

Influence of Environmental Policies on China's Lead-Acid Battery Industry

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Abstract: Frequently occurred “lead poisoning cases” in China have made the rapidly developing lead-acid battery industry a huge environmental harm in these years. Meanwhile, a series of related policies have been introduced by the Chinese government to inhibit the increasingly expanded effect by this industry on the environment. In this paper, the status of the lead-acid battery industry, including the demand, yield and growth rate, is discussed, along with the environmental regulation policies in this field as well as the secondary lead industry. Besides, this work also analyzes and discusses the specific content of the policies developed for environmental protection requirements and provides information on how enterprises can be properly prepared for the inspections and enter into compliance with the new regulations.

Keywords: Chinese policies, environmental inspection, lead-acid battery, lead poisoning.

1. INTRODUCTION

The urgent demand for energy in China promotes the development of traditional lead-acid battery greatly during recent years. Since nearly 98% of electric bicycles, electric motorcycles and electric tricycles now use lead-acid batteries as the power sources, the usage amount in these fields is higher than that in automotive field. In 2010, the number of lead-acid battery factories was around 2000, among which nearly 1600 factories have the production license whereas the rest didn't have. Over the years from 2009 to 2010, high level blood lead was detected in children, residents near the lead-acid batteries factories as well as the factory workers in many provinces. The State Department of Environmental Protection (DOEP) organized a full-scale rectification to the lead-acid battery factories and secondary lead factories around the whole country since March, 2011, and a series of policies related to environmental protection were issued at the same time.

A series of certifications including cleaner production, environmental protection and access condition checking were performed on the lead-acid battery factories and secondary lead factories by the present local government. The whole certification process should be finished by 31st December 2015, and the enterprises without passing the certifications will be closed since the beginning of January 2016.

In this paper, the present status of the lead-acid battery factories and secondary lead factories and the influence on these enterprises of the issued policies, especially the environmental protection part, have been summarized and analyzed in detail.

2. METHODS

We conducted the literature search mainly through the website of the ministry of environmental protection, as well as some News net.

3. RESULTS

3.1. Development of Lead-Acid Battery Enterprises in China

Even with the lead-acid battery industry in China under constant review and undergoing significant policy reform by the national government, lead-acid batteries are still the fastest growing chemical power sources in China (Table 1). According to statistics, lead-acid battery production in China has not diminished, even with the introduction of much stricter environmental protection policies instituted by the

Table 1. China's battery production output distribution in 2013.

Species	2013	Year on Year
Nickel-cadmium battery ($\times 10^8$)	3.86	4% decline
Nickel hydrogen battery ($\times 10^8$)	8.55	9% decline
Lithium-ion battery ($\times 10^8$)	25.3	10% increase
Lead-Acid battery ($\times 10^4$ kVAh)	18529	12% increase
Zinc-manganese battery ($\times 10^8$)	196	5% increase
Alkaline manganese battery ($\times 10^8$)	120	10% increase
Primary lithium battery ($\times 10^8$)	25	9% increase

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Chinese government. Instead the industry has been maintaining an 18% growth rate over the last decade. The industry's production output since 2002 is shown in Fig. (1) and the production distribution of Chinese lead-acid batteries in terms of applied use in 2013 is shown in Fig. (2).

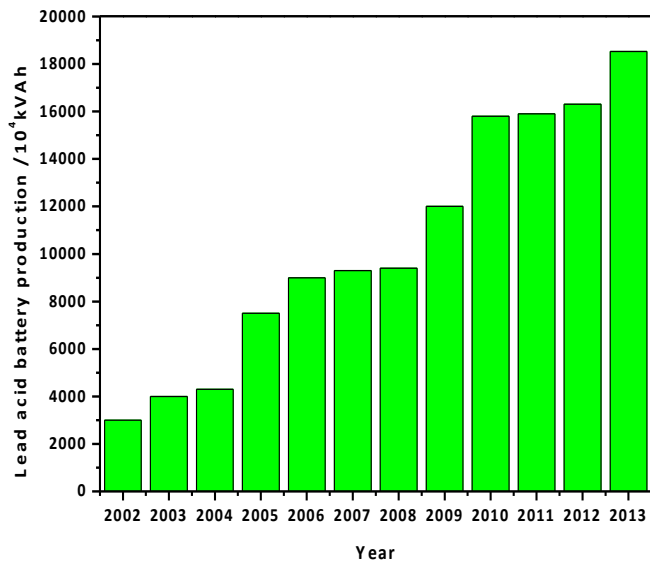


Fig. (1). Lead-acid battery production output in China.

