
Polymer bank notes

By Brian Lang and John Barry, Currency Department

On 3 May 1999 the Bank issued a new \$20 bank note into circulation that had been printed on a polymer substrate by Note Printing Australia Limited (a wholly owned subsidiary of the Reserve Bank of Australia) based in Melbourne. This note replaced the existing bank notes that had been printed on the more traditional, cotton-based paper. This article traces the history of polymer, briefly describes the process of production, and highlights the benefits of the substrate and the implications for the future of bank note handling within the country.

1 Introduction

Bank notes printed on paper have been around for over 300 years, with the first watermarked paper used in a Swedish bank note in 1666. Unfortunately counterfeiting has been around for even longer. Chinese currency notes in the early Ming Dynasty (1368-1644) carried the warning that...“whosoever forges notes or circulates counterfeit notes shall be beheaded”.

Traditional bank note paper is manufactured from waste cotton. This material absorbs moisture and is inclined to deteriorate quite rapidly with use. The average life of a paper bank note in New Zealand is about 12 months. Paper notes are also expensive to recycle and in most countries unfit notes are destroyed by furnace or by dumping the waste at a landfill.

Although paper notes can incorporate security features such as watermarks and threads, the introduction in the late 1980s of modern sophisticated imaging techniques is placing today's bank notes under increasing threat of widespread forgery.

Experience in Australia since 1992 suggests that the new polymer substrate will provide a stronger, cleaner and more cost effective note, with the added advantage of incorporating security features that are easy for the public to verify, but are difficult to counterfeit.

2 The history of the polymer substrate

In 1966 the Reserve Bank of Australia issued a new series of paper bank notes which included the latest security features available at that time. Within a year, very good forgeries started appearing, so the Bank commenced a project to research radically new security devices. This research led to the potential of incorporating visual features that could vary

when the note was tilted or held to the light. In the 1970s, interest moved to substrates or materials that were considered more suitable to carry such features.

It was discovered that substrates made from laminates of clear synthetic polymeric materials were a more suitable carrier for visually variable features, given their greater stability and smoother surface characteristics. Once the Australians started work on such substrates they realised that there were other advantages as well. Immediately obvious was the ability to block off most of the note with print while leaving a portion clear, (ie opacifying the substrate). This meant that security features could be seen from both sides of the note, and the surrounding transparent area could be an important security feature in its own right.

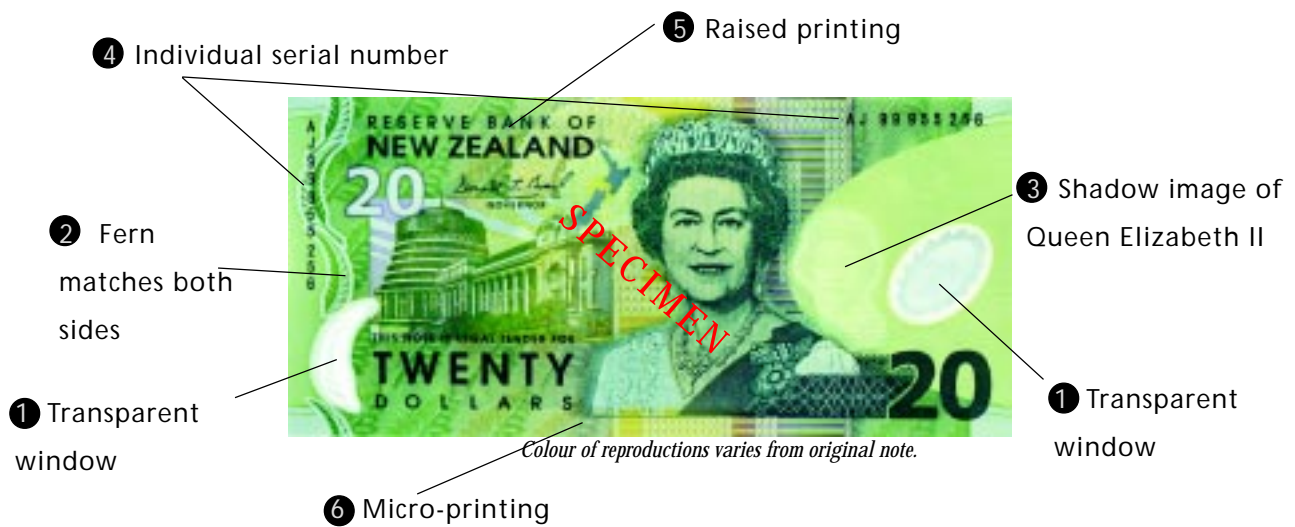
It was also discovered that the polymer substrate is a material that can be printed on. While polymer is non-fibrous, its surface does have a microporous structure that provides an excellent structure for the adhesion of print. Also, the chemical composition of the polymer substrate can be optimised to be compatible with ink chemistry.

In 1988/89 the Reserve Bank of Australia issued a commemorative polymer bank note into limited circulation. In 1992 the \$5 bank note was issued into general circulation and by mid-1996 all bank note denominations had been converted from paper to polymer.

