parameters relating to water requirements for hemp production

Parameter	Estimate	Unit
Hemp precipitation requirement per growing season	500-700	mm
Water requirement to produce 1kg of dry matter	300-500	l
Usable fibre from 1kg of dry matter	343	g
Water required to grow 1kg of useful matter	2041-3401	l
Water requirement for scouring of usefull matter	82	l/kg
Overall water requirement for 1kg useful fibre	2123	l

CREATING CONNECTIONS THAT PROTECT OUR PLANET

Oberthur Fiduciaire's research and development teams will work with any central bank that wants to explore integrating locally grown organic fibres into the production of their country's national banknotes.

The teams will identify the local fibres of the interested bank's geography and determine how to incorporate them into the banknote manufacturing process –and in what proportions.

Manufacturing national banknotes with a proportion of locally produced organic fibres can highlight a country's ethical agricultural ethos, connect its people to its agricultural heritage, contribute directly to its economy – and protect the planet.

OBERTHUR FIDUCIAIRE

Ms. Charlotte Lafont
Email: c.lafont@fcof.com
Website: www.oberthur-fiduciaire.com

TECHNICAL FACT SHEET

Sisal fibres for the integration into standard cotton banknote paper:

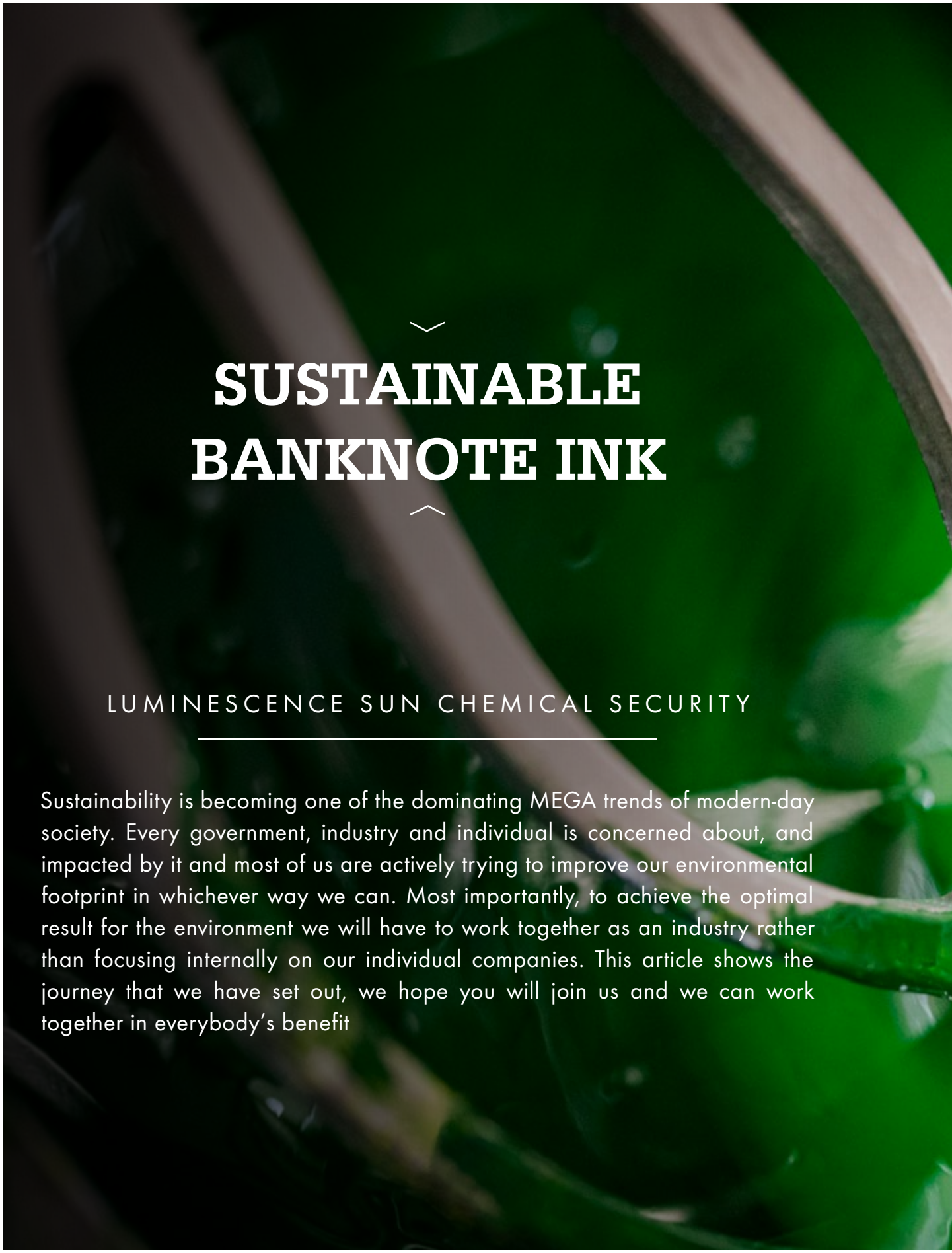
- Enhance the mechanical properties of the banknote paper mix
- Increasing the tensile strength, absorbency - porosity
- Increased durability
- Reinforcing their resistance to being folded or torn
- Same performance in relation to the watermark quality
- More environmental friendly and therefore better sustainability performance

Foto: Dave Hoefler / Unsplash

LUMINESCENCE
SUN CHEMICAL SECURITY

SUSTAINABLE BANKNOTE INK

A realistic journey



SUSTAINABLE BANKNOTE INK

LUMINESCENCE SUN CHEMICAL SECURITY

Sustainability is becoming one of the dominating MEGA trends of modern-day society. Every government, industry and individual is concerned about, and impacted by it and most of us are actively trying to improve our environmental footprint in whichever way we can. Most importantly, to achieve the optimal result for the environment we will have to work together as an industry rather than focusing internally on our individual companies. This article shows the journey that we have set out, we hope you will join us and we can work together in everybody's benefit

At Luminescence Sun Chemical Security we benefit from being part of the largest ink, pigment and coatings manufacturer in the world; Sun Chemical, a member of the DIC group. Our parent company has set out an ambitious plan to become carbon neutral and we can draw from their resources and best-practices. The group has annual sales of more than $7.5 billion. Over 24,000 employees located at 176 subsidiaries across 63 countries work every day to meet the needs of customers by improving performance on the essentials of business, such as reliable, on-time delivery and consistent product quality. Sun Chemical tailors solutions to unique customer needs and brings new ideas and the latest technology to market. Sun Chemical's unparalleled global presence allows for the delivery of local service and support that is customized to the markets it serves. Recognized as a leading source of innovation, the 17 research and development centers of Sun Chemical and DIC are committed to creating solutions that improve productivity, create new revenue opportunities for customers and contribute to a more sustainable future. DIC and Sun Chemical align their sustainability initiatives with the UN Sustainable Development Goals and expect that the main impact of these initiatives will be in the areas of climate change/ resource conservation, sustainable use of natural resources, as well as food, safety and health.

OUR APPROACH

It is our responsibility to raise awareness about environmental issues that are part of our industry, including issues raised by regulatory and consumer-driven forces. Given that responsibility, we have a history of, and continue to develop, methodologies to assess our impact and to innovate processes and products that are more sustainable from both an economic and an environmental dimension. We have in place a rigorous development process and analytical tools that guide our choice of materials and the safety of our products. We strive to use manufacturing processes that demonstrate environmental excellence through reduced waste generation, lower energy and water usage, and strong safety performance as measured by several key metrics—greenhouse gas emissions, energy and water consumption, carbon footprint and safety record. We commit to meeting local regulatory requirements and to working proactively with government, industry trade groups and business partners in the value chain to better define, measure and promote sustainability.

Product stewardship and risk management are also important components of our sustainability policy. We are committed leaders in this area and will continue to take a responsible, analytical-based approach in our efforts. The result of all of these efforts is our ability to provide our customers with eco-efficiency and, in turn, to enhance the sustainability of their processes and end products. Using our long-standing reputation for quality, service and innovation, our dedication to improving sustainability influences both our daily work and our strategic direction across the globe.

"Our key metrics are greenhouse gas emissions, energy and water consumption, carbon footprint and safety record."

CONTINUOUS QUALITY IMPROVEMENT IS IN OUR DNA

SUSTAINABILITY ROADMAP

Luminescence Sun Chemical Security takes a phased approach to our sustainability efforts and uses a roadmap to improve the environmental footprint of our processes and products.

For our processes, we will:

- Review all target reduction opportunities for improvements in energy and water consumption, greenhouse gas emissions and solid waste emissions.
- Measure and report these parameters regularly, by site and by product.
- Establish actions to improve, then recheck and remeasure.

For our products, we have:

- A structured and robust approach to product development that includes risk management and eco-efficiency improvements as key criteria. Throughout our organisation we are working on the development of a Product Sustainability Index that will assist with tracking the sustainability improvements in our product portfolio.
- An infrastructure for product stewardship that leads the industry.
- A proactive approach in working with suppliers, customers, industry partners and trade associations to promote best practices.

OUR PRODUCTS: DEVELOPMENT OF ECO-FRIENDLY SOLUTIONS

Luminescence Sun Chemical Security is committed to developing products that have good sustainability credentials and that assist our customers with their sustainability initiatives. Product sustainability initiatives can be categorized into three themes:

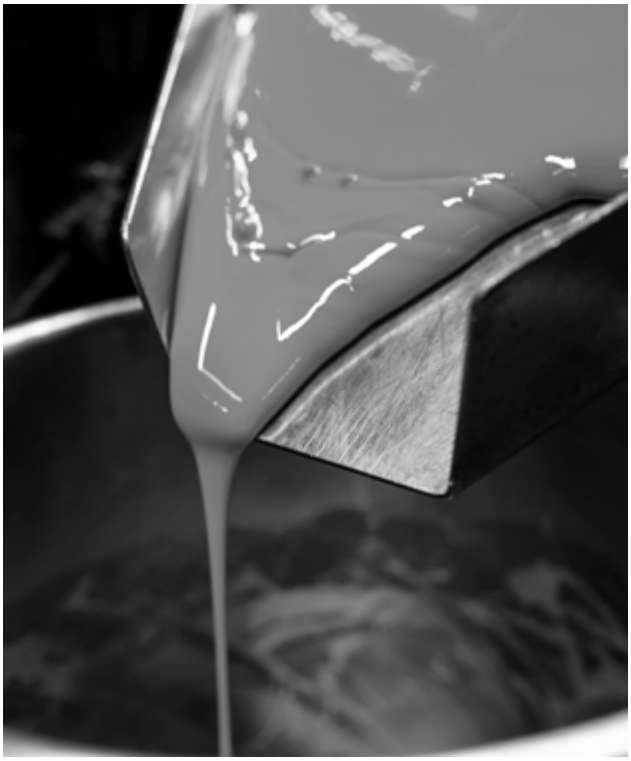
1. The raw materials used and the manufacturing processes
2. The production of our products and the environmental impact of this function
3. The end of life of the products and their interaction with recycling and composting.