The rapid development of passenger and low-speed electric vehicles has caused an incredible demand for lead-acid batteries (as shown in Table 2) and driven the fast growth in lead-acid battery production. Table 3 shows the lead-acid battery demand, lead consumption and the recycled lead movement from recycling waste lead-acid batteries in China according to the China Battery Industry Association's analysis and forecast.

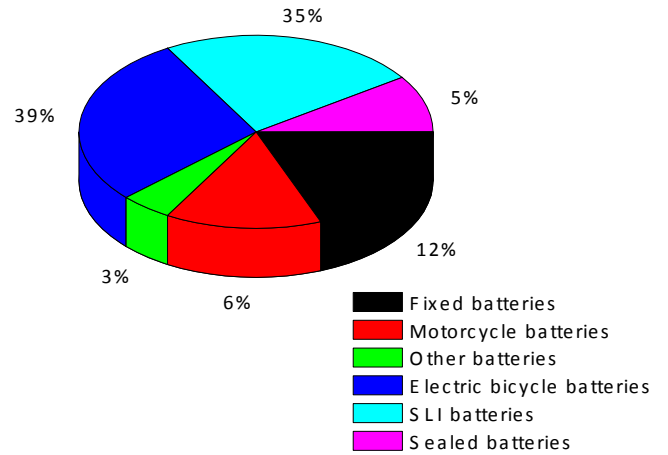


Fig. (2). Production distribution of lead-acid batteries in 2013.

3.2. Influence of National Environmental Protection Policies on the China's Lead-Acid Battery Industry

The enactment of a special action to introduce new environmental policies for the lead-acid battery industry was launched in March 2011. From statistics gathered as a result of the new polices, the government identified 1949 verified enterprises in China as of November 30, 2011 that existed before the legislation came into effect, consisting of 1772 lead-acid battery enterprises and 177 recycled lead enterprises. The 1772 lead-acid battery enterprises were primarily distributed in Jiangsu, Zhejiang, Guangdong and Shandong, as shown in Fig. (3).

While this was an extremely large number of enterprises, many of the businesses that existed prior to November 2011 were small and with very little production capacity, with

Table 2. Demand for lead-acid batteries in different markets of China in 2013.

Market	Car Ownership	New Increment	Battery Demand Growth
Car	1.04×10^8	1850×10^4	18.50%
Low-speed electric vehicle	35×10^4	30×10^4	85.71%
Motorcycle	1.02×10^8	2700×10^4	26.47%
Electric bicycle	1.47×10^8	3000×10^4	21.43%
Communication station	135×10^4	14×10^4	10.3%

Table 3. Lead consumption and recycled lead movement of lead-acid batteries in China.

Year	Demand (10 ⁴ kVAh)	Lead Consumption (10 ⁴ Ton)	Predict Recycled Lead (10 ⁴ ton)
2009	12000	305	124
2010	13500	313	149
2011	15100	300	175
2012	16900	332	193
2013 e	19000	372	212
2014 e	21300	418	240
2015 e	23900	469	269

