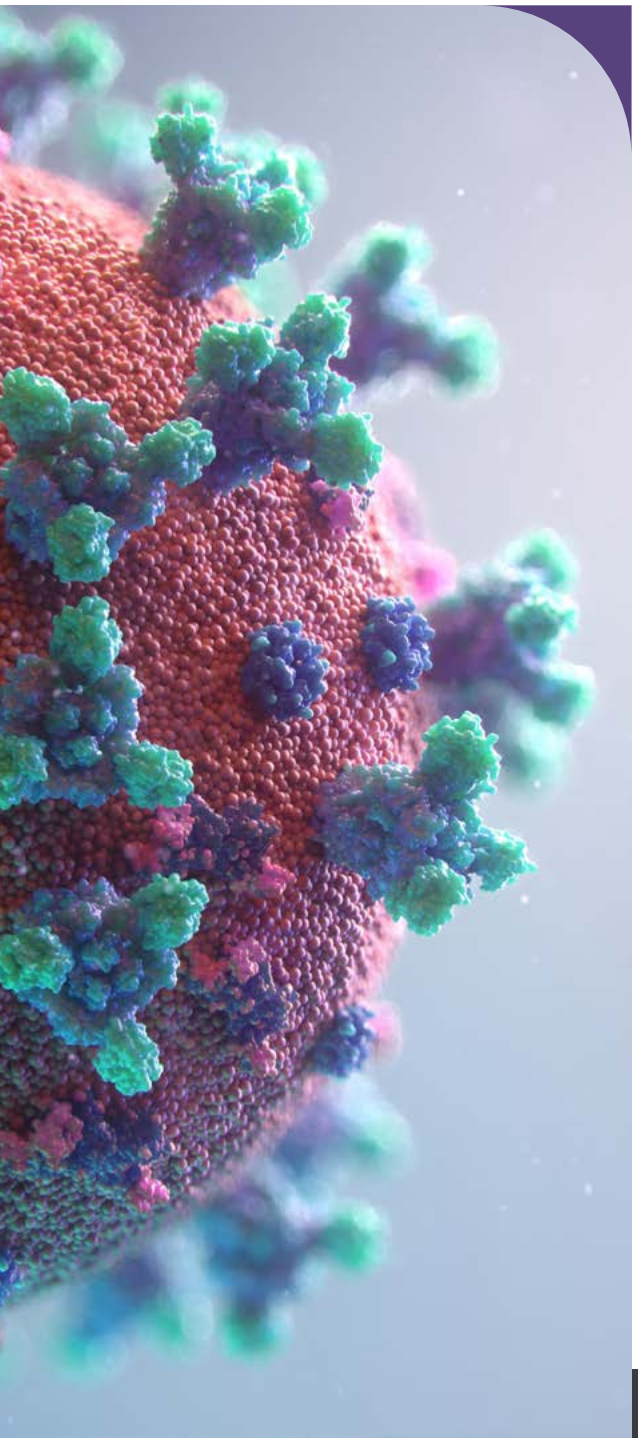
CURRENCY NEWS™

SPECIAL SUPPLEMENT – ISSUE 1 – MAY 2020

Protecting Cash, Safeguarding the Public Against COVID-19 – Part 1



In this report we put COVID-19 in context by explaining what viruses are and the history of recent pandemics. We then look at the evidence (or lack of it) that banknotes harbour and transmit viruses and bacteria and the risk they present to public health, before reviewing the options that central banks have to protect the banknote itself against that risk. Finally, we pause and reflect on what is missing from our defensive armoury and the case for co-operation by all parties to be confident in cash for use in payments.

This report considers mainly those steps that can be taken pre-issue, in the production of banknotes. A second report (part 2) will review how central bank policy and operational decisions contribute to safeguarding the public through measures such as clean note policies, quarantining and disinfecting banknotes.

Viruses and Coronavirus – An Overview

Viruses are coiled strands of genetic material, in a protective coat of protein (and sometimes an envelope of fat), which invade living cells in order to replicate themselves. Coronaviruses are extremely small (65–125 nm in diameter). Viruses are neither alive nor dead – they are not organisms because they can't reproduce or produce their own energy without a host cell.

Because every virus has evolved to target a particular species, it's rare for a virus to be able to jump to another species. But when they do jump to humans, they are known as zoonotic viruses. The transfer occurs by chance and is normally through close contact with body fluids like mucus, blood, faeces or urine.