In terms of raw materials we were the first to introduce Cobalt-free inks already a long time ago, we were also the first to offer mineral-oil free offset inks to the currency industry and now proudly add another step by offering mineral-oil free intaglio inks. With regards to the production process, we aim to conduct all of our operations with respect for the environment. We are seeking to lower our impact by reducing waste whilst using raw materials, water and energy efficiently. Even though ink manufacture is not regarded as an energy-intensive sector, and therefore is not included in national or EU energy management initiatives focused on high energy using industry processes we constantly monitor energy consumption and actively seek to minimise usage. In 2020 we moved all our solvent based ink manufacture into a dedicated facility with the latest, state-of-the-art equipment and process that ensure VOC emissions are reduced to the lowest possible levels. We have changed the cleaning materials we use to products with a lower solvent content and put in place a cleaning rag recycling program. Since our inks can print on all commonly used currency substrates we are neutral as to which is more sustainable than the other.

We encourage the industry to cooperate rather than to green-shame other products. We are working with various partners to see how we can further reduce the impact of inks in banknote recycling or repurposing schemes.

CONCLUSION

As per the title of this article, becoming more sustainable is a journey and in most cases a rather lengthy one. Therefore we want to be realistic about what is possible and what is not. As mentioned, we have looked through all our processes and products to see where the biggest optimization can be achieved. We also place a big emphasis on travelling this road together with our partners in the total supply chain. From using sustainably sourced raw materials to finding ways to improve recyclability of the end product. Let us, as a complete industry, look for solutions together rather than green-shaming competitors over their achievements, or lack thereof. We have to remember that this planet belongs to all of



us and that we all, together, strive to leave it to our children and grand-children in the best possible way.

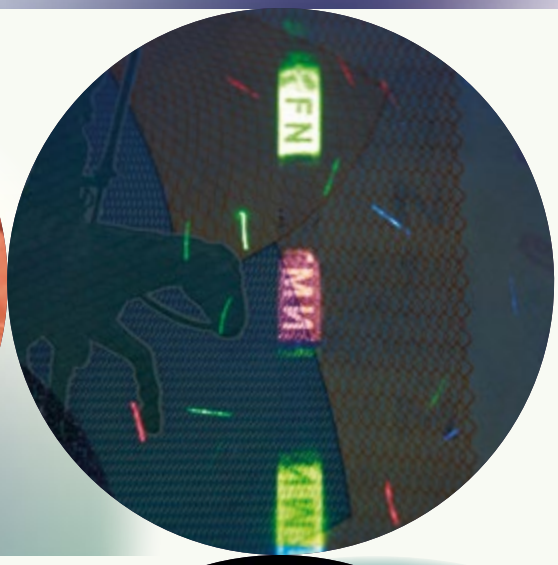
LUMINESCENCE
SUN CHEMICAL SECURITY

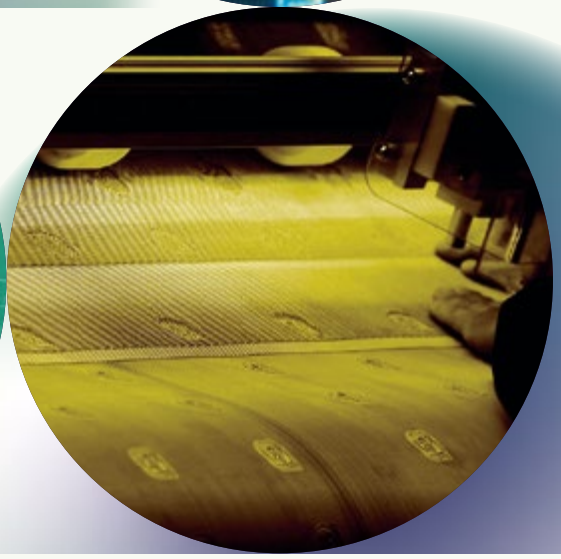
Mr. Gerben Van Wijk
Email: info@luminescence-scs.com
Website: www.luminescence-scs.com

TECHNICAL FACT SHEET

- Mother company Sun Chemical - DIC largest ink, pigment and coatings manufacturer in the world
- LSCS align their sustainability initiatives with the UN Sustainable Development Goals
- LSCS is targetting improvements in energy and water consumption, greenhouse gas emissions and solid waste emissions
- LSCS were the first ink supplier to introduce Cobalt-free inks (several years ago), mineral-oil free offset inks and now even offering mineral-oil free intaglio inks (first to market)
- LSCS inks can be printed on all commonly used currency substrates (cotton, polymer or composite)

QUALITY RELIABILITY SECURITY





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INK

SUPPLIER INSIGHTS

GLEITSMANN SECURITY INKS

MODERNISING TRADITION

THE NEXT GENERATION OF INFRARED INKS

Two years ago, Gleitsmann Security Inks GmbH (GSI) introduced a highly secure, unique and modern product - mouve^{INK} - combining traditional UV colours/inks with a phosphorescent afterglow effect – the World's First Traffic Light for high security printing. While mouve^{INK} clearly offers banknote designers and central banks a new UV-light responsive feature, most banknotes today also include standard, well established and much talked-about, yet simple features detectable in the infrared spectrum.

In the ID sector of the high-security printing industry it has become a standard design element to print parts of a e.g. coat of arms or national symbols with a combination of infrared visible and invisible intaglio colours. Although these features have created a significant barrier against low-budget forgeries, it is questionable how future-proof this IR-combination will be.

Looking at the banknote industry, a similar development can be noticed. Many decision makers have also been relying on a combination of IR-absorbing and IR-transparent inks which can easily be verified by traditional/current banknote inspection modules in sorting machines, ATMs and other conventional checking devices. Unsurprisingly, many forgers have succeeded in copying or imitating such IR-features by using carbon-black and other easily available chemical substances in counterfeit notes, thereby deceiving some low-end checking devices.

The desire of several central banks for more secure and future-oriented IR features has triggered GSI to develop a platform of next generation IR inks, suitable for intaglio and offset printing. Together with its long-term partner Inovink, based in the UK, GSI is now introducing three options of a new series of IR inks, offering decision makers and designers a choice of standard, more advanced and future-proof features. Depending on the individual requirements, customers are now able to select which level of security they want to include on their paper or polymer notes.

GSI's new ink series – called „glair^{INK}" – doesn't just offer different IR absorption characteristics, the raw materials used are also more sustainable than current solutions on the market. It goes without saying that all compositions are REACH compliant from the beginning.

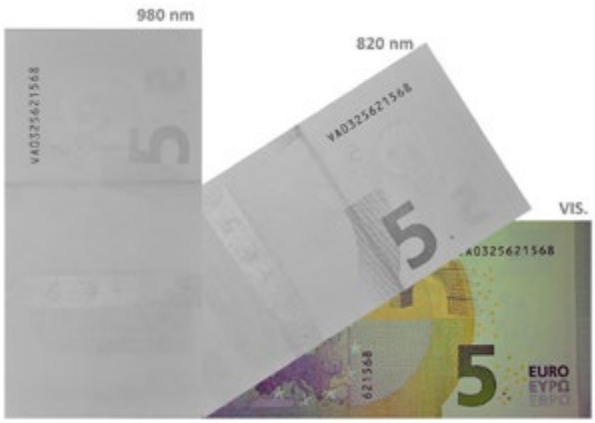
By using this next generation of inks, designers can combine bright, vivid colours with strong IR features in offset and intaglio. Despite the novelty of the applied technology, existing detection devices can verify the IR properties of glair^{STN} and glair^{ADV} without modifications. glair^{STN} provides security printers with a more economic option showing the same characteristic as it can be found on today's banknotes, although it's based on a new technology platform with its own IP attached.

When looking at the hardware used for detecting modifications and fully-fledged forgeries, a technology gap seems to have developed between sophisticated systems available – based on the rapid growth in expert hardware solutions -and todays world of banknote detection sensors.

In April 2022 Intel Inc. published a study which explores how organisations approach security innovation in an increasingly digital world to stay ahead of the evolving threat landscape.

Key results reveal that organisations value security product innovation, especially at the hardware level, when purchasing technologies and services. 64% of respondents say their organisations are more likely to purchase technologies and services from technology providers that are leading edge with respect to innovation[1].

For those banknote experts and decision makers who want to introduce future-ready IR security features which can be checked by the next (hardware) generation of sensors - operating in the range of 1300nm and beyond – GSI's new „glair^{PRO}" is the



[1] for more details refer to https://www.intel.com/content/www/us/en/newsroom/news/study-secure-systems-start-hardware.html#gs.rawxip

SUPPLIER INSIGHTS

product of choice. It exhibits complex IR absorption patterns in the NIR region only accessible to modern detection equipment . Together with other optical security features, the world of security inks can now help reduce the risk of fraud and incorrect findings of verification devices.

Find out more at www.glair.ink

GLEITSMANN SECURITY INKS

Mr Ulrich Walter
Email: sales.gsi@hubergroup.com
Website: www.gsi-gmbh.com

TECHNICAL FACT SHEET

- Central Bank requesting more secure and future-oriented IR features
- GSI in co-operation with its partner Inovink is offering three options of a new series of IR inks: glair^{INK}
- Designers can combine bright, vivid colors with strong IR features in offset and intaglio from now onwards
- Existing detection devices can verify the IR properties of glair^{STN} and glair^{ADV} without modifications

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SICPA

INTRODUCING THE GEORGE BOOLE SPECIMEN

A new intaglio-based multifactor machine-readable element

INTRODUCING THE GEORGE BOOLE SPECIMEN

SICPA

Can intaglio printing, micro-printed data codes and smartphone detection be brought together as an integral security solution?