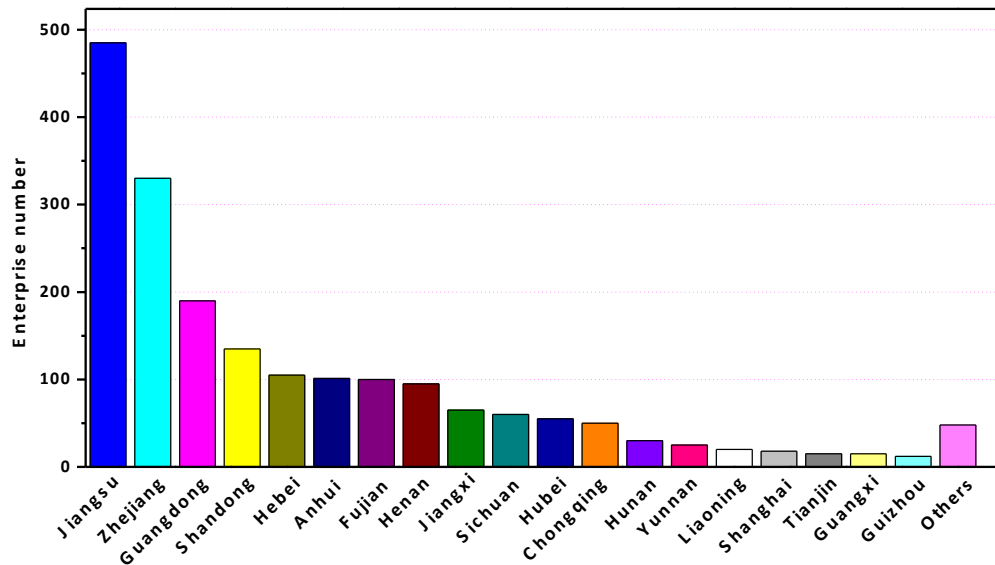


Fig. (3). Lead-acid battery enterprises by province before environmental regulation in 2011.

some enterprises making use of poor production equipment and protection facilities. Furthermore, many individual enterprises did not have environmental protection facilities, and discharged lead pollution directly into the environment, which meant that lead pollution accidents occurred quite frequently.

The total lead-acid battery output from the top 300 enterprises have already accounted for 80% of total output from China's lead-acid battery [1]. However, the total output of 1472 enterprises after the top 300, accounted only for 20% of total output from China's lead-acid battery, as shown in Fig. (4).

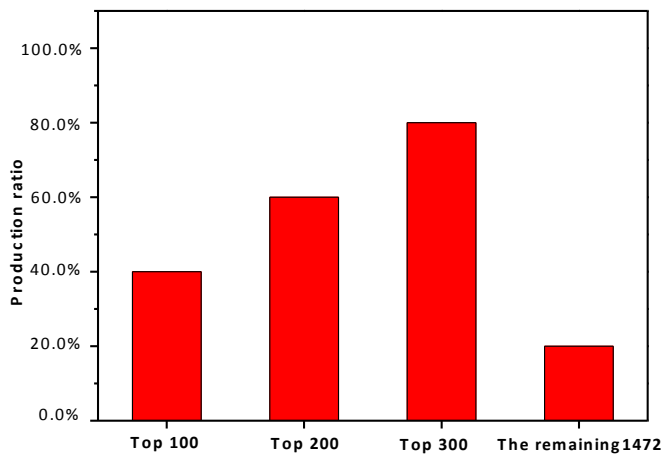


Fig. (4). Productivity distribution of lead-acid battery enterprises before environmental regulation.

This excess of widely distributed lead-acid battery enterprises in China meant that environmental protection policy was virtually impossible to enforce. On November 30, 2011, the national government issued a total of 1772 lead-acid battery production licenses, even though only 292 enterprises qualified for those licenses in terms of the environmental protections they provided, *i.e.* a qualification rate of only 16.48%. From these numbers, it is clear that the existing system to manage lead-acid battery production

licenses had problems, and the previous management scheme had helped to promote the large number, small size and wide distribution of enterprises, most of whom had only low production capacity, unreasonable industrial distribution and considerable negative environmental impact.

Between 2009 and 2011, the high frequency of blood lead poisoning accidents attracted considerable attention from both the Chinese government and the media. Since early 2011, the Chinese government began its overall rectification of the China's lead-acid battery industry and secondary lead industry. A series of policies were made to rectify China's lead-acid battery industry and secondary lead industry [2]; the main policies and measures are shown in Table 4.

Once the Chinese government formulated and enforced a series of policies for the China's lead-acid battery industry and secondary lead industry, the number of lead-acid battery enterprises sharply declined throughout China, particularly in Jiangsu Province which had the largest number of enterprises. The situation of Jiangsu province after environmental rectification is shown in Fig. (5).

