

The use of polymer in the banknotes of the Banco de México

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The Banco de México's interest in polymer dates back to 1996 when it first began to experiment with alternative substrates to paper for banknote production. Three different substrates were analyzed: DURANOTE, produced by Akro-Mobile, which is made up of two layers of polymer; LUMINUS, produced by Domtar, which consists of a thin layer of polymer covered on both sides with layers of cotton; and GUARDIAN, produced by Securrency, which is polymer created in such a way that the monomers are distributed in perpendicular fashion. All three substrates underwent laboratory tests and two underwent printing tests; as a result, the GUARDIAN substrate was chosen for further tests. In 2000 the Banco de México launched a research project on the viability of using alternative substrates, the main aim being to increase durability and, in particular, to enhance the quality of the lowest denomination banknote (the 20 peso note).

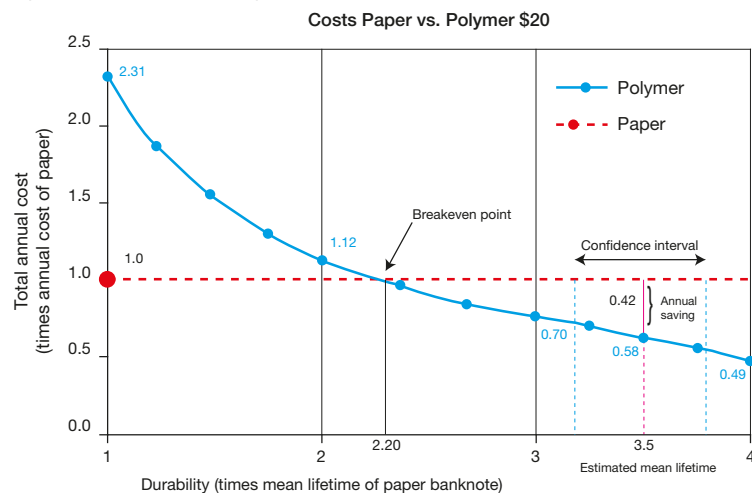
When the Banco de México decided to study the possibility of opting for polymer, a number of questions arose. Would polymer

banknotes last longer in Mexico than paper banknotes? Would they be safe from counterfeiting? Would the public accept them? What changes would the banknote production works have to make to use a polymer substrate? What problems would there be for processing polymer banknotes? Would ATMs work well with the new banknotes? What would the credit institutions think of them? What would be the costs and benefits for the Mexican people? This was to be an important change both for the general public and the financial system and for this reason the central bank designed a project divided into several successive stages: cost-benefit analysis; semi-industrial scale printing trial at the Banco de México's banknote production works; nationwide circulation trial; evaluation process based on focus groups; and nationwide survey of professional cash handlers, credit institutions and the general public. At the end of this process, the results were presented to the Governing Board for the final decision to be taken. This article presents a summary of the key findings at each stage of the project.

Cost-benefit analysis

A cost-benefit analysis was conducted, considering the direct production costs, the estimated decline in productivity, the distribution cost and the coating cost. The analysis showed that if the lifetime of a polymer banknote was at least 2.2x the mean lifetime of the paper banknote it was to replace, then the project would be economically viable (see Figure 1).

Figure 1. Cost-benefit analysis



In the end, the estimated mean lifetime of the polymer banknotes proved to be 3.5x that of their paper counterparts. The calculations showed that the mean lifetime, with a confidence interval of 95%, was between 3.2x and 3.8x higher than that of the paper banknotes, implying an annual saving of 42%, assuming the same number of banknotes in circulation. The mean lifetime of the 20 peso note rose from 8.3 to 28.8 months.

Semi-industrial scale trials and production viability

The printing tests conducted by the Banco de México with the GUARDIAN substrate produced important results in terms of the behaviour of polymer in the printing machines (see the article by Enrique Guarn-

er in this edition of BILLETARIA). As is well known, polymer banknotes require coatings. The coating process also had to be modified due to altitude, as Mexico City lies more than 2,000 metres above sea level and this meant that the polymer performed differently in the drying process. Technical problems of this kind arose throughout the printing tests, but they were all resolved with no adverse impact on the economic viability of the project.

The strategy followed by the Banco de México was to "polymerize" a denomination rather than replace it, that is, to respect, insofar as possible, the former design, so that the new banknote would form part of the existing series of banknotes, rather than replace it with a completely new design. Specifically, when the 20 peso note was polymerized, the same sheets or plates were seen to print differently, according to the substrate chosen, due to the different rate of absorption. Accordingly, changes had to be made in the thickness of the lines of the design of the banknote and in the spacing between the lines, so as to ensure that the polymer banknote was similar in appearance to the existing paper banknote.

In addition to the design modifications and the adjustment to the coating process, two further difficulties arose in the printing process. The first problem was blocking, as the printed sheets tended to stick together. The second problem was connected with physical handling of the polymer reams, as this proved to be quite different from handling paper reams. Nevertheless, all these problems were solved and the project progressed to the next stage.

Circulation trial

The circulation trial began in September 2002 with the 20 peso note and had two key features: first it was a nationwide trial, which is important in a country such as Mexico in which there are not only huge differences in climate but also in the way in which people use their banknotes; and second the banknotes in circulation were replaced swiftly and completely. To this end the Banco de México created a large stock of 20 peso notes, enabling it to replace virtually all the notes in circulation (200 million) in the space of just eight months. This meant that all the population had immediate access to the new banknote; it also meant that the estimated mean lifetime figures were not distorted by the co-existence of the two different substrates.