The SICPA Intaglio Lab and the Detection Security Lab joined forces to address such a challenge. The George Boole banknote specimen successfully brought into being what appears to be separate disciplines where their fruitful convergence marks a major step forward in banknote authentication and integrity.

The project scope spans a breadth of multidisciplinary competencies from banknote design, precision engraving and plate origination, security printing, ink formulation, feature integration, image processing, machine learning and algorithmics — all together supporting the concept of an augmented banknote.

The intaglio-printed Boole specimen contains the combined potential of established and innovative banknote security, ensuring optimal use of engraving technology, ink properties and machine readability.

The modern banknote printing industry has come a long way since its inception. Through the years, requirements in the cash cycle infrastructure have been steadily growing together with new circulation policies and increased safety and sustainability standards. All these require sophisticated ink chemistry to meet the never-ending demand for greater productivity, efficiency, security, resiliency, durability and flexibility. At SICPA, the intaglio ink developments demonstrate the permanent quest for performance and compatibility with the fast-changing parameters of security printing.

INTAGLIO, THE PINNACLE OF SECURITY PRINTING

Built on centuries of artistic heritage, intaglio has stood the test of time and has evolved as a technologically performing and industrially viable security solution for modern banknotes. Today, industrial intaglio printing is an expertise reserved for high-security printers and used for security applications in banknotes, tax stamps, high-value postage stamps and a range of official government documents. Intaglio has proven to be a universal sign of trust, integrity and value, not only for high-security printers, central banks and governments, but also for the general public who has reaped the benefits of its intuitive reading.

Since intaglio fine lines cannot be reproduced without specific materials and security equipment, it has provided high counterfeit robustness. Its contribution to the artistry, functionality, security and durability of a banknote makes intaglio printing undeniably the backbone of quality banknotes. Modern intaglio industrial printing takes a non-disruptive, evolutionary approach, embracing new technologies and methods while ensuring the continuity of existing practices.

Contributing to the evolution of intaglio mastery, SICPA developed an advanced set of processes, formulations and micro-codes leading to the combination of material and digital interactivity, setting a new milestone in the continuous innovation of intaglio printing. The George Boole specimen marks a major step forward in banknote authentication and integrity.

BEHIND THE MIND OF GEORGE BOOLE

Few of us are aware of how the legacy of the English mathematician, philosopher and logician George Boole continues to shape our daily lives in many ways. In 1847, Boole introduced a new branch of algebra dealing with symbols and variables in his first book The Mathematical Analysis of Logic, which later became known as Boolean Algebra.
Nowadays, we apply the law of Boolean Algebra — often expressed as binary code (0's and 1's) — to a vast range of applications and a host of electronic products. Boolean operators — Or, And, Not — are also based on the symbolic logic developed by Boole and are used with fundamental components of digital software and hardware.

George Boole is viewed as one of the forefathers of the information age, laying the groundwork for the development of microelectronic engineering and computer science. SICPA did not think twice of taking inspiration from George Boole's accomplishments into developing a specimen using his portrait which embodied a mind of innovative ideas that brought profound impact to our modern world. The Boole specimen portrays how technology which has been developed up until the 21st century, ultimately led to SICPA augmenting banknotes with novel encoding embedded in the high-resolution intaglio print.

INTAGLIO ENABLES SMART AUTHENTICATION OF BANKNOTES

Digitalisation continues to change and shape the world we live in today, calling for even more trust and security in the products and solutions SICPA offers.

SICPA designed and developed a specific solution intended to make a secure link with the oldest printing process, intaglio, together with one of today's modern and omnipresent sensor machine, the smartphone.

The George Boole specimen, in contrasting classic and contemporary designs, integrates both conventional and novel security features, and is printed entirely (excluding the serialisation) with the intaglio process. Proven security features are integrated into the specimen, alongside with the innovative intaglio symbology for smartphone verification. The combination of material and digital interactivity alongside printing,

image collection, image processing, machine learning, algorithms and smartphone reading sets a new milestone in the continuous innovation of intaglio printing.

THE GEORGE BOOLE SPECIMEN

In-house research and innovation at SICPA, together with developments in partnership with OEBS and their expertise in origination and printing, have brought machine-readable technologies to a new level of sophistication, ensuring the authentication and integrity of banknotes. The George Boole specimen taps into the rich colour potential of intaglio and highlights its universality and multiple capabilities. One may ask, how to tell whether the Boole specimen is genuine or not?

The specimen's latest innovative technologies allow to do so with the convenient use of a standard smartphone, that operates both online and offline, with a dedicated SICPA app. The smartphone's camera captures a live image of the banknote, algorithmically analysing the proprietary micro-codes printed with intaglio.

The Boole specimen involves intaglio printing of a proprietary code which requires specific engraving parameters to be combined with standard multi-tonal inks. Integrating seamlessly in combination with ink properties suitable for both paper based and polymer-based substrates, these codes are highly redundant and fragmented that they are barely visible to the naked eye, while still following and maintaining the overall visual design of the banknote. Moreover, information is encoded spatially and can carry a relatively high amount of read-only data per banknote (in addition to authenticity information) wherein these codes can secure the specimen against forgery through a unique intaglio printing process.

The analysis performed in the dedicated SICPA app determines the level of certainty that the banknote is genuine as well as not recomposed, and only a small number of codes are required to reach a very high level of certainty. This is made possible by the unique physical properties of intaglio and by the structure of the code, which works in favour of facilitating digital detection and interpretation.

SICPA actively works on advancing other projects in related fields to build a more secure and sustainable future.

SICPA

Mr. Diego Cabanelas
Email: security.inks@sicpa.com
Website: www.sicpa.com

TECHNICAL FACT SHEET

- SICPA developed a new element that is machine-readable, and which relies on image analysis and pattern recognition bringing accessible and instant feedback for end-users that include offline authentication.
- The new feature involves intaglio printing of a proprietary symbology/code, which requires specific engraving parameters to be combined with standard multi-tonal inks.
- The feature is compatible with polymer and paper-based banknote substrates.
- The feature can be printed with any standard intaglio presses, using suitable engravings.

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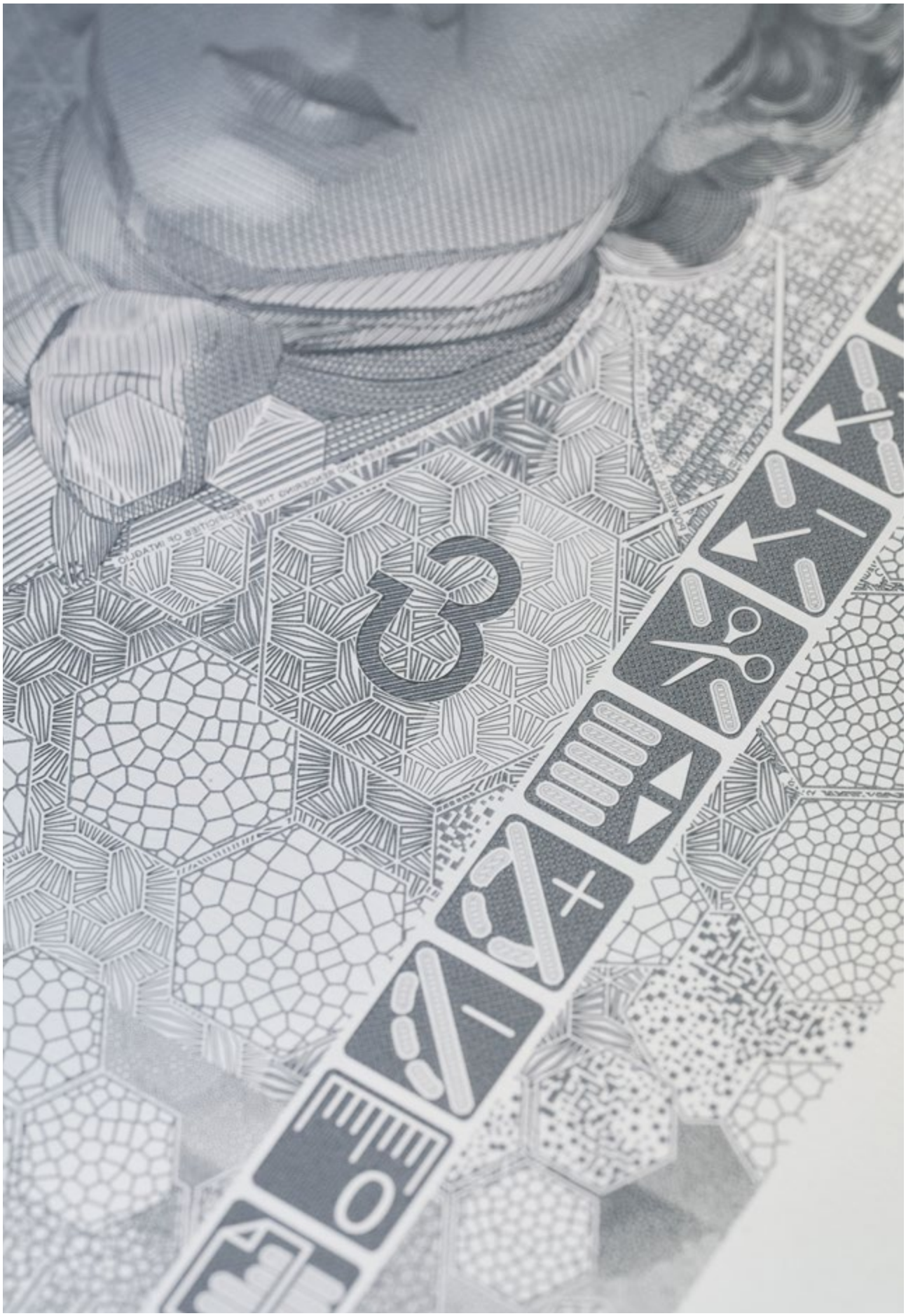
EQUIPMENT /PROJECTS



KOENIG & BAUER
BANKNOTE SOLUTIONS

NEW GREENER ENGRAVING POSSIBILITIES FOR INTAGLIO PLATEMAKING

New greener engraving possibilities for Intaglio platemaking

KOENIG & BAUER
BANKNOTE SOLUTIONS

As a member of the UN Global Compact, the world's largest sustainability initiative, Koenig & Bauer aims to further intensify its efforts to fulfill its ecological, social and community responsibilities. The list of tangible examples of these more sustainable products is getting longer and longer at Banknote Solutions. Today, our portfolio includes solutions for our Intaglio pre-press with our CTiP III machine that extends its engraving greener possibilities.