Coronaviruses are so called because they are covered with bulbous spikes, giving the appearance of a crown or corona. The current coronavirus, COVID-19, or Sars-CoV-2, is thought to have originated in bats and to have jumped to humans via an intermediary, perhaps a pangolin at a wet market in Wuhan, China, the city at the centre of the outbreak. Work continues in China, and around the world, to identify the actual source.

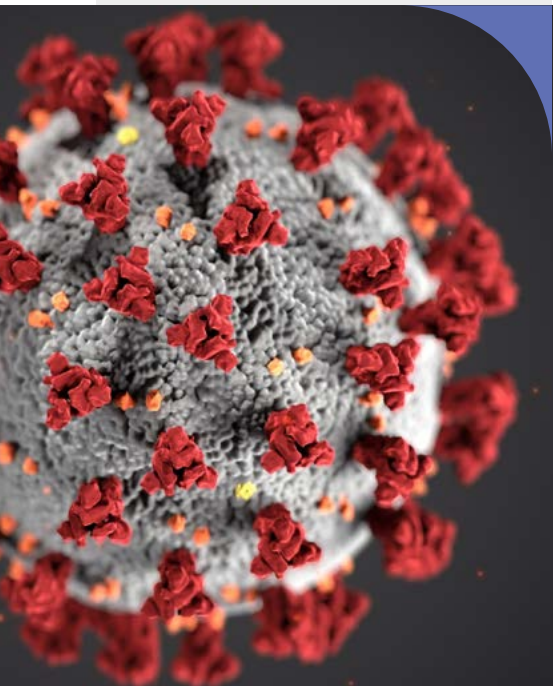
History of Virology

Disease-causing bacteria such as tuberculosis, cholera, and anthrax were first discovered and isolated in the late 19th century. However, a whole group of diseases – smallpox, measles, and flu – remained unexplained.

At first, their causative agents were thought to be very small bacteria, as they passed through the filters that trapped bacteria (in general, they are 50-100 times smaller). In 1898, Martinus Beijerinck noticed that the invisible agent that caused the tobacco mosaic disease could be grown in living plants. He thought it must be some kind of soluble living germ and dubbed it a virus, from the Latin meaning a poison, venom or slimy fluid.

By the 1920s it was clear that a whole class of tiny parasitic microbes called viruses existed. In 1933, it was established that one caused the Spanish flu, but it was not until the electron microscope was invented, in the late 1930s, that they were actually seen and their structure understood.

The second half of the 20th century was the great age of virus discovery: most of the 2,000 recognised species, from hepatitis B and rhinoviruses that cause the common cold to HIV, were discovered in these years. It has still not been established how viruses originated, since they leave no fossil record, but they are found wherever there is life.



Pandemics

When an epidemic spreads beyond a country's borders it officially becomes a pandemic. Today the WHO (World Health Organisation) is the body responsible for making the determination of when an epidemic becomes a pandemic.

In the 20th and 21st centuries the world has witnessed ten major pandemics affecting humans, the most common form being the flu virus (H1N1). The WHO estimates that 250,000-500,000 people die of seasonal flu annually, despite the fact that vaccines are now available to protect against this.

The first, the Spanish flu pandemic of 1918, is estimated to have killed more than 50 million and infected more than 500 million people. Asian flu in 1957, which killed 1.1 million people, was followed in 1968 by Hong Kong flu that killed an estimated 1-4 four million people. HIV 25 (AIDS), which was identified in 1980 although thought to have started in the 1970s, has infected 75 million people and killed 34 million to date.

Severe Acute Respiratory Syndrome (SARS) 2002/2003 is a viral respiratory illness caused by the first human coronavirus, and although its spread was limited to 9,000 people, the death rate was high at 8.6% (774 people).

In comparison, the swine flu of 2009/10, an H1N1 virus, was a type of annual flu virus (for which there is now a vaccine), and is estimated to have infected between 700 million and 1.4 billion people (or 21% of the then global population) and caused about 284,000 deaths. Unlike most strains of influenza, the pandemic H1N1/09 did not disproportionately infect adults older than 60 years.

MERS (Middle East Respiratory Syndrome) is a coronavirus that originated in Jordan in 2012 but was first reported in Saudi Arabia in the same year. The largest known outbreak outside of the Arabian Peninsula occurred in Korea in 2015. The pattern of transmission and virological studies point towards dromedary camels in the Middle East as being a reservoir from which humans sporadically become infected through zoonotic transmission. So far 27 countries have reported cases of MERS, with 4,500 cases and 912 deaths, most resulting from preconditions.

