

# Lead battery markets and recycling in Mexico and South America

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## Abstract

A review is presented of the automotive markets in Latin America and their dependence on the lead produced in the region. It is found that Latin America markets have still a long way to go to reach acceptable stabilization and maturity. Environmental aspects are a very sensitive area and business strategies must be redirected towards saving the pollution problems that are inherently associated with the processing of lead. © 1997 Elsevier Science S.A.

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## 1. Worldwide overview of lead

The consumption of refined lead in the Western World reached its peak in 1995, at 4.928 million tonnes, 45% (2.200 million tonnes) correspond to primary lead and the rest to secondary lead. This is a 3.3% increase over 1994 brought on basically by a strong demand of the battery industry. The greatest demand for batteries has taken place in the USA for which lead demand reached close to 85% of the total lead consumption of the country, as opposed to 60% in 1980. Doubtless, this change is due to the tremendous growth in the vehicle population. In 1979, there were 152 million vehicles circulating in the USA while there were 200 million in 1995. That is, 48 million more automobiles, which represent a growth of 31.6%. In the same 15 years, Japan's automotive supplies grew by 20 million units. The vehicle population of Europe has also grown to such an extent as to be comparable with that of the USA. Latin America has experienced a substantial growth as well. In 1995, there were 43.49 million vehicles in circulation, a fifth of the vehicle population of the USA. With a population of 475.5 million, this represents 10.93 persons per vehicle. It is clear that the automotive industry is growing fast and, for many years to come, it is expected to be linked with the lead-based electrical energy source.

It should come as no surprise that the lead/acid battery industry has been decisive in the growth of the automotive industry since it has shown great flexibility of design to keep up with the increasingly demands of the automotive industry. Furthermore, the lead/acid battery is still the best option for electric vehicles.

The growth in the number of vehicles and the associated demand of lead/acid batteries, as well as the strict regulations of environmental authorities are creating the need to relocate, modernize and/or reconvert processes for both batteries and lead recycling to avoid a negative impact on the environment. Japan, for example, has already been forced, because of its growth, to relocate both its automotive and battery plants. This loss for the Japanese economy will be to the advantage of other countries of the Western World.

The two regions that can offer the adequate conditions for such expansions are, without a doubt, the developing countries of Asia and Latin America. There are already examples of important investments in Brazil and Mexico, the two main centres of economic development in Latin America.

Low-cost labour, the facilities offered by the governments for investments and the creation of job openings, as well as the potential growth of these economies are magnets that attract the attention of European, Japanese and American investors and industrial organizations that see the possibility of setting up highly profitable operations in Latin America. On the other hand, these investors must take into consideration that, as a result of the political systems in Latin America that constantly affect the economic scene of the region, there are also big risks, such as:

1. exchange rate instability due to frequent devaluations;
2. the high inflation in Brazil (45%), Argentina (16%), Mexico (42%);
3. high market inconsistency because of economic recessions which are, at times, prolonged;

4. economic bubbles that later bring about setbacks;
5. highly protectionist policies that make setting up free-trade agreements ever harder;
6. age-old tax evasion practices, and
7. environmental control laws and mechanisms that are too relaxed and incipient, thus permitting the operation of companies that severely affect the ecological environment; the control measures are not exerting the necessary force to correct the pollution problem, but they do allow disloyal competition.

## 2. Contraction in the supply of lead

The 1993 decline in the production of primary lead in North America was due to mine shut-downs and strikes like that of Del Faro in Canada, and caused a drop of more than 160 000 tonnes in the production of lead. In Europe, the temporary shut-down of Metaleurop's Nordenham plant in Germany affected the supply of primary lead. The production of Union Minière of Belgium fell from 90 000 to 70 000 tonnes in the following two years. The GNB's recycling plant in Columbus, USA, with a planned production of 80 000 tonnes/year, has delayed its starting operations and has, consequentially, held up GNB's self-supply for battery production. The Asarco shut-down (in Mexico in June 1996) was due to environmental reasons. In 1994, the shut-down of operations at Japan's Sagamoseki and Naoshima plants moved the lead demand to South Korea. For all these reasons, the lead market is expected to depend more and more on secondary production and, according to experts, it is unlikely that the price of lead (London Metal Exchange) will drop significantly.

## 3. What part does Latin America play in the lead scene?

Mexico has an important primary lead producer, namely, is Peñoles, with a production of 175 000 tonnes/year that represents 3.5% of the lead consumption of the Western World.