Our Intaglio engraving equipment has greatly improved its plate engraving capabilities over the last few years, not only through new developments to improve the production performance of the CTiP but also by taking into account more important aspects such as the health of the operators and its environmentally responsible role. Today, while taking into account these crucial aspects, the CTiP III offers the banknote market new engraving possibilities that are as ecological as they are efficient, with engraving on new materials.

A COMMITMENT TO SUSTAINABILITY GOALS FOR THE FUTURE

Koenig & Bauer's concern is not only to ensure that all our products meet the high standards we have set ourselves in terms of energy and resource efficiency. For us, effective environmental and climate protection also means adhering to forward-looking and responsible best practices in our plants and those of our customers.

Minimising the consumption of energy and resources in the production centres and reducing emissions at the workplace are permanent objectives. To this end, we systematically invest in efficient technologies and equipment.

Constantly looking to push our limits and find solutions that are favourable to the development of our environment, our aspirations are based on three axes:

- Increase efficiency by optimising resources and processes, saving inks and reducing waste,
- Enhance security by developing recognisable and attractive Security Features for the general public and cash machines,
- Lower environmental footprint by developing advanced, environmentally friendly solutions and optimising consumption of ink as well as energy.

The CTiP III's developments are impressive in themselves keeping the system fully in line with our commitment.

The CTiP III is a laser system designed for the direct engraving of Intaglio printing plates and Intaglio master plates. Its solid construction, high-precision assembly and its unique drum-based fixing module ensure

stable, accurate and reproducible work throughout the engraving process.

MORE ENVIRONMENTALLY FRIENDLY INTAGLIO PLATEMAKING

Until now, creating an Intaglio printing plate involved multiple steps , three of them using chemicals (nickel and chrome), and took at least a week.

A few years ago, Koenig & Bauer made a huge step towards a greener Intaglio platemaking with the introduction of the PlateCoat. Based on a Physical Vapour Deposition (PVD) process, the PlateCoat was specifically designed for the chroming of Intaglio plates without any production of the harmful hexavalent chromium. Flexible and efficient, the machine is fully integrated in the Intaglio platemaking workflow, while being environmentally friendly.

Today, with the introduction of the CTiP III and its direct engraving capabilities, we go a step further, by offering our customers a safer and greener process. It reduces the time needed to manufacture a plate to about two days, while contributing to the health of operators and the environment by eliminating direct contact with nickel and chromium.

FLEXIBLE PRE-PRESS WITH CTIP III

Equipped with the latest generation of laser (i.e. ultra-short pulse lasers), the CTiP III can engrave directly into metal precise and neat engravings without any redeposition on the sides. The resulting engraved metal plates can be used either as a matrix or as direct plates, for a very flexible process.

The solid granite block avoids vibrations, while the drum-based fixing module allows for

a better precision during engraving. With its adjustable resolution, this versatile solution for plate manufacturing offers total flexibility to your production and saves time and costs.

The CTiP III is your next step toward a more modern and sustainable platemaking solution.

NEW AND GREENER ENGRAVING POSSIBILITIES

Traditionally, metal engraving is done on brass or copper as these materials are easier to engrave. Thanks to the latest generation of lasers featured in the CTiP III, the machine can engrave different types of material, including steel. Due to the material properties, the resulting engraved plate would have therefore a higher resistance on the press. Engraving on steel offers a completely chemical neutral production and is therefore fully environmentally friendly, as it does not use any galvanic solution.

The user-friendliness of the CTiP III makes the switch from brass to steel easy, as only minor adjustments are required. This flexibility is a tremendous asset to cope with the needs of the production.

CONCLUSION

We do everything in our power to optimise the intaglio process, as we are convinced of the value and security it brings to a banknote.

At Koenig & Bauer Banknote Solutions, we pride ourselves on the continuous development of all our processes. Being a full solution provider, we do not limit ourselves to the printing process. This reflects in our activities in the field of Intaglio pre-press over the past few years, where we have made major improvements.

Around the world, governments and Central Banks are making Intaglio the cornerstone of banknote security. It is one of the oldest printing processes, and its distinct texture and tactility make it the most immediately recognisable Security Feature in today's banknotes.

More than half a century ago, our founders developed the first multi-colour Intaglio printing machines. Our commitment to Intaglio is just as important today, as we seek ever more effective and innovative ways to combat counterfeiting in the banknote creation process while respecting our planet.

KOENIG & BAUER BANKNOTE SOLUTIONS

Ms. Vanessa Lauzier
Email: vanessa.lauzier@koenig-bauer.com
Website: www.banknote-solutions.koenig-bauer.com/en/

TECHNICAL FACT SHEET

- CTiP III offers for the banknote market new engraving possibilities that are as ecological efficient and with engraving possibilities on new materials
- CTiP III is a laser system designed for the direct engraving of banknote plates in Intaglio
- CTiP III provides greater process stability and better plate quality
- The CTiP III can engrave plates on steel

BRAKEWALLS ON GIETZ FSA 1060 FOIL COMMANDER NOTA

GIETZ AG

APPLICATION OF NEXT GENERATION SECURITY FEATURES BY HEAT TRANSFER

Application of Next Generation Security Features by Heat Transfer

GIETZ AG

The banknote world and the requirements for banknotes are subject to rapid changes. Security features are evolving, making their application more challenging. The next generation of security foil features pose new challenges.

However, professional solutions for the heat transfer of security features are available. Gietz is known for state of the art in the application of security features in a heat transfer process. With a new release technique for security features the advantages of the flat-flat stamping principle can now be combined with a gentle heat transfer process.

There are three generally available machine technologies to apply security features by heat trans-fer processes in the banknote world: The round-round process, the round-round process in a satel-lite principle and the flat-flat principle. The classic round-to-round, or otherwise called rotary process is becoming less influential in the banknote production process.

Besides the flatbed principle, the round-round process in satellite principle are the most widespread technologies for the applica- tion of security features by heat transfer. Those technologies were developed by various market leaders in the security industry and offer their own advantages.

Since its early beginnings Gietz focused on the flat-flat or flatbed principle and it is the core of Gietz's technology. The flat-flat principle ensures a smooth and high-quality application of security features. The flat stamping process allows for the longest bonding time to transfer the security feature onto the substrate, whilst working with low application temperatures. The low temperature is to protect the security feature as well as the already processed sheets from damage. It further ensures a very homogeneous result over the whole sheet with individual make-ready possibilities.

It provides the best positioning solution to counteract the sheet distortion that may occur in the banknote production process. Foil webs are individually adjustable to achieve the best results. Multiple adjustments are possible. The flat-flat principle allows for a very ergonomic and operator friendly machine. Experience and feedback from the market as well as knowledge gained from hundreds of installed machines flow into the further development of the application of security features by the flat-flat hot stamping principle.

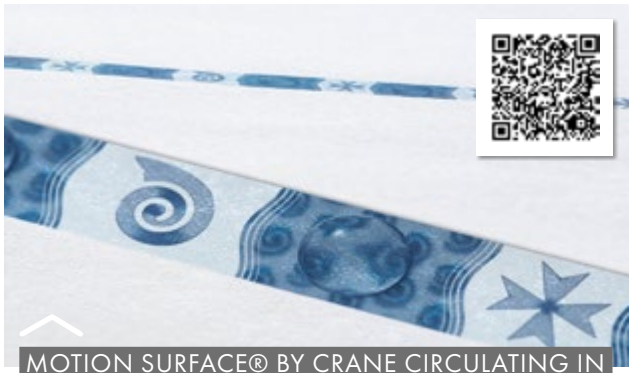
HISTORY OF SECURITY FEATURES BY HEAT TRANSFER

Security foil features applied by heat transfer are one of, if not the most by the public recognised security feature on banknotes, and available in different security levels. This was proven by multiple studies in the past and even today, for a few hundred banknote denominations the security feature by heat transfer is the main key feature seen on banknotes.

When looking back to the history – it all started with different types of holograms, whose introduction onto banknotes started in the late 1980s of the last century. The starting point were 3-D, 2-D, 2- D/3-D holograms.

Various well-known manufacturers of such security features via hot transfer continued to develop their technologies and in addition to, cross-manufactured further developments. Only the most common and popular security features are represented in this report, as there are too many to name. The development and continuous improvements served the goal of making these features more counterfeit-proof and consolidating their presence on banknotes.
Hot transfer security features have a very complex and ever-evolving structure, consisting of many different layers, each with a specific function. In the case of the security features described above, a material that can best be described as a wax was predominantly chosen as the release layer to separate the security feature from its carrier medium. When heated, the wax melts, and the security feature can be applied to the substrate cleanly and with a sharp edge. There is much more to the process just described, and every known manufacturer of these security features has their own know-how in the composition of the various layers.

A few security feature suppliers use other approaches and chemical structures to ensure the re- lease of the security feature from the carrier. In the past the approaches were exotics, but today, the creation of more and interesting secure visual effects is driving security feature suppliers to innovate different feature structures and release mechanisms. Naturally, Gietz is innovating in step with these.