In 2014 to 2016 there was a new highly infectious and deadly virus outbreak, Ebola, thought to have originated from monkeys, which occurred in New Guinea, Liberia and Sierra Leone. Some 20,600 people were affected and 11,225 died. There have been other smaller outbreaks

The pandemic with us now, COVID-19, has a new coronavirus, SARS-CoV-2, that is highly infectious and, as of the end of April, had spread to 212 countries and territories with 3,070,000 reported cases and 202,090 deaths. Reported cases are increasing at around 42,500 each day. These numbers represent tested cases only – many more are thought to have had the disease but with only mild symptoms.

Epidemiologists estimate that 20-60% of the world's adult population could catch this virus. Unlike flu, COVID-19 can take from 2-14 days before symptoms show; with flu it is much less and so COVID-19 has much more asymptomatic time to spread. The result could be 3 billion people catching the virus (assuming 40%), with the inevitable deaths that COVID-19 brings.

Risk of Contagion from Banknotes and Coins

In the March issue of *Currency News*® we covered in some detail the issue of whether or not cash is safe to use. This followed a statement by the WHO (World Health Organisation) after it had declared COVID-19 a pandemic and subsequently advised against the use of banknotes and coins on the basis that the virus could survive on them. The implication was the disease could be transmitted by their use.

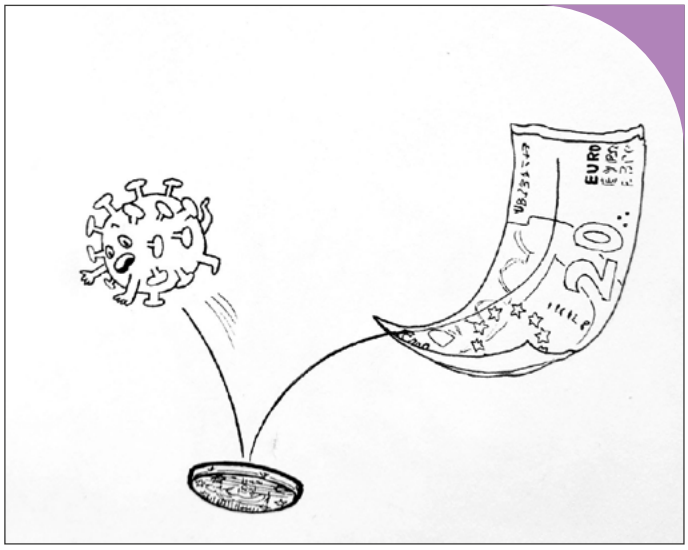
The WHO subsequently issued a statement saying that they had not advocated avoiding cash – 'we did not say that cash was transmitting COVID-19' – but suggested that contactless payments may be a good idea.

The implication that cash could transmit COVID-19 nevertheless remained, as the statement went on to say that the risk posed by handling a banknote is no greater than touching any other common surface. This implied that the risk remained from handling cash and consequently cashless is the better option.

The damage was done – such was the fear of contagion that this information spread like wildfire around the world via both official and social media. And those whose payment systems compete with cash were quick to fan the flames of the fire. Confirmation that people have heeded these warnings is evident in the number of countries where cashless payments have increased since the WHO's statement.

Globally it has been clearly and officially stated that the main form of contagion by COVID-19 is by person-to person contact and hence lockdowns have been established. There are also warnings of contagion from touching anything that may have virus droplets on its surface because these minute droplets could be transferred to the hands and, from there, to the body via the eyes, nose or mouth. However low risk it may be in reality, banknotes and coins are assumed to be a likely medium for catching the disease.

This presents all stakeholders working with cash payments with a significant challenge about how to respond. It is not possible to say that cash is without risk. Pointing out that the touch pad in the self-service check out area or the PIN pad on the payment terminal offers similar risk, let alone the packaging used on the shopping, is a negative and difficult message to communicate.



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Central and commercial banks have had to take immediate steps to safeguard their own staff and to reassure the public about cash usage. Some of these such as quarantining and even sterilising banknotes may have caused as much negative as positive feelings, as such measures imply the banknotes may have been infected.

An area where the industry can be proactive is in new research to help establish reliable statistics on the threat of infection from banknotes.

There has been some research about the ability of cash to carry bacteria and viruses as well as research about its ability to pass bacteria and viruses to those using cash. But none of this research has been with COVID-19, much of it is dated and does not relate to current banknote substrates and technology, and neither does it represent best practice with modern cash cycles nor take into account that some banknotes are treated with products that inhibit bacteria.