There are three important lead recycling plants in Mexico:

1. PIPSA, with a capacity of 10 000 tonnes/year, sells its lead to small battery factories in Mexico and some clients in the USA. Due to its conditions, PIPSA now facing problems with environmental authorities.
2. Deutch Industries, with a capacity of 10 000 tonnes/year recycles used battery lead for its clients. This company is also facing serious problems with the environmental authorities.
3. Enermex, a 100% Mexican-owned company, vertically integrated, has facilities that currently recycle 68 000 tonnes of lead per year through a combined process that uses a blast and a rotatory furnace. This is presently

going through a technological reconversion process. Besides increasing the capacity to 100 000 tonnes of lead per year, it will also comply with all the EPA environmental regulations. This capacity will increase the company's lead self-sufficiency to close to 90%. The reconversion is scheduled to be completed by the second quarter of 1997.

In the last ten years in Mexico, several minor recycling plants have closed down since they did not have the economical resources to pull through the situation.

At the beginning of the 1990s, there was a drop in the price of lead, to as low as US\$ 380/ton, i.e., 17.2 ¢/lb (FOB Rotterdam). In addition, the authorities of several countries established severe pollution regulations to which primary producers and recycling companies must comply. As a result, in South America there has been a significant change in the buying/selling market of lead. With low reference prices established by the London Metal Exchange and pressure by the authorities to comply with strict pollution regulations, primary production and recycling companies suffered a decline in the first years of the 1990s. Negative economic results were obtained due to low lead prices and high financing costs caused by a potential inflationary effect in this area.

The lead-producing industry in Latin America was in no condition to invest in innovative equipment for its processes, nor could it provide the necessary equipment to control pollution. As a result, all the companies set up in South America have out-of-date engineering and they do not comply with environmental control regulations. Many industries were shut down because of environmental pollution or persistent economic losses.

The regulating barometer in the lead market in South America is Brazil because it is the largest non-primary lead-producing consumer of the region. At the onset of the 1990s, Brazilian authorities prohibited the importation of used batteries to be recycled by domestic recycling companies. Thus, lead-consumers such as battery companies and producers of oxides for pigments and chemical products were forced to import primary lead to cover their needs since the Brazilian recycling companies did not have sufficient raw material for their requirements.

## 4. Lead status per country

### 4.1. Venezuela

Venezuela imports pure lead and exports ingots of recycled lead to Brazil. The country has the following four recycling companies.

1. FUN-METAL, independent recycling company with a capacity of 24 000 tonnes/year; it exports 60% of its volume to Brazil. This company operates within the environmental regulations and complies with EPA. The plant is working at 65% of its capacity.

2. FUNDICION DEL CENTRO with a capacity of 18 000 tonnes/year is part of Ducan and Titan Batteries. It can collect large volumes of exhausted batteries through its large battery distribution network. It is unknown if it complies with environmental regulations. The plant is working at 70% of its capacity.
3. ALEPROCA, independent industry that, in 1993, completed a project to produce 12 000 tonnes/year. This company has never reached the objectives for which it was designed. The plant currently operates at 25% of its capacity and it is unknown whether environmental control regulations are met.
4. BERA DE VENEZUELA, an independent company that is inoperative due to its out-dated process and for not complying with environmental control regulations. The situation in Venezuela is unusual because the country exports recycled lead and imports pure lead.

#### 4.2. Colombia

This country has a negative lead balance: it imports pure lead and exhausted batteries. These are two recycling plants in operation. Several small recycling companies supply unrefined lead to the two main recycling companies, with all the ecological problems imaginable. The smaller recycling companies purchase Venezuelan scrapped batteries at the border cities, due to the benefits of the exchange rate and the free-trade agreement of the region.

The main recycling plants in Colombian are:

1. BERA DE COLOMBIA, an independent company with a capacity of 6000 tonnes/year. The processes are out-dated and the company is currently negotiating with the authorities to set up new facilities and close down the present ones. This company purchases unrefined lead from the small recycling companies, as mentioned above.
2. MAC, a recycling company, vertically integrated, with the largest battery manufacturing plant in Colombia. It has a capacity of 12 000 tonnes/year. The company can produce lead alloys as well as part of the pure lead that it requires. During 1995 and 1996, the facilities have been updated to comply with the environmental control regulations.

#### 4.3. Brazil

The largest consumer of South America used to have a large recycling capacity. A primary producer, Cobrac, shut down in 1995 due to the depletion of mineral reserves. Some recycling companies also closed down, while others were left with out-dated technology. Brazil, hitherto a lead-exporting country, became a potential lead importer.

Another important factor that marked a significant change in the Brazilian lead market was due to the stabilization and trust in the Real (Brazilian currency). Brazilian importers obtained high profits importing lead on

credit granted by American banks at a 7 to 8% annual interest rate and instalments that ranged from 180 to 290 days, while the inflation in Brazil is 45% per year. Thus, the financial aspect became the main business of battery manufacturers. Exporting became an extremely attractive process and as a result, Brazil imports more lead and recycles less. Although this must be a temporary situation, it has been going on for quite a while.