MOTION SURFACE® BY CRANE CIRCULATING IN ASIA, AFRICA AND THE AMERICAS IS AN EXAMPLE OF A NEXT GENERATION SECURITY FEATURE

ROLLINGSTAR® LEAD PURE BY LOUISENTHAL

HOLOGRAM STRIPE "AUSTRIAN ALPS" BY HUECK FOLIEN WITH STATE-OF-THE-ART NANOTECHNOLOGY

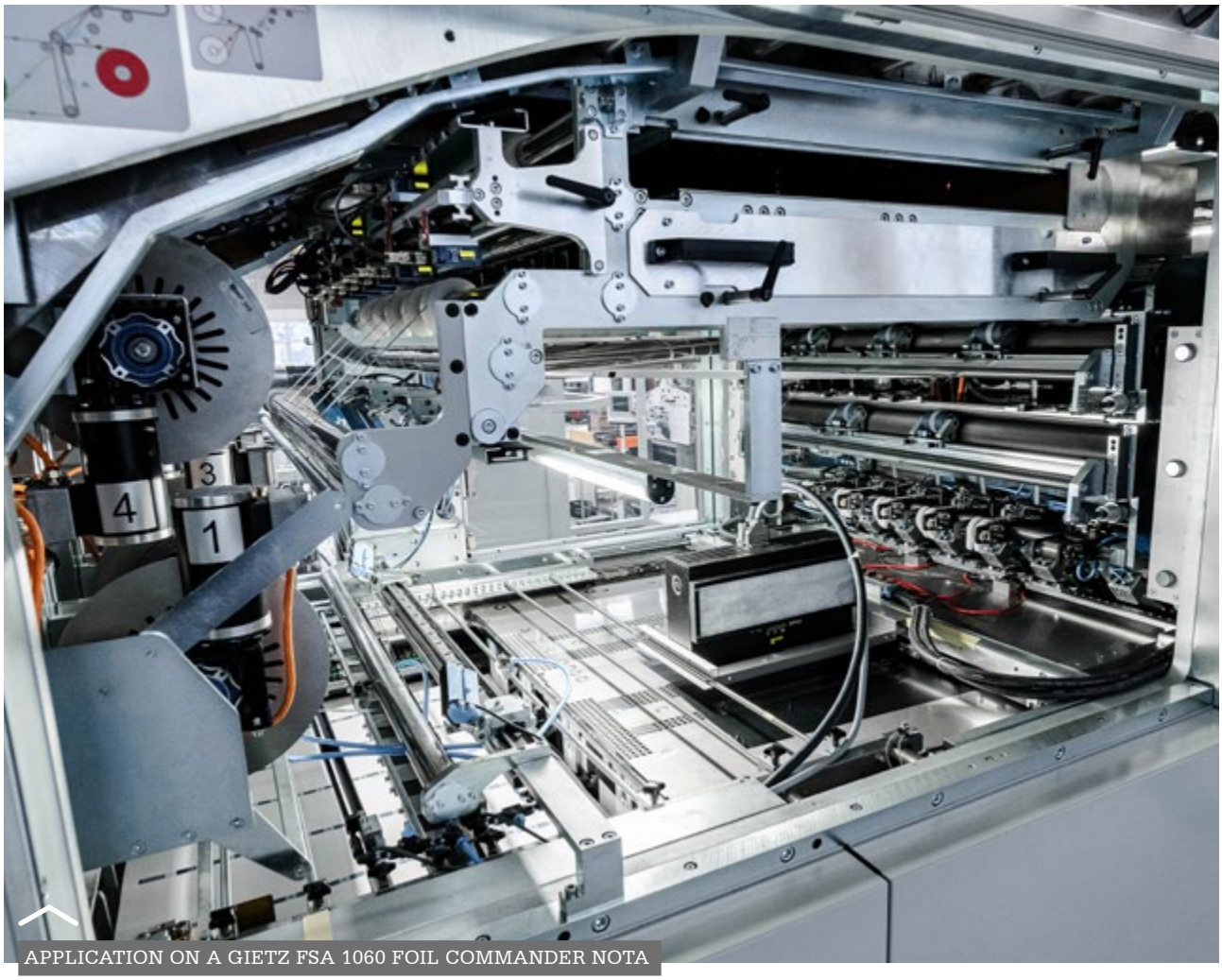
GIETZ APPLICATION ON OUMULAT HOUSE NOTE 'CHIAROSCURO' WITH A KINEGRAM COLORS® REGISTERED STRIPE AND KURZ HOUSE NOTE WITH A KINEGRAM DYNAMIC® PATCH

CHALLENGES FOR A MACHINE MANUFACTURER – TRANSFER PROCESS

In the past few years, the development of security features has accelerated tremendously. The developments have been enormous, and as a result they have been received with amazement and admiration in the industry. The reason for this is that the newly developed security features have increased counterfeit-protection. Nano and micro textures, electron beam technologies, laser lithography, nano imprint technologies, micro and nano structures, micro-lenses, and micro-mirror technologies and more are available.

These newer technologies have brought security features, which are applied via a heat transfer process to another level. A great deal of attention has been paid to micro-lenses and micro-mirror technologies. Not least because of the ease with which they can be recognised and identified by the public.

However, to transfer these new security features requires new structures and materials. The wax as previously described, no longer works here. If particles of the wax from the release layer remain on the surface of the security feature, the appearance of the security feature is impaired.



APPLICATION ON A GIETZ FSA 1060 FOIL COMMANDER NOTA

The big challenge is that the chemical structures of these security features and the release from the carrier medium are fundamentally different and involve very high release forces. The detachment forces are about a factor of 20 times higher compared to the wax types.

IMPROVING THE FLATBED TECHNOLOGY

The described next generation security features pose extremely high challenges for the classic flat- bed process, as the security feature is released simultaneously over the entire surface after the transfer to the printed sheet. This used to be no problem, when the release layers were made of waxes, whereas the new chemical release layers made the application in the flatbed process practically impossible.

In reaction to this, Gietz started a joint project with a strong partner in the field of security feature providers in 2018, with the aim to offer a professional solution. The goal of Gietz was and still is to be able to offer customers and users a versatile machine solution which does not impose any restrictions regarding the manufacturer of security features. Therefore, in addition to the initiating partner, other suppliers of such security features of the newer genera- tions were involved in the development process.

With the newly developed application process, Gietz has succeeded in setting a milestone by using a release technique for the security features applied by heat transfer from the carrier medium. An-other focus of the project was to ensure the ability to convert machines already installed in the market to this new innovation.

Many of the security features are treated again by UV drying after the application to the printed sheet in order to achieve an even better anchoring of the security feature on the printed sheet. For this too, solutions were found and implemented in cooperation with partners from industry.

Gietz is eager to launch its latest developments to the market. This is foreseen by the end of 2023. The market makes the requirements, Gietz answer with the corresponding solutions. The company is excited to see what the further development of security features will bring in the future, knowing that Gietz machines are ready to apply them.

A PIONEER IN A NICHE MARKET

Gietz has been a machine supplier for the application of security features in a heat transfer process for over 40 years. Nowadays Gietz AG is independent and managed in the fifth family generation.

Gietz started with the development of a fully automatic hot stamping press in the late 50ties. The first machine installation for the application of holograms took place in the early 80ties. More than 60 machines in this half sheet size (FSA 790 Nota, FSA 870 Nota) were installed in the high security industry for the application of security features onto banknotes.

In 2010 the first Gietz FSA 1060 Foil Commander NOTA machine was delivered to produce bank- notes. Many more followed in the past years and made Gietz the leading machine supplier for the application of security features in the hot transfer process, still known colloquially as hologram application. The challenges of providing optimal machine solutions continues. With our knowledge, focus on developing solutions and a company philosophy based on customer satisfaction, Gietz can offer the best possible machine solutions.

GIETZ AG

Mr. Michael Grau
Email: michael.grau@gietz.ch
Website: www.gietz.ch

TECHNICAL FACT SHEET

- Gietz developed a new transfer technique by heat transfer for the application of security features (from the carrier medium) - the technique is new to the flatbed process.

- Gietz found also a solution for the treatment by UV curing after the application to the printed sheet in order to achieve an even better anchoring of the security feature on the printed sheet

SUPPLIER INSIGHTS

CASH INFRA PRO

CONTRACT DESIGN FOR INTERNATIONAL CASH CENTER PROJECTS

Central Banks and commercial banks around the world initiate international tenders for the design and implementation of modern state-of-art cash centers and vaults/ warehouses. The specialized companies participate in such tenders worldwide with their internationally valued expertise in cash center engineering by means of optimized workflows and their control, automation, cash handling equipment, IT and security systems. In such international projects, both parties are confronted with different forms of contract design and the legal systems in the respective countries.

Cash center projects are assigned to plant engineering and construction.

When designing and implementing modern cash centers and vaults, the technical components are combined to form an overall "fit for purpose" system with defined objectives relating to the receiving of cash shipments, cash processing and destruction, storage and retrieval, order picking, and consignment to customers.

The technical components of cash handling systems, automation of vault storage and robotics, IT software, and security systems are typically not catalogue products. They are customized and manufactured individually for a cash center to specific customer needs. The implementation must be interconnected for an optimized process flow; coordinated in conjunction with the architecture and the corresponding building services as well as with a control and monitoring concept. The result is a complete cash factory concept.

In this respect, the design and implementation of automated cash centers are plant engineering projects, and therefore a typical project business. As plant construction projects are generally associated with higher risk, the contract should also be suitable for international cash center set-up and reflect their technical and organizational project conditions and risks. In addition, it must adequately and meaningfully address the challenge in a "cross-border project" when project participants from different legal systems come together.

FIDIC model as contractual standard for cash center projects

In order to facilitate international projects in plant engineering and construction, the standard terms and conditions of the FIDIC (Federation Internationale des Ingenieurs-Conceils) contract models were created. Corresponding experience over many years of international practice has been turned into a legal concept that focuses on a frictionless, in-time and overall successful project execution. In relation to typical legal contracts, FIDIC contracts are understood by all parties and not only by lawyers, but also by technical specialists and commercial responsible, and can therefore be implemented in a practical and legally compliant manner.