Treatments to Prevent (or Reduce) Bacteria and Viruses on Banknotes

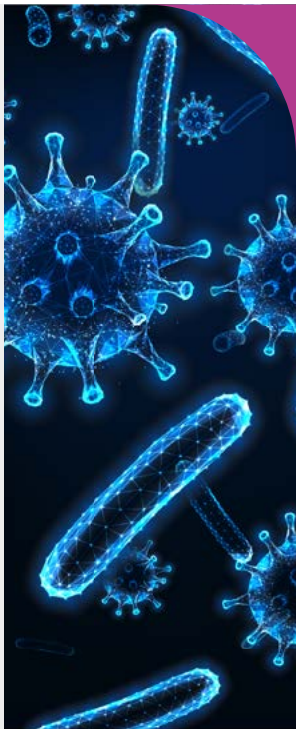
There are three types of unwanted organisms that can contaminate banknotes. Mould or fungal growth, which can affect their appearance, bacteria and viruses.

In the case of mould or fungal growth, fungal spores abound in the atmosphere. Spores on banknotes, when left in an ideal environment for fungal growth – ie. warm, humid conditions – will show mould growth quickly, as this is a natural biological process. Fungal spores can contaminate banknote paper during the paper production process as they are resistant to the temperatures used to dry the paper and it is common practice to treat the paper in production at the size bath. Treatments can also be coated or applied in printing.

A difference between bacteria and viruses is that most viruses cause illness, whereas not all bacteria do. Harmful bacteria are usually called pathogenic bacteria because they cause disease and illnesses like strep throat, staph infections and food poisoning. Some of the most common viral infections include the cold and flu viruses.

There are two types of bacteria that affect banknotes in circulation. Actinobacteria, which proliferate on the substrate and physically degrade it, and those types that merely survive on the substrate but do not proliferate.

As a result, two distinct types of chemical treatment have been developed for banknotes – fungicides for preventing fungi and mould growth, and biocides for the prevention of bacteria and viruses.



Contaminants on Banknotes – Overview of the Research

By far the most likely way of becoming infected is from direct contact or close contact with other infected people. The potential also exists, of course, to pick up bacteria or viruses from anything we touch as they live on virtually everything that we all encounter in making payments or withdrawing cash, so not only banknotes but also credit cards, the buttons on ATMs and POS terminals, smartphones, door handles, pens and counters.

There are two types of organic contamination on banknotes, bacterial and viral. Concerns are nothing new and a number of studies have been undertaken over the past five decades into bacterial contamination.

The first time the presence of bacteria on the surface of banknotes was identified was in 1972 by the American Medical Association. Then in 2001 a study by the Institute of Biomedical Studies in Rio de Janeiro found that eight different types of micro-organisms could commonly be found on paper and plastic banknotes.

In 2010, in a paper entitled 'Evaluation of the Microbial Contamination of Bangladesh Paper Currency Notes (Taka) in Circulation', conducted by the Institute of Food and Science, seven species of organisms were detected from which 169 bacterial isolates were recovered. The study suggested that Bangladesh paper currency is contaminated by, and may play a significant role in the transmission of, harmful micro-organisms such as cholera, diarrhoea, and skin infections. The conclusion was that great care should be taken during the handling of money and food to avoid cross contamination.

A similar conclusion was drawn in a paper entitled 'Dirty Money – An Investigation into the Hygiene Status of Some of the World's Currencies as Obtained from Food Outlets' by the Institute of Crop and Food Science, the University of Ballarat, Victoria, Australia, A total of 1,280 banknotes obtained from food outlets in 10 different countries (Australia, Burkina Faso, China, Ireland, the Netherlands, New Zealand, Nigeria, Mexico, the UK and US) were examined for their bacterial content.

There was a strong correlation between the presence of bacteria and a series of indicators of economic prosperity of the various countries. The strongest correlation was found with the 'index of economic freedom', indicating that the lower the index value, the higher the typical bacterial content on the banknotes in circulation.

Other factors that appeared to influence the number of bacteria were the age of the banknotes and the material used. The banknotes were also screened for the presence of a range of pathogens but these could only be isolated after enrichment and their mere presence did not appear to be alarming.

So a good number of scientific studies by reputable institutions have revealed the presence of bacteria on banknotes. But what about viruses?

The argument as to whether or not physical currency carries a risk of transmitting the novel coronavirus COVID-19 to the handler is currently of paramount importance in this pandemic, especially as the public has been led to believe that it can.

Three studies conducted before the emergence of COVID-19 on the microbiology of pathogenic agents are of interest.

Thomas et al (2008) of the Central Laboratory of Virology, University Hospitals of Geneva, Switzerland determined that some viruses, including human influenza, can survive for hours or even days on banknotes.

