

Bulgaria

Industrial Pollution Improvement Project in Plovdiv

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Field Survey: December 2005

1. Project Outline and Japan's Yen loan



Map of project area



Renovated KCM Plant

1.1 Background

Under the former socialist system, Bulgaria failed to adopt adequate measures against air and water pollution, and as a result its environmental problems remained serious even after the shift to a market economy in 1989. Therefore, taking appropriate environmental measures, including the establishment of a legal framework and environmental standards, was an important and an urgent issue. In such a circumstance, Bulgaria signed an agreement with the European Union in 1993 and the Treaty of Accession in 2005, and is advancing establishment of environmental legislation and related regulations aiming for joining the EU in 2007.

KCM S.A. is in operation in the suburbs of Plovdiv, Bulgaria's second largest city (with the population of 370,000). It is one of Bulgaria's leading state-owned enterprises engaged in zinc and lead production. At the beginning of the 1990's, KCM faced serious environmental problems such as pollution of the surrounding area. The main causes are the deterioration of plant facilities introduced during the 1950s and 1960s from the former Soviet Union and the company's failure to take adequate environmental measures under the former socialist regime. As a result of such insufficient environmental measures, KCM's zinc and lead smelting facilities for many years released emissions containing sulfur dioxide and heavy metals, as well as dust and water containing heavy metals exceeding environmental standards. These harmful substances markedly polluted the air, water, and soil of the surrounding area, and had an impact on residents' health and agriculture. Air pollution was also known to have affected ancient monuments from the Roman era that are located around Plovdiv, as well as churches,

paintings and other artifacts of the country's cultural heritage.

In order to prepare for the accession to EU membership in 2007, the Bulgarian government adopted policies to bring its emission standards into accord with EU standards. As a result, KCM was forced to cut the operation rate of its facilities down to a low level of production so that it could meet the new environmental standards in 1994. Bulgaria's economy depends on exports of lead and zinc as a means of acquiring foreign currency, and for KCM to continue producing high-quality lead and zinc while complying with environmental standards, the company had to replace and modernize its aging facilities. Another important issue for the company was introducing an appropriate environmental monitoring system and improving its environmental management capabilities.

1.2 Objectives

The objective of this project was to reduce the harmful substances emitted into the air and discharged into water from KCM plant, the zinc and lead smelter located in Plovdiv, the Republic of Bulgaria, through appropriate countermeasures to produce cleaner exhaust gas and wastewater, thereby contribute to environmental improvement and economic growth in Bulgaria.

1.3 Borrower/Executing Agency

Borrower: KCM S.A./ Guarantee: Government of the Republic of Bulgaria

Executing Agency: KCM S.A.

1.4 Outline of Loan Agreement

| | |
|-------------------------|---|
| Loan Amount | 5,955 million yen |
| Disbursed Amount | 5,955 million yen |
| Exchange of Notes | October 1995 |
| Loan Agreement | November 1995 |
| Terms and Conditions | |
| - Interest Rate | Main project: 2.7% p.a. Consultant 2.3% p.a. |
| - Repayment Period | 30 years |
| (Grace Period) | 10 years |
| - Procurement | General Untied |
| Final Disbursement Date | January 2004 |
| Main Contractor | Marubeni Corporation |
| Consulting Services | MESCO, Inc. |

2. Evaluation Result

2.1 Relevance

2.1.1 Relevance at the time of appraisal

In March 1993, Bulgaria signed the European Union agreement (for associate membership) and put into effect environmental standards conforming to the EU's emission standards for air polluting substances. In Bulgaria, the importance of the non-ferrous metal sector (copper, zinc, and lead) is high. The country's exports center on mining and manufacturing and agricultural products, of which non-ferrous metals such as copper, zinc, and lead account for 7%. KCM's export ratio is approximately 80%, and for this reason the company occupies an important position in the Bulgarian economy in acquiring foreign exchange. At the time of the appraisal, smelting plants in Bulgaria's non-ferrous sector were forced to reduce their production output in order to meet environmental standards conforming to the EU. KCM (zinc and lead smelter), the focus of this ex-post evaluation, did not satisfy environmental standards for either wastewater or exhaust gas due to the inadequacy of environmental measures. As mentioned above, this has brought pollution in the air, water, and soil of the area, and raised concerns about detrimental effects on the health of residents in the surrounding areas. In addition, ancient monuments from the Roman era are located around the city of Plovdiv, and it was said that air pollution was affecting the city's cultural treasures. For these reasons, the urgency and priority levels of this project were exceptionally high in terms of KCM's continued operation, protection of the surrounding environment, and preservation of cultural heritage.

2.1.2 Relevance at the time of evaluation

Bulgaria signed the EU agreement in 1993 and the Treaty of Accession in 2005, and has been advancing establishment of environmental legislation and related regulations with a view to join the EU in 2007. As a result, Bulgaria's domestic environmental standards for air pollution and wastewater are currently in line with EU standards. In addition, the importance of the non-ferrous sector in Bulgarian economy and the importance of KCM in this sector have not changed from the time of the appraisal. Owing to the country's shift to a market economy and its membership in the WTO in 1996, the composition of Bulgaria's export products has changed and now consists principally of clothing, metals, and chemicals. Non-ferrous metals continue to account for a high percentage, or 9.9% (in 2000) of the export products. KCM is the leading company in the production of lead and zinc, and in 2004 commanded very high shares—81.6% and 79.5%, respectively—of Bulgaria's overall

production of these metals. Because KCM exports 85.96% of its lead and 87.40% of its zinc (as of 2004), it continues to occupy an important position as a generator of foreign exchange. In terms of environmental measures, KCM's emission standards for air pollutants and wastewater treatment standards generally meet EU standards at present. Thanks to the reduction in polluting substances released by KCM, the range over which sulfur dioxide, dust, and other substances in the air land to the ground has become smaller, and as a result, the impact on surrounding cultural treasures has declined. From this perspective, this project had relevancy for being in concordance with the needs of Bulgaria, KCM, and residents in the surrounding areas.