Major contract models are:

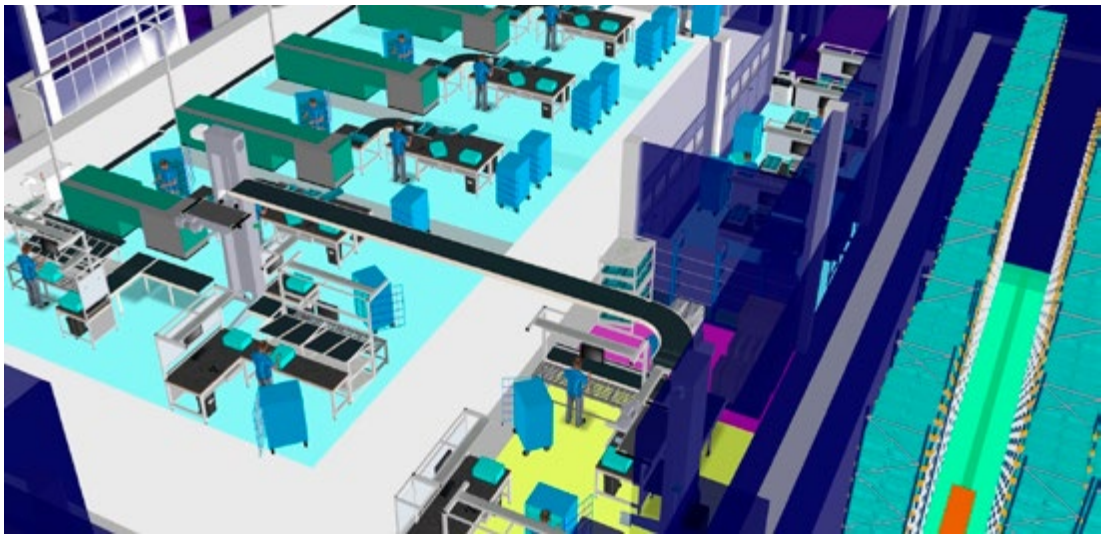
- FIDIC Red Book (Construction)
- FIDIC Yellow Book (Plant and Design-Build)
- FIDIC Silver Book (Turnkey Projects)
- FIDIC White Book (Engineering and Consulting)

In this respect, Central Banks and other cash center principals should consider FIDIC as a balanced and fair standard contract which regulates the relationship between all discipline experts that are involved, from architects and cash center specialists to contractors for building construction and to suppliers for cash handling and automation equipment.

The FIDIC contact standards are enjoying increasing acceptance worldwide and are ideally suited for international cash center construction and automation projects. Today, FIDIC contract templates are already used in all public and World Bank-supported construction and plant engineering projects in Central and Eastern Europe, as well as in the Middle East, India and Africa.

CASH INFRASTRUCTURE PROJECTS AND SERVICES GMBH:

Mr. Jens Eberhardt
Email: jens.eberhardt@cashinfrapro.com
Website: www.cashinfrapro.com



SHRED DING

HUNKELER SYSTEME

ENERGY SAVING DURING THE WHEEL OF DESTRUCTION

Energy Saving during the Wheel of Destruction

HUNKELER SYSTEME

Sustainability is becoming key for our world of tomorrow – Central Banks around the world & the banknote industry are targeting an improved cash cycle. An uncontrolled shredding process can waste up to 100 kW/h, therefore it is essential to pay attention to the end of the lifecycle of a banknote:

An optimized destruction process with the right shredding equipment can support a Central Bank's sustainability target, and support the right recycling strategy for unfit banknotes.

The Wheel of Destruction

Hunkeler Systeme created the "Wheel of Destruction" (see below graph) to achieve a sustainable process in banknote destruction via different steps (see next page(s): Notably, process steps two (2) till five (5) unveil efficiency / energy saving potentials which should be reviewed by each Central Bank.

1. SORTING/WASTE

The pre-defined quality criteria are set by a Central Bank determine the fitness of a banknote at the point of processing. Declared 'Fit' Banknotes will be re-circulated within the banking system, while soiled / worn-out and declared 'unfit' banknotes will be returned to the Central Bank for destruction.

2. SEPARATION

Polymer and cotton-based banknotes in circulation require a different destruction process in order to be "fit for recycling". At this point in the destruction process it can be noted that only with the separation of different banknote substrates a downstream recycling process is feasible.

Until now dedicated shredding lines have been processing either 100% cotton or 100% polymer banknotes. Due to the increased
switch to a mixed substrate strategy by the Central Banks we need to differentiate two different types for destruction:

(I) SEQUENTIAL or (II) PARALLEL: While for (I) the shredding process is fully dedicated to handle only one single substrate at the time, for a parallel sorting and destruction (II), different substrates can be processed simultaneously for destruction, as this system is built up on different "shredding pipelines" which are automatically switching when shredding the one or other substrate.

WHICH SUBSTRATE REQUIRES WHICH DESTRUCTION TYPE?

OPTION 1: COTTON AND COMPOSITE SUBSTRATE IN CIRCULATION.

If cotton and composite banknotes are in circulation, there is no need for separation and sequential shredding is sufficient depending on the recycling process.

Key Findings:

- Cotton and composite substrates with up to a 30% cent polymer /plastic proportion contain the same degree of briquetting feasibility
- The briquettes of both shredded banknote substrates can be used afterwards to the same degree e.g. burning for heating (systems)
- In case briquetting is not required, a big bag or container can be adapted at the end of the destruction lines. The loose material can then be used e.g. for the production of other products such as automotive parts

OPTION 2: COTTON / COMPOSITE AND POLYMER SUBSTRATES IN CIRCULATION (MIXED SUBSTRATES).

In case a Central Bank employs a mixed substrate stratetgy compromising at least one denomination on a polymer substrate, it is recommended to adapt the destruction line to a parallel shredding process. On one line the polymer banknotes will be shredded while the other line is fully dedicated to the shredding of the cotton or composite banknotes. This is required by the nature of the polymer substrate, as a high degree of purity is required for a possible recycling process afterwards. With this purity approach the shredded polymer notes are fit for recycling into other high quality plastic products. For the cotton-based substrates (100 %cotton or composite solutions) standard briquetting can be put in place at the 2nd line of the parallel shredding process (see also above explanation for Option 1).

Key Findings:

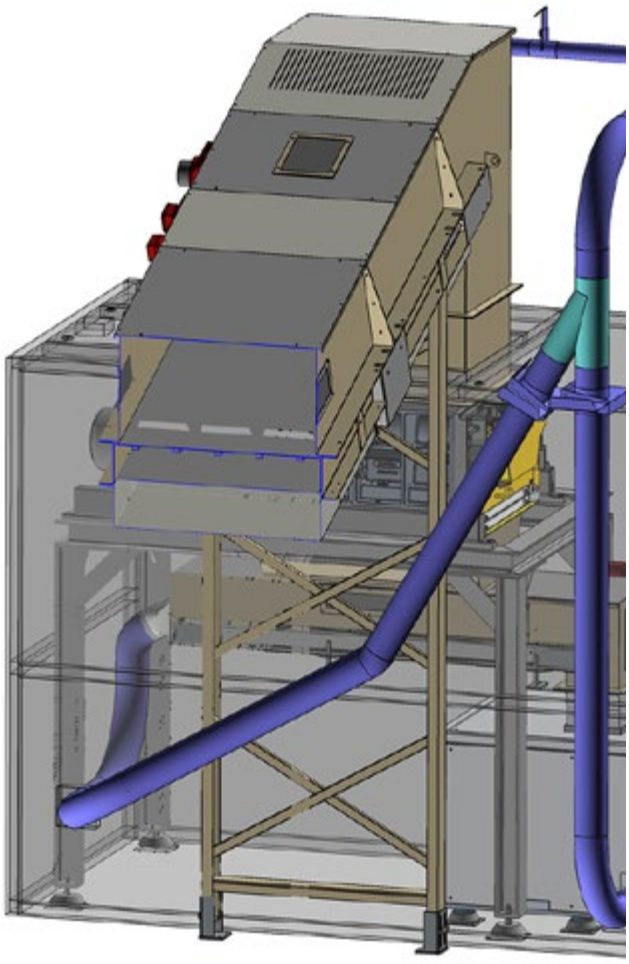
- Mixed substrate strategy requires a parallel shredding system / process to enable recycling.
- Polymer substrate needs a high level of purity for a correct recycling approach.
- A sequential destruction should only be considered if the banknote shreds cannot be recycled

OPTION 3: 100% POLYMER SUBSTRATE IN CIRCULATION

In this case a dedicated destruction line meets the shredding demand. As briquetting is not possible for polymer material the destruction lines are usually equipped with a big bag or stationary press with an exchangeable container solution (in case of larger destruction volume).

Polymer tends to get stuck in various places in the system during the destruction process due to the static charge. The design of the destruction process should comprise of:

- antistatic belt at the conveyor belt
- scraper on conveyor belt
- non-painted inner and clamping surfaces at shafts
- antistatic filter bags
- temperature sensor in the granulator due to the low melting properties of the polymer material



3. SHREDDING

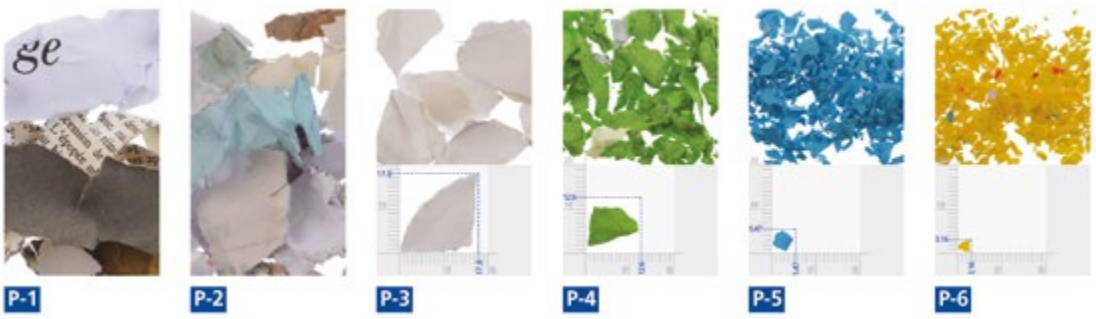
Now we come to the key destruction and we need to differentiate between either a (a) one-stage or (b) two-stage destruction system.

For a "one-stage" destruction system, the shredder chops up the banknotes to the required particle size. Based on the general security level for the destruction of unfit banknotes, a minimum security level of P4 (P5 for lower volumes) conforming to the DIN-66399 is required, while a security level 4 and lower are used e.g. for unprinted banknote sheets.