Influenza A viruses tested by cell culture survived up to three days when they were inoculated at high concentrations. The same virus in the presence of respiratory mucus showed a striking increase in survival time (up to 17 days). Similarly, B/Hong Kong/335/2001 virus was still infectious after one day when it was mixed with respiratory mucus.

The authors concluded that the unexpected stability of influenza virus on banknotes, a non-biological environment, suggests that unusual environmental contamination should be considered in the setting of preparations of a pandemic.

Lopez et al (2011) found that porous surfaces, such as paper, are associated with less efficient transmission of viruses and bacteria in comparison to non-porous surfaces. Nine different materials were tested, including cotton-based $1 bills, which showed a comparatively low transfer rate from the object to fingers for all tested pathogens in a variety of environmental conditions.

Research of Angelakis et al (2014) showed that various pathogens including viruses, bacteria, fungi and parasites can persist on banknotes and coins. It concluded that paper currency and coins may be a public health risk when associated with the simultaneous handling of food and could potentially lead to the spread of infections in health care facilities.

But while the above studies are of value in indicating that banknotes can carry bacteria and viruses, it is COVID-19 that is currently disrupting the world. Facts and figures are needed about how COVID-19 survives on banknotes and how readily it can be passed from the banknote to its handler.

Kampf et al (2020), from the Greifswald University Hospital and Ruhr-Universität Bochum, in Germany, have recently compiled information from 22 studies on coronaviruses focusing on how long these can survive on inanimate surfaces, such as tables and door handles.

The authors show that, depending on the material and the conditions, human coronaviruses can remain infectious from two hours to nine days at room temperature. At higher temperatures of 30–40°C, coronaviruses tended to persist for a shorter time. At room temperature, a coronavirus responsible for the common cold (HCoV-229E) persisted significantly longer in 50% humidity than 30% humidity.

The analysis of the literature on the persistence of coronaviruses on different surfaces showed variable results.

For instance, the MERS virus persisted for 48 hours on a steel surface at 20°C. However, on a similar surface and at the same temperature, transmissible gastroenteritis virus (TGEV) survived for up to 28 days. Similarly, two studies investigated the survival of two strains of the SARS coronavirus on a paper surface – one survived for 4–5 days, the other for just three hours.

The latest study by Chin et al (2020) from the University of Hong Kong examines survival types of COVID-19 on various surfaces including paper, plastic and banknotes, among others. On ordinary paper the virus was not detectable after three hours, but on a banknote it survived for between two and four days. On plastic the survival time was even longer – four to seven days.

Overall, COVID-19 (SARS-CoV-2) was found to be highly stable in a favourable environment but was also susceptible to standard disinfection methods.

In summary, research has shown that banknotes can carry both bacteria and viruses and many types of both. We also know they can carry them for periods as short as hours or for several days.

However, apart from the recent study by Chin et al, which was not specifically related to banknotes, most of the research is dated and banknotes have gone through much change in the last 15 years. In particular, most cotton-based substrates now use pre – or post-print treatments or varnishes to extend note life by preventing the adherence of substances from repeated handling. Furthermore, there are now more countries using polymer banknotes plus a number of hybrids. Both developments have fundamentally altered the surface characteristics and/or composition of banknotes.

We do know from one research study that COVID-19 can be carried on banknotes but there is much more that we don't know and that we need to know if banknotes are to continue to be used without undue fear of infection from this virus.

There are treatments (reviewed here) for bacteria and viruses that, in conjunction with a robust clean note policy, should greatly improve the public's perception of and confidence in banknotes.

Bioguard – an Industry 1st

***Bioguard*® was developed by the French banknote papermaker Arjowiggins Security and introduced in 2004 to prevent the spread of bacteria and fungi on paper. It contains a treatment that prevents reproduction by two of the most notorious families of bacteria widely found on banknotes, e-coli and staphylococcus, as well as microscopic fungi.**

It was tested by both NAMSA (North American Science Associates) and Lyon University's Faculty of Pharmacy. In one test Bioguard paper inoculated with e coli showed a growth rate of less than ten CFUs (colony forming units) per gram in 24 hours, whereas the normal rate of reproduction for paper contaminated with this bacterium is 21 million CFUs per gram in 24 hours.

The bactericidal and fungicidal properties of Bioguard paper had no effect on its physical properties, were not affected by lithographic and intaglio printing and by washing, and were maintained in artificial ageing tests. From a health and safety perspective, the treatment did not result in any additional irritation or sensitization.

BioGuard was first used in 2005 on Morocco's 100 Dirham note and was adopted for all six notes in the new Philippines series introduced in 2011.