Brazil presents a negative lead balance: it imports both primary and secondary lead. The country has several independent recycling industries and others that are part of the battery industry verticalization.

Currently, the lead consumption in Brazil comes close to 120 000 tonnes/year. The lead-recycling industry is having severe problems due to out-dated technology and pollution. Because of this, some of them are about to shut down under the pressure of the authorities. The companies set up in Brazil are facing major problems in the technical conceptualization of machinery and equipment design, the geographical location, and the metallurgical technology in use.

At present, the recycling companies are:

1. TONOLLI DO BRASIL, an independent company with a capacity of 28 000 tonnes/year. It was inoperative during part of 1995 due to economic problems that were worsened by the pollution of solids in water and air. Production recommenced at the beginning of 1996 at a low capacity, with high production costs under the strict supervision of the Brazilian authorities. Operations are possible only because of the high cost of lead established by the London Metal Exchange. The plant works at 50% of its capacity.
2. FAE, an independent company with a capacity of 24 000 tonnes/year. It has two lead-recycling operations, one at Sao Paulo and the other in the State of Rio Grande del Sur. During 1994 and 1995, the plant had to shut down because of pollution. It is currently operative; large investments are required to up-date the facilities to compete with companies that have high-tech equipment and processes that can recycle at low cost with good pollution control. The plant operates at 70% of its capacity.
3. SATURNIA–MICROLITE, a vertically integrated company with a capacity of 18 000 tonnes/year. Brazilian authorities shut down this plant in 1995 due to pollution problems. Currently, the company is limited to purchasing pure and secondary lead to refine and produce its alloys at high cost. This is because the present technology is unable to recycle batteries with up-to-date processes and low costs.
4. MOURA, a partially integrated company with a capacity of 10 000 tonnes/year. The lead purchased and recycled supplies part of the company's needs. New recycling facilities are planned for 1997.
5. REIFOR, an integrated company with a capacity of 6000 tonnes/year. The recycling company is part of the

verticalization of this battery manufacturer. The plant is located in the southern part of Brazil. Like the others, this plant must up-date its facilities in order to keep up with international regulations.

6. AJAX, a vertically integrated business with a capacity of 7200 tonnes/year. The company is a battery manufacturer, which has a battery lead-recycling plant and produces only lead alloys to satisfy its needs.
7. RONDOPAR, a vertically integrated, company with a capacity of 7000 tonnes/year. It is a small battery manufacturer and has a recycling capacity to supply lead alloys that it requires.
8. There are many small recycling companies in Brazil with a total combined capacity of 18 000 tonnes/year that recycle battery lead and sell the rough furnace metal (furnace lead) to the other more technically advanced recycling plants that refine the metal and sell it on the market or use it to manufacture batteries. These small plants, in fact, pose a serious threat to the environment, since they are so small and so scattered and they do not have the minimum required environmental control equipment.

#### 4.4. Argentina

Argentina presents a negative lead balance: it imports pure lead. This country recycles around 27 000 tonnes/year, with ten very small companies that can hardly invest in recycling machinery and equipment, nor can they produce the high-quality lead used in the automotive battery industry. The primary producers of this country were not considered because they are inoperative at the present time.

#### 4.5. Peru

Peru has a positive lead balance. It has an important primary producer, Minera del Centro de Peru with a capacity of 89 000 tonnes/year. Peru is the only primary lead-producing country in South America, and because of the Free Trade Agreement with the countries of the Andean Pact and its agreements on customs tariffs preference with Brazil and Argentina, it is the natural pure-lead supplier in this region. Because of its limited number of automobiles, Peru (along with Chile, Bolivia, Paraguay and Uruguay) has a battery-recycling industry that is not significant and has no effect on the South American market.

### 5. Automotive batteries in Latin America

#### 5.1. Automobile reserve tendency

The vehicle population in Latin America is divided into the following four areas:

Table 1  
Trends in vehicle population in Latin America

Millions	1995	1996	1997	1998	1999	2000
Mexico	12.50	12.71	12.97	13.23	13.50	13.77
Caribbean	2.91	2.97	3.03	3.09	3.15	3.22
Central America	1.48	1.51	1.54	1.57	1.60	1.64
South America	26.60	27.09	27.68	27.99	28.5	29.17
Total	43.49	44.28	45.22	45.88	46.83	47.80

1. *Mexico*, country of the American Continent, located in North America; North America is made up of Canada, USA and Mexico, members of the NAFTA; Mexico has a vehicle population of 12.5 million units.
2. *Caribbean*, made up of all the islands of the sea of the same name; has a vehicle population of 2.91 million units.
3. *Central America*, part of the continent connected on the north with Mexico and the south with Colombia; has a vehicle population of 1.48 million units.
4. *South America*, has a vehicle population of 26.6 million units.