At the "two-stage" destruction process higher security levels Level 4+ can be achieved with a post granulator with its long-lasting shredder blades. This shredding process is required e.g. for unfit banknotes out of circulation or finished printed banknote sheets at the printing premises which do not match specifications.

Reduction from a two-stage to a one-stage destruction process can cause savings of thousands of Euros p.a. as one shredder aggregate requires up to 25 kW/h less consumption compared to a granulator (two stage process).

The Hunkeler control and workflow manager is continuously monitoring the entire disposal process during the production time. All the relevant information is being stored and displayed in a central control station. The interface allows a transparent view of the actual production as well as of the history data. The workflow software shows transparently to the supervisor in real time the status of the destruction line and the summary of the production data's within a day or a week. The visualization tool is an extension of the HCM PVS17 software and can be adapted to the customer host via XML, CSV interfaces.



LONGEVITY OF SHREDDING KNIVES

It is recommended to pay attention on the longevity of shredding as this reduces maintenance costs and can result in saving of a solid four-digit Euro value per year.

4. FILTRATION

Banknote shreds and other production waste all interfere with production when aiming at higher levels of economic efficiency. The dust-loaden transport air is cleaned in the jet-filter and is either returned to the production rooms or exhausted outside the building; this is the base of saving energy with conditioned (warm / cold) air treatment.

5. BRIQUETTING/COMPACTING

The shredded particles then are sent into a briquetting system or a bagging system.

Main target at the Briquetting/Compacting step is the volume reduction by a factor of up to 12 times. A specific pressing force of 1700kg/cm^2 is the minimum requirement to keep a solid compact shape of the briquettes.

Feasibility of briquetting depends on the substrate type and we need to differentiate between:

a. polymer substrates
b. cotton based substrates inclusive composite

Cotton-based and composite (cotton/polyester) banknotes of up to a 30% polymer/plastic proportion have excellent briquetting properties. The density of pure cotton-based banknotes is significantly higher than composite based banknote shreds.

As for polymer banknotes, briquetting is not feasible, and alternative solutions for shred transportation must be considered (‚Big Bag' solutions for small to medium volume amount or Stationary press /exchangeable containers for large scale destruction volumes).

Key findings
The quality of briquetting is a driver for:

- better transport possibilities
- reduced CO2 footprint
- better burning properties
- easier handling for further processes
- lower disposal costs
- increased cleanliness at the workplace

6. STORAGE/ HANDLING

It is necessary to store the shredded banknotes in an easy-to handle and compact form. Briquetting / compacting of shredded banknotes supports the storage capacity of shredded banknote material:

Calculation example:

- ≈ 100'000'000 shredded banknotes
- ≈100'000 kg
- ≈1000 m3 shredded notes (not compacted / loose)
- ≈100 m3 cotton briquettes

7. TRANSPORT

The transport routes must be taken into consideration when evaluating the most sustainable approach. The following parameters need to be put into consideration:

- volume of shredded banknotes until a full truck can be loaded
- recycling option for shredded banknotes vs distance of transportation

It can be more sustainable to avoid long transport routes for recycling and to incinerate the waste in a controlled manner next to the central bank destruction location.

Lets have a look at a calculation scheme: Transportation of 100 tons shredded cotton banknotes will require several times the total amount of tours if shredded banknotes are not briquetted /compacted: Uncompacted storage and transport leads to unnecessary environmental impact.

8. DISPOSAL / RECYCLING

To learn more about it, please see the recent published 'Sustainability & Destruction Technology' page 10ff

www.banknote-industry-news.com/recycling-report

CLICK OR SCAN

ENERGY SAVING WITH THE GREENLINE CONCEPT

The Greenline Concept from Hunkeler Systeme AG is an energy & cost saving system based on the following parameters:

1. **Automatic switch-off assistant (ASA)**
   A suction system consumes energy at a steady level, whether it is transporting material or not. With the ASA, the suction system is only operating when suction is required, otherwise it is automatically switching off.
2. **Energy saving system (ESS)**
   The energy saving system regulates the energy consumption according to the actual need. With an integrated ESS, the electrical energy can be lowered by up to 40%

3. **Recovery of waste heat from a suction system.**
   A suction system is generating thermal energy when operating. The warmed air allows to heat the production rooms in the cooler months of the year.
4. **Concept and architecture**
   A state of the art concept and architecture of the system including high efficient drives and components reduces the general level of energy consumption and reduces the operating costs for the system.

HUNKELER SYSTEME AG

Mr. Roman Gerhard
Email: info@hunkelersysteme.com
Website: www.hunkelersysteme.com

TECHNICAL FACT SHEET

- The Greenline Concept increases the sustainability of your system.
- The ESS can save up to 40% of the energy consumption of the suction system
- A specific pressing force of 1700kg/cm^2 is required to produce perfectly shaped briquettes
- Recovery of the filtered process air back into the production environment saves energy for AC-units engravings.

CONFE
RENCES

INTERGRAF CURRENCY HIGH & INTERGRAF CURRENCY+IDENTITY

Bilbao, Spain

- Join central banks from around the world to discuss common challenges!
- A truly neutral, professional, non-profit platform to develop the vision, skills and mindsets needed to power up the currency industry
- Action-driven knowledge and resources to help central bank decision makers tackle the challenges of tomorrow
- Practical insights from leading central bank experts into the latest technological innovations and best practices

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- Intergraf Currency+Identity – 18-20/10/2023: € 790 (in stead of € 1 890)

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The Banknote Conference

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Banknote Conference is the industry's premier technology-focused event and has a long and rich history of hosting the worlds technology experts from central banks, printing works and industry suppliers and providing unparallelled opportunity to discuss emergying trends, technologies and innovation.

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CBDC CONFERENCE

The CBDC Conference is the premier event in the Central Bank Digital Currency sphere.

Join central banks, retail banks, policy makers, technology providers and academia in the discussion about CBDC.

Istanbul, 12 – 14 September 2023

Explore. Engage. Excel. **www.cbdc-conference.com**

Conference Announcement

After the successful return of the Mint And Print (MAP) conference held in Dubai in 2022, the MAP team is happy to announce the sixth version of the conference that will be held in Dubai from the 3rd to the 5th of October.
MAP 2023 will provide the perfect platform for Issuing authorise and their suppliers to meet and discuss the latest trends, opportunities and threats related to currency production.
Central Bank attendance is expected to exceed 50 banks, along the line of MAP 2022, and representatives of more than 30 sponsoring institutions.

Join us at the the city where continents meet.

The Conference Topics:

- Currency design
- Banknote origination materials
- Central Bank Digital Currency
- Banknote substrate
- Banknote printing
- Banknote security features
- Currency commemoratives and revenue generation
- Currency processing
- Coin minting
- Contingency planning and crisis management
- Challenges and opportunities

The conference aims to present the latest innovations and initiatives, related to the different steps of the cash cycle, done by both the industry and the central banks and offer a platform to discuss the challenges and opportunities that the currency industry is facing.

We would like to invite you to co-sponsor MAP 2023 that will gather, in the heart of Dubai, central banks and private industries to focus on leading technologies and emerging trends in the banknotes and coins industry.

Sponsorship categories and fees - Banknotes & related suppliers

	Platinum Sponsor	Gold Sponsor	Silver Sponsor	Delegate from non-sponsoring company
Speakers per sponsorship type	3	2	1	-
Meeting room	Allocated	Allocated	N/A	-
Number of delegates (including speakers)	4	3	2	-
Fees per sponsorship type (USD) - excluding VAT at 5%				
Early Registration (Before May 1st 2023)	45,000	30,000	15,000	3,000
Registration (Before July 1st 2023)	50,000	35,000	20,000	3,500
Late Registration (Before September 1st 2023)	55,000	40,000	25,000	4,000
Extra Delegate	2,500	2,500	2,500	N/A

Sponsorship categories and fees - Coins & related suppliers

	Platinum Sponsor	Gold Sponsor	Silver Sponsor	Delegate from non-sponsoring company
Speakers per sponsorship type	1	1	-	-
Meeting room	Allocated	Allocated	N/A	-
Number of delegates (including speakers)	3	2	1	-
Fees per sponsorship type (USD) - excluding VAT at 5%				
Early Registration (Before May 1st 2023)	20,000	15,000	10,000	3,000
Registration (Before July 1st 2023)	22,500	17,500	12,500	3,500
Late Registration (Before September 1st 2023)	25,000	20,000	15,000	4,000
Extra Delegate	2,500	2,500	2,500	N/A

Booth Types

	Large	Medium	Small
Furniture and company logo signage included	5000	3000	2000

Kindly email us if you intend to co-sponsor the event, and in which sponsorship category to send you the registration form.

For further information, you are cordially invited to contact the MAP team at the following email addresses:
info@mintandprint.com | Mazen Hamdan: **mhamdan@mintandprint.com**

Looking forward to seeing you in Dubai

Best regards,
The MAP Team

The Central Bank Payments Conference

CBPAYMENTS.COM

#CBPC2023

CAPE TOWN, SOUTH AFRICA
26 - 28 JUNE 2023

The premier conference for central bank payments and market infrastructure.

FACT SHEET SUMMARY

DE LA RUE p.12

- IGNITE® is now available with sharper and more precise transmissive surface-relief microstructures, which enables new geometric, rotational and contoured effects.
- SPOTLIGHT™ provides intuitive and obvious movement above or below the plane of the foil. It also interacts with a smart phone to become sharper under its torch light.
- Combining effects such as DEPTH™, TRUEIMAGE™, PUREIMAGE™ or SPOTLIGHT™ requires entirely different advanced surface-relief micro-structures, making banknotes more secure.
- The next wave of innovation will be based on the design-led integration of advanced surface-relief micro-structures into SAFEGUARD® polymer windows.