In 2010, the company introduction *Bioguard V*, which additionally offered a defence against viruses, specifically those which caused common colds and influenza. The company claimed it was shown to have reduced the density of an invasion of viruses to negligible levels within 24 hours.

Arjowiggins ceased production of banknote paper in France in 2019 but prior to that, in 2017, sold its Dutch papermill, VHP to Oberthur Fiduciaire and, with it, the rights to use its technologies and expertise, including Bioguard and Bioguard V.

Now Oberthur has taken the technology further with the launch, announced in the March 2020 of *Currency News*™, of *Bioguard Enhance*™.

According to the company, Bioguard Enhance, which is applied to the surface of banknotes in either the paper making process or as a post print varnish, is effective against coronaviruses. Tests carried out in an independent accredited laboratory in the US, BCS, involving the coronavirus OC43, a family that affects humans, showed that under standard test conditions 99.9 % of the virus was eliminated.

The Bioguard technology from which Bioguard Enhance was developed has already been certified under ISO 10993 in France and, in the US, by Biomatech, a NAMSA member company.

Oberthur Fiduciaire has indicated that Bioguard Enhance is available to all accredited banknote papermakers and banknote printers as part of its commitment to assist the world's fight against COVID-19.

A number of paper mills have already had experience of adding the Bioguard family of products to paper – Louisenthal in Germany, Crane in Sweden, FNMT in Spain, Portals in the UK and Oberthur's own paper mill, VHP Security Paper in the Netherlands.

Goznak's Biocide Solution

The Russian banknote printer and papermaker Goznak was the second substrate producer to develop a fungicide and biocide treatment, in cooperation with the Research Institute of Epidemiology and Microbiology of the Russian Academy of Medical Science.

The two organisations conducted an analysis of the surface micro flora on worn banknotes to establish the general microbial impurity, the identity of the micro-organisms and the integrated level of potentially pathogenic micro-organisms, finding that 100% of the notes were contaminated and that around 20% of the 34 micro-organisms revealed were potentially pathogenic.

To counter this and provide antimicrobial properties to the substrate, Goznak developed treatments which did not affect the technical process in paper production or the paper's mechanical and other properties. The chosen treatment, based on a polymeric solution, was found to provide protection from a variety of viruses, fungi and bacteria and was safe for humans.

Goznak's treatment can be used in the pulp or applied to the surface of the finished paper web and, according to the company, has the added advantage of improving the mechanical characteristics of the paper. Moreover, the consumption of the solution is economic – roughly 5 grams per litre.

Goznak patented the technology in 2006 (RU No 2318942) and uses the technology in both its St Petersburg and Krasnokamsk banknote paper mills. To date the export market for the product on banknotes has been for countries in Africa.

To add to this, and in response to the currency pandemic, Goznak has issued a statement, commenting that 'special additives with biocidal properties are used in the production of banknote paper applied for printing Russian banknotes.

'The exact composition of such additives is not disclosed because it is classified as restricted-access information. The applied agent prevents and slows down reproduction of viruses, fungi and bacteria on the product surface. Thus, Russian banknotes really have additional protection against harmful microorganisms in their basis'.

Comprehensive Protection from Intace

One company that specialises in supplying both fungicides and biocides for the protection of paper, board, non-wovens, textiles and plastic is Paris-based Intace.

The company's fungicide treatments consist of two or more substances that provide comprehensive protection against a wide range of moulds and fungi. Similarly, the company's anti-microbial products protect against a wide range of microbial infections.

Both the fungicides and the biocides are designed to be easily fixed to the surface and do not migrate. The anti bacterial, anti viral treatment is best added in a varnish because the bacteria and viruses adhere to it and are then killed. Even after washing the varnish it remains active. Protection against fungi and moulds, and bacteria and viruses respectively, lasts for up to three years, even in conditions highly favourable to growth such as tropical conditions.

Both types of product, according to the company, have each been successfully tested against a wide range of organisms and although the anti-bacterial product has not yet been tested against COVID-SARS-2, the company is confident that it will kill the virus as it is similar to other coronaviruses that the product has been tested against and proven to kill.

To the left of the red line is the mould on banknotes that have not been treated with Intace Protect® after six day's exposure to humidity, whilst to the right are the same banknotes to which Intace Protect® has been applied.

A dosage of 3 kg per tonne is considered adequate for protection. Application can be at the paper mill, via the size press, coater, and the converter or at the print station. The company's formulations are patented and meet European BPR and USA EPA requirements.