Nationally, the number of lead-acid battery enterprises in China dropped from 1772 before the country's environmental rectification to just 450 at the end of 2013. The present output relies primarily on these 450 enterprises, as shown in Table 5.

3.3. The Chinese Lead-Acid Battery Industry Encounters Difficulties with the New Environmental Policies

To meet the standards developed for the lead-acid battery industries and secondary lead industries issued by the Ministry of Industry and Information Technology, the Environment Ministry and three other Ministries on March 12, 2013, all lead-acid battery enterprises and secondary lead enterprises throughout China are expected to undergo a thorough environmental inspection organized by the Environmental Department, as well as an admission

Table 4. Environmental reform campaign of the Chinese lead-acid battery industry.

Time	Organizer	Project Content
Mar 2011	Environmental Department	The Environmental Supervision Bureau issues an on-site environmental supervision guide for the lead-acid battery industry (draft).
Feb. 20, 2011-Mar. 10, 2011	Environmental Department	The Environmental Department and local Environmental Supervisory Departments are divided into 11 groups to coordinate on-site environmental supervision of enterprises; the Battery Association assigns someone to coordinate the process.
Mar. 28, 2011	Environmental Department	Nine national ministries hold a video conference on the environmental campaign to reform the lead-acid battery industry, with 72000 people attending.
Mar. 2011	Environmental Department	The Environmental Supervisory Departments of Zhejiang, Shandong, Anhui and Guangdong Provinces conduct a thorough investigation of the lead-acid battery industries and recycled lead industries, shutting down all unqualified enterprises.
Jun. 3, 2011	State Department	The State Department conducts a press conference concerning lead pollution remediation.
July 2011	Environmental Department	The Environmental Department reorganizes its Environmental Supervision Bureau.
July 30, 2011	Environmental Department	The Environmental Department issues its first public status list of lead-acid battery enterprises and recycled lead enterprises.
Aug. 2011- Dec. 2011	Ministry of Industry and Information Technology	The Ministry of Industry and Information Technology mandates the Battery Association to investigate and formulate a list of outdated low-capacity production techniques within the lead-acid battery industry.
Nov. 30, 2011	Environmental Department	The Environmental department issues its second public status list of lead-acid battery enterprises and recycled lead enterprises.
Dec. 2011	Ministry of Health	Formulates an occupational health standard for the lead-acid battery industry.
Mar. 1, 2012- Mar. 9, 2012	Ministry of Industry and Information Technology, Environmental Department	Issues its third public description of operating conditions for lead-acid battery manufacturers.
Mar. 19, 2012	Environmental Department	Notice to conduct environmental inspections of lead-acid battery enterprises and recycled lead enterprises ([2012]325) attachment: the environmental inspection guide for lead-acid battery and recycled lead enterprises.
May 11, 2012	Ministry of Industry and Information Technology, Environmental Department	The Ministry of Industry and Information Technology and the Environmental Department issue new conditions for manufacturers to operate as part of the lead-acid battery industry.
Jun. 30, 2012	Environmental Department	The Environmental department issues the third public status list of lead-acid battery and recycled lead enterprises.
Sep. 5, 2012	Ministry of Industry and Information Technology, Environmental Department	The Ministry of Industry and Information Technology and the Environmental Department issue new conditions for manufacturers to operate as part of the lead-acid battery industry.
Sep. 21, 2012	Finance Department	In order to curb their environmental impact, the government levies a 5% battery consumption tax, which includes lead-acid batteries.
Oct. 8, 2012	Environmental Department, National Development and Reform Commission, Ministry of Industry and Information Technology, Ministry of Health	Environment and Development [2012]123, issues its Hazardous Wastes Control Program as part of the Twelfth Five-Year Plan, which involves construction of a national recycling system for waste lead-acid batteries and the development of market regulations for recycled lead.
Nov. 8, 2012	Environmental Department	The first batch of enterprises apply for material verification; 17 enterprises apply as part of this first group.
Nov. 29, 2012	Ministry of Industry and Information Technology, Environmental Department	The Ministry of Industry and Information Technology publishes interim consumption management measures for the lead-acid battery industry [2012]509.
Nov. 30, 2012	Environmental Department	The Environmental Department seeks advice concerning lead-acid battery production and renewable pollution control techniques (exposure drafts).