KURZ p.22

- World leading state-of-the-art security elements
- Foil for any application format, machine, and substrate
- Full extent of application support
- Highly robust, resilient supply chain
- Maximized application speed - Minimized waste and down time in production
- Consistent circulation quality and reliability
- Optimized total cost of banknote production

META MATERIALS p.30

- Maximum resolution: 25,400 ppi
- Applied foil thickness: $< 10\,\mu m$
- Feature thickness: $3–6\,\mu m$
- Durability: Fully compliant with established chemical, physical, and harvesting resistance standards
- Standard dimension: Up to 30 mm × 70 mm
- Perceived depth range: Up to 1 cm
- Colour palette: Pastel colour palette that covers the full visible spectrum
- Colour type: Plasmonic colours produced by pure meta-structures that require no dyes, inks, microlenses, or diffraction

CRANE CURRENCY p.40

- Micro-optic windowed security thread, 4 – 6 mm wide
- High-speed moving color effects that are bold and beautiful
- Real time synchronization of color and movement; never before seen and proven easier to use
- Fully customizable color, movement and graphic combinations
- Like RAPID® HD, RAPID® Vision is highly durable and virtually impervious to soiling
- RAPID® Vision Detect provides high security machine-readability
- RAPID® Vision can be overvarnished

CCL SECURE p.44

- Guardian™ by CCL Secure is the #1 polymer banknote substrate with banknotes in circulation for more than 40 Countries worldwide
- 'Window' as a security feature for polymer based banknotes offer a huge range of anti-counterfeiting technology.
- 'Window' itself is a security feature, but can be also over-printed - applied with a Patch or foil stripe (e.g. Kinegram, Motion Surface etc.)
- VIVID™ is a range of coloured visible inks that fluoresce in a contrasting colour when illuminated under UV
- VIVID™ Colour in ambient light, the image appears opaque, but under ultraviolet light a high resolution full colour image comes to life
- Security feature innovations on Guardian™ polymer substrate by CCL Secure are designed to support central banks with their comprehensive strategies to combat counterfeiting

SURYS p.52

- A clear and rapid verification
- Vibrating customized image with numerous animations
- A wide range of possible colors
- Contrasting effects
- Metallic thread attributes (structure, conductivity and durability)
- Width from 4mm
- Options: Bas relief, Cleartext, fluorescence and magnetism

HUECK FOLIEN p.60

- TRILUMIC® is a trademark resulting from cooperation between Hueck Folien and Banque de France
- Hueck Folien uses a special software to generate the print pattern and print all TRILUMIC® colors by three unique inks in different graduation
- The TRILUMIC feature can be used for holographic stripes or security threads
- TRILUMIC® can be over varnished or over printed
- "The Reef" stripe shows a combi-nation of classic hologram together with color relief holograms

PURA p.64

- Pura Group is the largest integrated banknote manufacturer in SE-Asia offering high security banknote paper and state of the art security thread technologies.

- Pura is the Main supplier for banknote paper and security threads for the Bank of Indonesia
- TRANS-COLOR™ security thread to be used as window threads on banknotes and combines color changes both on visible / UV light spectrum with a striking color changing effect.
- TRANS-COLOR™ is available in Copper-Green, Green-Blue, and Gold-Green for visible light and Blue-Green, Green-Yellow, and Gold-Green for UV light spectrum.

IQ STRUCTURES p.66

- Colourless optical security features
- Sophisticated mathematical algorithms
- Advanced nanofabrication
- Wide range of animated non-chromatic 3D effects

SECURITY FIBRES p.70

- Security fibres provide a wide range of verification and anticopy features that are constantly updated in response to countefeit threats
- Fibres can be unique to an application and the colours chosen can be customized
- Leading currencies and most circulating banknotes as the "Euro" or Indian Rupees using fibres
- Fibres have controlled dimensions, consist of overt visible features, covert spectroscopic as well as forensic level and machine-readable components
- Security fibres are one of the most reliable anti-copy security features for cotton-based banknotes

NPA p.80

- An end-to-end robust quality program that ensures spoilage is kept to agreed low levels and delivery dates are met.
- 'Layered' testing approach to maintaining quality using multiple systems ensure that manufacturing defects are minimised.
- Single-note inspection in Finishing is NPA's guarantee to the customer that banknotes have met the agreed quality standard.
- The comprehensive installation of vision inspection systems has enabled NPA operations to track printing performance in real time.
- QMS effectiveness is measured using Spoilage, Schedule Attainment and Overall Equipment Effectiveness (OEE) data.
- Note Printing Australia is at the forefront of a state of the art Quality Management System within the printing industry.

BANQUE DE FRANCE p.90

- The Banque de France Printing Works has a production printing capacity of 2.8 billion banknotes per year >50% earmarked for the export market. Latest printing equipment by Komori and Koenig & Bauer Banknote Solutions have been recently installed
- Recent ISO 37001 Certification
- EuropaFi - the Banque de France's paper mill has a production capacity of 4,500 tonnes a year incl. inline traceability and inspection system.
- LongerFit® offering high soiling and mechanical resistance to banknote paper
- EverFit® is a printed and secured paper banknote that is laminated with a protective layer on both sides as a finishing step.
- The BdF has actively investigated sourcing alternative fibres for its banknote substrates, working towards a more sustainable product.

BUNDESDRUCKEREI p.98

- Bundesdruckerei's SIRA LAB innovation hub seeks to trigger creativity in banknote design and production
- This SIRA LAB innovation hub includes esteemed partners such as Koenig & Bauer, SICPA, KURZ, CCL Secure and Landqart
- Latest banknote design innovations from the innovation hub particularly include ways to use dark coloration to create more secure banknotes

CBN p.106

- CBN has a proven record of integrating innovative technologies into bank note design
- CBN is providing in-house Highly Accelerated Lifetime Testing (HALT) simulations
- CBN has a an indepth understanding of the sensors for machine-readable features
- CBN offering service to "get a Central Bank's perfect banknote"

LANDQART p.110

- Concept and Design: Andreas Iten (andreasiten.ch)
- Concept and Substrate: Landqart
- Laminating foil: KURZ
- Origination and Print: Orell Füssli Security Printing
- Inks and SPARK® feature: Sicpa

ORELL FÜSSLI p.114

- Intaglio is one of the essential elements of a banknote design.
- The Escher(r) method renders shadows and contours in the finest detail and is compatible with multiple security screens.
- The resulting screened 3D object can be quickly repositioned directly in the banknote design, without rescanning or remodelling the obejct.
- The realism is outstanding and the results comply with the highest security printing standards

PWPW p.122

- Production of security paper (offering latest durable cotton based substrate technologies with high soiling and mechnical resistance),
- Production of banknotes, passports, IDs, visas, cards and other security prints,
- Providing IT systems in which phisical documents function. Our IT experts design author's IT solutions such as eID/ ePassport, specialist software (the so-called applet) together with an operating system and dedicated microchip for biometric documents and cryptographic cards (PWPW SmartApp®), solutions for digital tachographs, elements of Track&Trace systems, Public Key Infrastructure (PKI), and provide a safe wide area network (PWPW WAN).
- Experts of PWPW, state-of-the-art machine park and innovative solutions guarantee high quality and security.

OBERTHUR p.130

Sisal fibres for the integration into standard cotton banknote paper:

- Enhance the mechanical properties of the banknote paper mix
- Increasing the tensile strength, absorbency - porosity
- Increased durability
- Reinforcing their resistance to being folded or torn
- Same performance in relation to the watermark quality
- More environmental friendly and therefore better sustainability performance

LUMINESCENCE p.138

- Mother company Sun Chemical - DIC largest ink, pigment and coatings manufacturer in the world
- LSCS align their sustainability initiatives with the UN Sustainable Development Goals
- LSCS is targetting improvements in energy and water consumption, greenhouse gas emissions and solid waste emissions
- LSCS were the first ink supplier to introduce Cobalt-free inks (several years ago), mineral-oil free offset inks and now even offering mineral-oil free intaglio inks (first to market)
- LSCS inks can be printed on all commonly used currency substrates (cotton, polymer or composite)

GLEITSMANN p.148

- Central Bank requesting more secure and future-oriented IR features
- GSI in co-operation with its partner Inovink is offering three options of a new series of IR inks: glair^{INK}
- Designers can combine bright, vivid colors with strong IR features in offset and intaglio from now onwards
- Existing detection devices can verify the IR properties of glair^{STN} and glair^{ADV} without modifications

SICPA p.152

- SICPA developed a new element that is machine-readable, and which relies on image analysis and pattern recognition bringing accessible and instant feedback for end-users that include offline authentication.
- The new feature involves intaglio printing of a proprietary symbology/code, which requires specific engraving parameters to be combined with standard multi-tonal inks.
- The feature is compatible with polymer and paper-based banknote substrates.
- The feature can be printed with any standard intaglio presses, using suitable engravings.

KOENIG & BAUER p.164

- CTiP III offers for the banknote market new engraving possibilities that are as ecological efficient and with engraving possibilities on new materials
- CTiP III is a laser system designed for the direct engraving of banknote plates in Intaglio
- CTiP III provides greater process stability and better plate quality
- The CTiP III can engrave plates on steel

GIETZ p.172

- Gietz developed a new transfer technique by heat transfer for the application of security features (from the carrier medium) - the technique is new to the flatbed process.
- Gietz found also a solution for the treatment by UV curing after the application to the printed sheet in order to achieve an even better anchoring of the security feature on the printed sheet

HUNKELER p.184

- The Greenline Concept increases the sustainability of your system.
- The ESS can save up to 40% of the energy consumption of the suction system
- A specific pressing force of 1700kg/cm^2 is required to produce perfectly shaped briquettes
- Recovery of the filtered process air back into the production environment saves energy for AC-units engravings.

Foundation of Trust

A highly secure substrate is the essential foundation of any valuable document. Such a foundation contributes to building and maintaining the public's trust in banknotes, passports, and other secure documents. This in turn contributes to fraud prevention, and reduces the financial and social costs associated with these crimes.

We take this important message to heart in Landqart. Nestled in the safe and tranquil Swiss Alps, since 1872 we have focused on producing substrates for security documents of the highest possible quality and with unrivalled fraud protection. We continue this tradition today, supplying the substrate used by the world's most recognized and secure banknotes and passports.

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GSI GLEITSMANN SECURITY INKS

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Daylight view | Rising colour | UV-A Image | Fading colour

The unique, innovative security feature combines well-known fluorescent color emissions with a long-lasting phosphorescent after-glow effect, previously not available for the high security printing industry.

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