According to Intace, it provides quantitative and qualitative laboratory services, including AATCC, Afnor, Tappi, and ASTM testing, and can evaluate the mould and bacterial resistance of customers' products, identify the origin of the contamination (species) and recommend the dosage of its products accordingly.

BioNote – Organic Banknote Protection

***BioNote*®, produced by Inovink – a British specialist in additive ink materials for banknotes – is the latest addition to the list of products to protect currency against contaminants.**

BioNote is a novel anti-microbial material which can be added to all types of protective varnish coatings used in banknote printing and can also be added to paper during the manufacturing stage or to polymer substrates during the opacification process. Inovink has a long history of developing additive materials for banknotes and is the owner of some 30 patents worldwide, most of them banknote related.

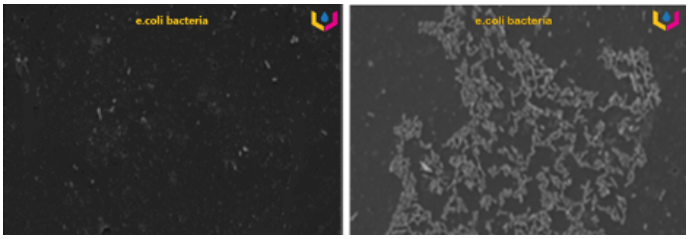
BioNote does not rely solely on killing microbes on contact but works by using nature's ability to keep surfaces clean. When microbes land on a surface, biofilms are formed which create an attractive environment for other microbes to join. It is this biofilm that then becomes a potential health hazard. BioNote works by inhibiting the formation of this harmful microbial colonisation, thereby keeping banknotes safer and cleaner for longer. It is a new science for the banknote industry and different from current anti-bacterial products.

BioNote was developed over a period of four years in conjunction with Penrhos Bio, a Unilever joint venture company. The companies' combined research showed that a naturally occurring material found in marine ecosystems can be applied to banknotes to fundamentally inhibit microbial growth, thereby preventing a problem from developing.

The active material in BioNote is a furanone chemistry analogue which provides an effective, broad spectrum microbial, fungal and algae inhibitory action and is non-toxic to humans.

In tests, both polymer and paper banknote substrates were printed with banknote varnish containing varying concentrations of BioNote material. Printability and appearance were not affected by its presence and subsequent independent laboratory tests (crumpling, abrasion etc.) proved that the inherent protective benefits of the banknote varnish were not diminished by its inclusion.

Proof of the efficiency of BioNote was obtained by submitting banknote samples to an independent microbiology research organisation which carried out biofilm efficacy testing using an extensive library of biofilm forming species. A test result can be seen in the illustration that compares two banknotes, one with and one without the treatment.



The presence of e.coli bacteria on varnished polymer banknote substrate at 1,000x magnification treated with BioNote (left) and without BioNote (right).

BioNote and technical support regarding its use is available to all central banks' and commercial substrate producers and banknote printers – it can be added at any part of the current supply chain for a current banknote series. As this is a new product, test quantities are available upon request.

Central Bank and Industry Cooperation?

The means to treat banknote paper and reduce or eliminate fungicidal growth, bacteria and viruses has existed for many years and, as indicated above, improvements and new products are emerging.

However, none have been tested, as yet, against the novel coronavirus. It would be a major breakthrough if tests could show the products to be effective against the COV-SARS-2 virus and an even greater achievement to show that the treatments prevented the virus from being transmitted from banknotes to people.

The response by central banks and the industry to claims that banknotes can infected and transmit COVID-SARS-2 virus have been inconsistent, for example saying banknotes are no riskier than other materials but then encouraging contactless payments and quarantining banknotes.

There is a need, therefore, to establish the facts about whether currency is infectious and should be avoided. In order to be credible, the response must have substance and the best means of achieving this is with independently researched facts and data. The list of topics below is an indication of what is required:

1. To what extent the portfolio of today's banknote substrates carry COVID-19 and, if so, for how long?
2. Can COVID-19 be transferred from the banknotes to fingers/hands and if so a) how easily, b) for what length of time, and c) in what quantity. In summary, what is the risk of infection from banknotes?
3. What is the effect and how important are the different environmental and circulating conditions across the world, and the condition of the banknote (age, soiling, limpness etc.)?
4. Are the use of anti-viral treatments effective against COVID-19?
5. How long do the treatments last for in use – ie. what is the rate of decline of the effectiveness of these treatments (age and use)?

Information on bacteria and viruses generally, not just COVID-19, is also needed to give the full picture.

In the search for a vaccine for COV-SARS-2, national organisations and commercial companies are sharing research and other data to solve this problem as quickly as possible. Competitive attitudes are being replaced by cooperation.