The data given in Table 1 show that a net growth of 4.3 million vehicles is expected during the next five years, i.e. 11% between 1995 and the year 2000. This is despite the present economical recessions Mexico and Venezuela that are, perhaps, the worst during the past twenty years.

#### 5.2. Terminal industry tendency

The growth in the 'original equipment industry' will be 19 million vehicles between 1996 and the year 2000; 3.5 million of these will be exported by Mexico to the USA in the same period of time. Latin America will supply the automotive industry with up to 90% of the batteries that it requires.

#### 5.3. Replacement battery tendency

Although each segment will be analyzed separately, the replacement battery market in Latin America will demand 148 million units between 1996 and the year 2000. This means that, in the next five years, the Latin America market will demand a total of 167 million batteries that will require 1 753 500 tonnes of lead.

### 6. Market segments

#### 6.1. Mexico

Mexico has the second largest population in Latin America, with 90 million (note, Brazil has 163 million inhabitants). This country has the highest vehicle population in Latin America: 12.5 million, at a rate of 7.2 inhabitants per vehicle. This automotive reserve demands

more than 6 million batteries a year for the replacement market and more than a million batteries a year for the original equipment market, of which 50 to 60% is exported to the USA.

The battery industry consumes close to 80 000 tonnes of lead a year, which is obtained mainly from recycled batteries, the remainder is provided by Peñoles, a Mexican lead producer. This primary lead represents from 15 to 20% of the total lead demand for batteries. Primary and secondary lead supply in Mexico is 230 000 tonnes/year.

### 6.2. Caribbean

The Caribbean is made up of 13 countries located in the sea of the same name, with a total population of 35.03 million. Cuba stands out for its population of 11 million inhabitants, as does Puerto Rico with a vehicle population of 1.7 million representing 57% of the total vehicle population in the region at a rate of 2.37 persons per vehicle.

The region has 3 million vehicles in circulation at an average of 11.8 inhabitants per vehicle. Due to the heat, the road conditions and the physical conditions of the vehicles, the period for battery replacement is estimated to be one year. Therefore, there is a demand of practically 3 million batteries a year. There is no local manufacturing of original equipment. For the required battery production, 31 000 tonnes of lead are required a year, all of which is imported since there is no production of primary lead nor any significant recycling.

### 6.3. Central America

Central America has a total population of 43.76 million. Ecuador stands out with a population of 11 million inhabitants, followed by Guatemala with 10 million. In this region of America, there are 1.5 million vehicles, i.e. 30 inhabitants per vehicle.

As in the Caribbean, battery replacement is yearly and there is no manufacturing of original equipment. The resulting total battery demand is around 1.5 million a year. This requires 15 500 tonnes of lead, all which is imported.

### 6.4. South America

The economically outstanding country in South America is Brazil with 163 million inhabitants and close to 14 million automobiles. It is, no doubt, a very important developing country.

South America, made up of nine countries, has an overall population of 306 million inhabitants and an auto-

motive reserve of 27 million, i.e. 11.53 inhabitants per vehicle. Batteries are replaced on the average every 1.5 years. The annual battery demand is close to 18 million, plus 2.2 million for the original equipment assembly plants. This demand of batteries requires 210 000 tonnes of lead per year, 80% of which is supplied by local recycling and 20% is imported from Peru and Venezuela, the former supplies primary while the latter supplies secondary lead. Primary and secondary lead supply in South America is 283 000 tonnes/year.

## 7. Conclusions

Latin America has still a long way to go to reach the necessary stabilization and maturity in its battery markets. Unsteady economies are prey to the 'political chess game' played by the countries that make up Latin America and which, from time to time, suffer from destabilizing circumstances. Efforts are being made to develop an 'ecological coalition' for lead recycling, but these are yet incipient. These endeavors require large investments, a limiting factor for the lead-recycling countries that lack the economic capacity needed.

The last relevant point in this analysis refers to collection systems for scrapped batteries. These systems vary from the most sophisticated systems accomplished through battery manufacturer commercial networks to the simplest scavenging systems that pass through as many intermediaries as the price can take. They are, consequentially, business that still require time to mature.

As in all other regions of the world, the battery industry's future depends on its ability to safeguard against the risks of pollution. Every effort must be made to develop environmentally friendly processes, to keep the facilities clean, and to be conscientious about the conservation of the environment. Thus, those involved in lead-related activities have the grave and motivating responsibility to design processes and systems that can associate lead, human beings and the environment both constructively and in harmony.

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