50 Mexican peso polymer banknote.

Surveys

The decision to change a banknote substrate cannot be taken lightly, as there are numerous technical, economic, cultural and even political aspects to be considered. To learn the extent of the cultural aspect of the decision, market research surveys were conducted among the general public and in the financial sector.

A year after the start of the circulation trial, a survey was conducted among 2,200 households, in towns and cities with more than 50,000 inhabitants. Interestingly, when asked "If you had the choice between a 20 peso coin, polymer banknote or paper banknote, which would you prefer?", 59% of the respondents said they would prefer a polymer banknote, 22% a paper banknote and 18% a coin. In addition, when asked "Would you like to see another denomination printed on polymer?", 68% said they would and only 31% said they would not.

Three months later another survey was conducted, in this case in the banking industry, among bank cashiers, banknote processing company staff and credit institution representatives. When asked "How would you assess polymer banknotes compared with paper banknotes?", the majority said they were cleaner (92%), better quality (64%) and more durable (94%). However, when asked "How do they compare in terms of processing?", the majority said that processing was more difficult (45%), slower (23%) or just the same (15%). Nevertheless, despite the greater difficulties experienced in processing polymer banknotes, the general opinion of the financial sector was positive and in favour of changing another denomination over to polymer.

Processing polymer banknotes

Damage to paper banknotes results from their becoming soiled and flaccid, whilst damage to polymer notes results from ink loss or tearing. This difference in the way the banknotes become damaged presents a challenge in the initial stages of a first polymer note issue, as the central bank must establish a new standard for banknote fitness.

The Banco de México defined this standard by means of a range of ten banknotes showing progressive levels of deterioration, from a brand new banknote to one that was completely damaged. Initially, laboratory-produced photographs of damaged banknotes were delivered to the banks; after a couple of years, there were sufficient samples to be able to deliver them a complete set of damaged banknotes.

Two key changes were seen in the damaged banknotes that the banks returned to the Banco de México: there was a sharp drop in the number of damaged banknotes received, and an increase in the proportion of torn banknotes. Destruction outside the sorting machines was slower, but the number of banknotes to be destroyed fell considerably.

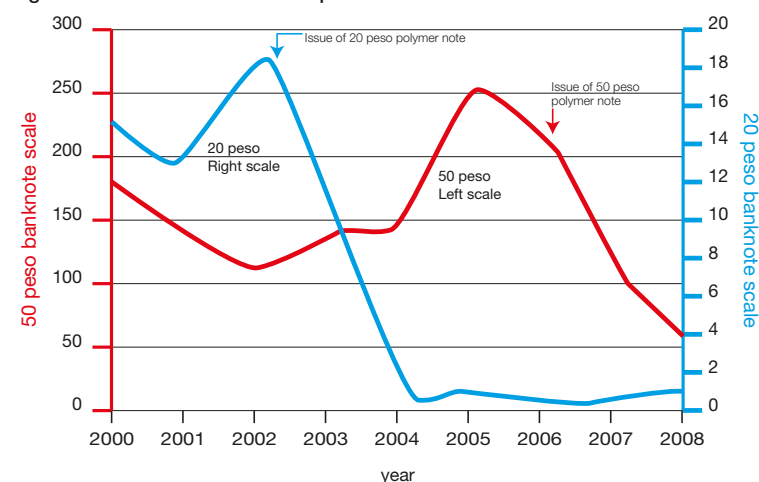
For the Banco de México, the new substrate implied no need for additional human resources in either banknote production or cash handling. Productivity levels did fall in some processes, but this was more than offset by the reduction in the number of banknotes produced or processed. An added advantage was that the greater durability of the polymer banknotes implied savings in the cash handling area, as the reduced flow of banknotes led to a decrease in commissions and in transport and insurance costs.

One change that was made was in the packaging system. The thermo-shrink plastic packaging was replaced, as it was suspected that when packets of new polymer banknotes were opened with knives, tiny cuts could be made on the edge of the notes that would subsequently become tears.

Counterfeits

As indicated at the beginning, the main reason behind the introduction of polymer banknotes in Mexico was to extend the average lifetime and enhance the quality of the notes in circulation. However, and despite the fact that the number of counterfeit 20 peso notes detected each year was already quite low, in subsequent years there was a dramatic reduction in this number. In fact, as Figure 2 shows, in the six years since issue of the new polymer banknote, very few counterfeits using a plastic substrate have been detected.

Figure 2. Number of counterfeits per million banknotes in circulation



In November 2006 the 50 peso polymer note was issued. In that year, as in the previous two years, this was the most popular denomination for counterfeits in absolute terms. However, just one year later, the 50 peso note had dropped to third place in the counterfeit ranking, and in 2008 it fell to fourth place. Accordingly, in Mexico the introduction of polymer has been an important barrier to the type of counterfeits existing in the country.

Conclusions

Adoption of a polymer substrate is a complex task that requires that many details be taken into account. Nevertheless, it has been a beneficial move, for the Banco de México and possibly for society overall. Polymer banknotes are cleaner, they are less costly to produce, they are less harmful to the environment and they are apparently safer from the threat of counterfeiting. The public information campaign conducted played an important role, informing the public about the new product and what to expect from it. A working group was also organized with the Mexican Banking Association to enable the Banco de México to learn and settle the concerns of the financial sector.