Is this the best way for the currency stakeholders to respond to the current attacks on cash in this pandemic, at least in obtaining answers to the first three questions listed above?

Further Reading

Disinfection of Environments in Healthcare and Non-Healthcare Settings Potentially Contaminated with Sars-Cov-2

European Centre for Disease Prevention and Control (2020)

Read more

Persistence of Coronaviruses on Inanimate Surfaces And Their Inactivation With Biocidal Agents

G Kampf, D Todt, S Pfaender, E Steinmann (2020)

Journal of Hospital Infection

Read more

Dirty Money: a Matter of Bacterial Survival, Adherence, and Toxicity

F Vriesekoop et al (2016)

Microorganisms

Read more

Parasitic Organisms on Nigerian Currency Notes in Ojo Local Government, Lagos, Nigeria

O O Okwa, S A Bello (2016)

International Journal of Pure and Applied Zoology

Read more

Transmission of SARS and MERS Coronaviruses And Influenza Virus in Healthcare Settings: the Possible Role of Dry Surface Contamination

J A Otter et al (2015)

Journal of Hospital Infection

Read more

Paper Money and Coins as Potential Vectors of Transmissible Disease

E Angelakis, El Azhar, F Bibi, M Yasir, A Al-Ghamdi, A Ashshi, A Elshemi and D Raoult (2014)

Future Microbiology

Read more

Money and Transmission of Bacteria

Gedik et al (2013)

Antimicrobial Resistance and Infection Control

Read more

Potential Risk of Handling Nigerian Currency Notes

AJ Uraku et al (2012)

International Journal of Advanced Biological Research

Read more

Transfer Efficiency of Bacteria and Viruses From Porous and Nonporous Fomites to Fingers Under Different Relative Humidity Conditions

G Lopez, C Gerba, A Tamimi, M Kitajima, S Maxwell and J Rose (2011)

Applied Environmental Microbiology

Read more

Survival of Influenza (H1n1) on Materials Found in Households: Implications for Infection Control

J S Greaterex et al (2011)

PLoS ONE

Read more

Screening of Currency in Circulation for Bacterial Contamination

B Dhanashree (2011)

Indian Academy of Sciences

Read more

Dirty Money: an Investigation into the Hygiene Status of Some of the World`s Currencies as Obtained from Food Outlets

F Vriesekoop et al (2010)

Foodborne Pathogens and Disease

Read more

Evaluation of The Microbial Contamination of Bangladesh Paper Currency Notes (Taka) in Circulation

S U Ahmed, U Ahmed (2010)

Advances in Biological Research

Read more

Risk of Handling Paper Currency in Circulation – Chances of Potential Bacterial Transmittance

Lamichhane et al (2009)

Nepal Journal of Science and Technology

Read more

Survival of Influenza Virus on Banknotes

Y Thomas et al (2008)

Applied and Environmental Microbiology

Read more

Stability and Inactivation of SARS Coronavirus

H F Rabenau et al (2004)

Medical Microbiology and Immunology

Read more

Final Thought

COVID-19 cannot be eliminated. A virus, by its nature, will remain and mutate, and so we will need to learn to live with it. It won't, of course, be the last virus. Although we will learn to live with it, we will not forget this one.

And people are unlikely to have forgotten that banknotes were supposed to be one of the ways that infection took place. That is why it is so important we do three things:

1. Carry our research to establish the facts – as indicated earlier.
2. Universally adopt the use of treatments for banknotes to both cleanse them and prevent infection.
3. Universally adopt efficient clean note policies – the next special Currency News supplement will explain the health benefits of doing this, not just from having higher quality banknotes in circulation.

These actions will allow all stakeholders to respond appropriately to safeguard the public and to enable them to have confidence in their currency.

As a final note, we ran an article back in 2014, at the height of the ebola crisis in West Africa, entitled 'How Clean are Our Banknotes' which examined some of the same issues and emerging solutions, as they were then, as this report.

The uptake of such solutions was minimal and we concluded that article with the comment: 'maybe it is better to be safe than sorry – perhaps there is a case for fungicides and biocides to become an industry norm to consolidate the position of banknotes as a safe and secure means of transaction.'

Anyone can be an expert after the event, but even so – those words are eerily prophetic.

Publisher: Currency Publications Ltd
Editor: Astrid Mitchell
Author: David Tidmarsh

10 Windmill Business Village,
Brooklands Close, Sunbury, TW16 7DY, UK
Tel: +44 (0)1932 267 232
www.currency-news.com

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