3 Process of production

The polymer substrate used by Note Printing Australia Limited is manufactured exclusively by UCB Films Pty Ltd, under a joint venture arrangement. The substrate is based on a specialised form of Biaxially Orientated Polypropylene (BOPP).

The polymer substrate is a multi-layered structure, which comprises a core layer of polymer film. It arrives at Note Printing Australia Limited as a large roll of clear plastic film, very



similar to a role of paper used in a traditional bank note or newspaper printing works. It is then processed through the following steps:

Opacifying

Two layers of ink, (usually white), are applied to each side of the note apart from an area that is deliberately left clear.

Sheeting

The opacified substrate is cut into sheets suitable for feeding into printing presses.

Printing

Traditional offset, intaglio (ie raised print) and letterpress processes are used.

Overcoating

The notes are coated with a protective varnish.

In fact the polymer notes are printed using the same processes applied to paper bank notes. The New Zealand notes include intaglio, offset and letterpress printing. Also incorporated is micro-printing, intricate background patterns, a see-through feature that will match exactly when viewed from either side of the note, visible and invisible fluorescent and phosphorescent features and metallic ink.

4 The benefits of polymer Security

One of the key challenges facing a central bank is dealing with the risk of better and a greater number of counterfeits. The objective, therefore is to provide a bank note that is difficult, time consuming and costly to counterfeit; is easier for the general public to recognise as genuine; and provides a platform for new and varied security features which can be introduced when needed.

In Australia this challenge was taken up by the development of an innovative new substrate. Experience since 1992 shows that the number of counterfeits passed in Australia has reduced dramatically. In fact, no counterfeits surfaced in any noticeable numbers in the four years after the polymer notes were first introduced.

In New Zealand, our polymer notes have two clear windows, which are easily seen by the general public and are expected to provide a major hurdle for counterfeiters. The transparent windows and other security features present in the \$20 polymer note are shown on this page:

In the future the clear window feature in a polymer note will be able to be used as an aid in validating other features in the note. For example, the clear window can incorporate a filter that will highlight an otherwise invisible feature printed elsewhere in the note's design. Thus, it will be possible to have a "self-authenticating" feature in a bank note, rather than relying on verification by using a UV light or magnifying glass.

Durability

Australia has experienced a quadrupling of the average life of low denomination notes with the move to polymer. The increased durability is a consequence of the following characteristics:

- the non-porous and non-fibrous nature of the substrate and the overcoating of finished notes with a clear varnish mean that the notes do not absorb moisture (oils, sweat, beverages, etc) as paper notes do. These same properties also mean that the notes do not stain or accumulate dirt as easily as paper notes do;
- the non-fibrous nature of the polymer substrate also means that it does not physically deteriorate with repeated folding, as occurs with paper notes which, in part, causes paper notes to go limp;
- the toughness of the polymer substrate makes it much more difficult to initiate a tear in a polymer note compared to a paper note, although it is true that once a tear is initiated in a polymer note it spreads more easily than in a paper note. The initial toughness is the overriding characteristic.

Surveys of the general public in Australia indicate that the cleanliness aspects of polymer notes are much appreciated.

Cost effectiveness

From the central bank's point of view there are also cost savings in issuing polymer bank notes. Experience in Australia has proven that polymer notes last at least four times as long as paper notes. This durability factor will offset the higher production costs of polymer over a relatively short period.

The Reserve Bank of New Zealand expects to save about \$1 million on our annual bank note printing costs within three years.

Functionality

Polymer notes have been proven to work in all climatic conditions. For manual processing, there are slight handling differences between polymer and paper, but people do adjust to these differences very quickly.

For machine processing, users and suppliers in Australia have reported that polymer notes will process better than paper notes. This is because polymer notes deposit less dirt and inks on the transport belts and sensors in machines. They also create less dust. The result is fewer jams, fewer service call-outs, and a reduction in machine maintenance costs.

Environmental considerations

Polymer notes are more environmentally friendly than paper notes. The polymer substrate is less polluting and more energy efficient in production and is also recyclable at the end of its useful life.

Waste polymer notes can be granulated and recycled into plastic products such as wheelbarrows, compost bins, plumbing fittings and other household and industrial products. Paper bank note waste is currently dumped at the rubbish tip, as it has proved to be uneconomical to recycle.

5 Implications for the future of note processing

With paper bank notes the Reserve Bank currently receives over 500 million notes a year from the banks, which need to be counted and verified for authenticity and quality by machine processing. Around 92% of these notes, on average, are then re-issued back into circulation.

With polymer notes, because of the likelihood of fewer forgeries and the enhanced durability qualities, the case for continually processing notes through expensive sophisticated machines at the Reserve Bank of New Zealand is less compelling.

In recognition of the above, the Bank has decided, from about the middle of next year, gradually to withdraw from the business of processing bank notes once they have entered into circulation. It is believed that this function can be handled more efficiently by the banks and security companies who manage the general distribution of bank notes. This decision is likely to result in the closure of the Bank's Auckland and Christchurch branches within the next year or so.