(Table 4) contd.....

Time	Organizer	Project Content
Nov. 30, 2012	Environmental Department	The Environmental Department issues the fourth iteration of its public status list of lead-acid battery enterprises.
Jan. 2013	Environmental Department	Issues a public notice identifying the 12 lead-acid battery enterprises selected for the first batch of environmental inspections.
Mar. 12, 2013	Ministry of Industry and Information Technology, Environmental Department, Commerce Department, Development and Reform Commission, Finance Department	The Ministry of Industry and Information Technology issues an Opinion concerning lead-acid battery industry and recycled lead industry development promotion [2013] 92.
Mar. 16, 2013	Environmental Department	94 enterprises apply for material verification in the second batch of environmental inspections.
Apr. 16, 2013	Environmental Department	The Environmental Department publicly announces that ten of the lead-acid battery enterprises from the first batch of enterprises have completed their environmental inspection.
Jun. 30, 2013	Environmental Department	The Environmental Department issues its fifth public status list of lead-acid battery enterprises.
Nov. 20, 2013	Ministry of Industry and Information Technology	The Ministry of Industry and Information Technology publicly announces that six lead-acid battery enterprises from the first batch of inspections have passed their operating permit inspection.
Dec. 17, 2013	Environmental Department	The Environmental Department publicly announces that 12 lead-acid battery enterprises and 2 recycled lead enterprises from the second batch of enterprises have completed their environmental inspection.
Mar. 18, 2014	Ministry of Industry and Information Technology	Begins on-site minimum operating conditions inspection of the 12 lead-acid battery enterprises and 2 recycled lead enterprises that have passed their environmental inspection.

Table 5. Number and output of Chinese lead-acid battery enterprises after environmental reform.

Year	Number of Manufacturers	Nameplate Capacity (10 ⁴ kVAh)	Assembly Capacity (10 ⁴ kVAh)	Battery Output (10 ⁴ kVAh)
July 30, 2011	229	10865	15069	14230
Nov. 30, 2011	291	13460	15432	
Jun. 30, 2012	373	14079	14485	17486
Nov. 30, 2012	398	22335	26017	
Nov. 30, 2013	450	25053	30292	18529

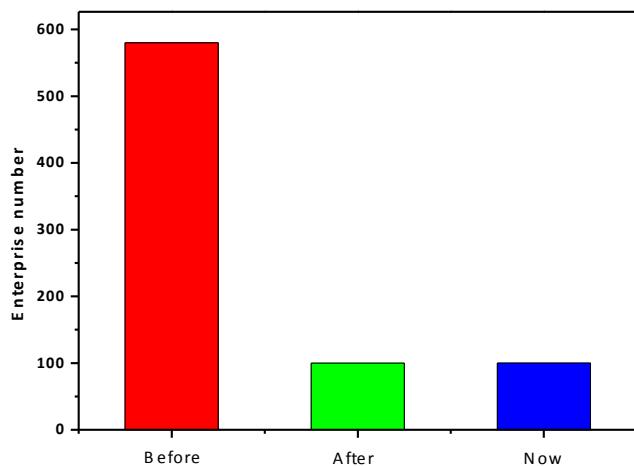


Fig. (5). lead-acid enterprise numbers in Jiangsu province before and after environmental regulation.

inspection organized by the Ministry of Industry and Information Technology before December 31, 2015. The

Environmental Department issued its notice to carry out environmental inspections of lead-acid battery enterprises and secondary lead enterprises on March 19, 2012, while the Ministry of Industry and Information Technology and the Environmental Ministry issued their access conditions for lead-acid battery manufacturers on May 11, 2012 and access conditions for the secondary lead industry on September 5, 2012. However, progress in terms of the number of enterprises who have completed the access process has been very slow. Table 6 shows the number of lead-acid battery enterprises and secondary lead enterprises who have completed each stage of the process.

The only foreign enterprise that completed its environmental protection inspection and received and passed all access conditions in the first batch of enterprises was the East Penn (Wujiang) Battery Co., Ltd., and the only enterprise in the second batch was Apollo Battery Co., Ltd. In fact, there were more than 20 foreign enterprises in China, as shown in Table 7.

These foreign lead-acid battery enterprises possess state-of-the-art production equipment and environmentally sound

Table 6. Number of enterprises who have completed the environmental inspection issued by the Environmental Ministry and met all permits to operate conditions issued by the Ministry of Industry and Information Technology.

Batch	Start Time	First Step: Number of Environmental Inspection Applications	Second Step: Number of Enterprises Who Completed the Environmental Inspection	Third step: NUMBER of Applications for an Operating Permit	Fourth Step: Number of Enterprises Who Passed All Operating Conditions
First batch	Nov.8, 2012	17	10 (announced on Apr. 16, 2013)	9	6 (announced on Nov. 20, 2013)
Second batch	Mar.16, 2013	94	14 (includes 2 recycled lead enterprises) announced on Dec.17, 2013	10 (includes 2 recycled lead enterprises)	7(announced in June. 23, 2014

Table 7. Foreign lead-acid battery enterprises in China.

Company Name	Site
Enersys	Shenzhen, Yangzhou, Chongqing, Chaozhou
EXID	Shanghai
Johnson Controls	Shanghai, Zhejiang Changxing, Chongqing
Haze	Shenzhen
East Penn	Jiangsu Wujiang
C&D	Shanghai
B&B	Raoping, Changsha
GS Yuasa	Tianjin, Zhangqiu, Shunde, Wuxi
Panasonic	Shenyang
Hitachi	Dongguan
Fiamm	Wuhan
FAAM	Jiangsu Yixing
Hoppecke	Wuhan, Shanghai, Beijing
Ricun	Changzhou
Apollo	Yangzhou
Toplite	Guangzhou

production facilities; however, most did not apply for the environmental inspection or the necessary operating permit because of their failure to understand the new Chinese environmental policies. In fact, all lead-acid battery enterprises and secondary lead battery enterprises had to accomplish the following three standard steps in order to undergo environmental protection inspection and access conditions before Dec.31, 2015 [3].

- i) The first step is to undergo a clean production audit organized by the Environmental Department of the region, and this audit must be conducted every two years. Experts provided by the regional Environmental Department shall determine whether an enterprise meets the required level of recycling and cleaner production and the enterprises should reach secondary level of cleaner production.
- ii) The second step is to pass an environmental inspection organized by the National Environmental

Department, formal announcement of National Environmental Department shall prevail.

- iii) The third step is to pass access conditions inspection organized by the National Ministry of Industry and Information Technology. However, an enterprise must pass the environmental inspection prior to applying for this permit inspection.

After more than a year of work to move the new inspection process forward, it was clear that the pass rate for the second step (the environmental protection inspection) is very low, and this step for most enterprises dragged out for a very long time. There were 94 enterprises who had applied for an environmental protection inspection in the second batch of enterprises, out of which only 27 enterprises entered the public stage of the process, among which only 14 enterprises completed the entire inspection and could publicly announce that they had passed the inspection. In the third batch of enterprises, 32 enterprises entered the public stage and 26 enterprises passed the inspection. It seems that

most Chinese lead-acid battery enterprises—and this includes foreign enterprises within China—have not yet mastered the logistics and necessary paperwork required for the environmental protection inspection or understand how to meet all the new operating conditions now required for the lead-acid battery industry [4].

The purpose of this paper is to provide a comprehensive description of the environmental protection inspection requirements and all necessary operating conditions for lead-acid battery enterprises in China so that competitors in the industry, particularly foreign enterprises, can fully understand the necessary details and so pass all the necessary steps to receiving an operating permit. The government's objective was to have 300–500 lead-acid battery enterprises in China by the end of 2015; this means the remaining number of current competitors will be eliminated.

CONCLUSION

Although Chinese government has shut down most of lead-acid battery factories and secondary lead factories, the output in this field hasn't decreased due to the production scale expansion of the existing factories.

It has been estimated that only 100-200 factories will pass the environmental protection inspection and access condition audit performed onto the factories planned to finish before December, 31th, 2015, which has been attributed to the strict vetting conditions and slow speed.

CONFLICT OF INTEREST

The authors confirm that this article content has no conflict of interest.

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