2.2 Efficiency

2.2.1 Outputs

The initial plans for this project called for measures against exhaust gas and wastewater. Measures against exhaust gas included (1) replacement of a roasting plant for zinc concentrate, (2) installation of SO₂ gas cleaning facilities (including Hg removal system), (3) replacement of sulfuric acid plant, and (4) replacement of bag filters for exhaust gas. Measures against wastewater included: (1) replacement of residue dryer and (2) installation of wastewater treatment. Also included in the plan were the installation of monitoring, measurement, and analysis equipment, and the provision of consulting services for management. At the stage of implementation, however, the output was changed somewhat. The main changes were: (1) removal from the scope of the project the Hg removal system as an exhaust gas measure, because they were deemed unnecessary since Hg was not contained in raw materials, and (2) the scope relating to the complete wastewater treatment facilities as a wastewater measure was divided into two sections due to a fund shortage, and the Yen loan was applied to the installation of a weak acid neutralization plant (see Table 1).

Table 1. Overview of Project and Status of Implementation

| Item | Plan (time of appraisal) | Actual | Reasons for Discrepancies between Plans and Actual Performance |
|------------------------------|--|---|--|
| Measures against exhaust gas | (1) Replacement of roasting plant for zinc concentrate (2) Installation of SO ₂ gas cleaning facilities (including Hg removal system) (3) Renovation of sulfuric acid plant (4) Replacement of bag filters for exhaust gas treatment | (1) As planned (2) Hg removal system not installed (3) Installation of closed-type water cooling equipment, an addition to project scope. (4) As planned | (2) Hg removal system were included in the calculation of cost at the time of the appraisal, but at the implementation stage, it was decided that since Hg was not contained in raw materials, the facilities were not necessary and therefore not installed (3) Measures to reduce the amount of wastewater by curtailing use of fresh water |
| Wastewater measures | (1) Replacement of residue dryer (2) Installation of wastewater treatment system | (1) As planned (2) Initial scope divided into two sections, and installation of weak acid neutralization plant through Yen loan Additionally, after the end of the project period, construction of the central wastewater treatment plant was completed in October, 2005. | (2) Fund shortage |
| Other | (1) Installation of pollution monitoring equipment, measurement equipment, and analysis equipment, etc. (2) Complete renovation of existing foundation and piping accompanying conversion | (1) As planned (2) As planned (3) Water demineralization plant was additionally installed because it was essential for exhaust gas system | (3) The water demineralization plant was required in order to obtain cooling water for the roasting plant, the gas cleaning system and the sulfuric acid plant and demineralized water for the roasting plant boiler. It was installed as an integral component of exhaust gas facilities renovated through Yen loan |
| Consulting service | (1) D/D, tender assistance, construction supervision, etc. (2) Management consulting services including overall management, accounting, finance, marketing, organization structure, quality control, and operation skills and business strategy. | (1) As planned (2) Limited implementation | (2) Management consulting services for “supervision and advice concerning overall management, accounting, finance, marketing, organization structure, quality control, and operation skills and business strategy” in the original plan was reduced, and only the provision of production control guidance in the plant was implemented. |

2.2.2 Project period

The initial implementation period was November 1995 to December 1999 (50 months). The actual period, however, was November 1995 to March 2003 (the month of the completion ceremony) (88 months), which is 176% longer than planned. The reasons for the delay included: (1) time was required for preparation and approval of tender documents (due to complexity of technical scope, changes in Bulgaria's legal system, etc.); (2) higher prices than expected due to exchange rate fluctuations (depreciation of the yen), requiring more time for the main agreement negotiations with Marubeni; and (3) as a result of these time extensions, the start of work was delayed by about two and a half years beyond the initial schedule (until November 1999). Consequently, a three-year extension of the final disbursement date of March 2001 was applied (the final disbursement date after the extension was March 25, 2004).

2.2.3 Project cost

At the time of the appraisal, the project cost was estimated at 7,940 million yen. After the start of the project, because of exchange rate fluctuations and lack of counterpart fund, KCM divided the scope into two sections, as indicated above, whereby JBIC would finance only Section I. With respect to the complete wastewater treatment facilities of the remaining Section II, KCM received financing of US\$7.371 million from the Black Sea Trading & Development Bank and used it to complete these facilities. In principle, this amount should be regarded as part of total project cost, and adding it into the project cost results in a total of 7,799 million yen. Compared to the 7,940 million yen calculated at the time of the appraisal, this amount represents 98.2% of the initially planned amount.

2.3 Effectiveness

2.3.1 Performance of exhaust gas and wastewater facilities

An outline of the status of facilities operation is given in Table 2 below. After the replacement of the roasting plant for zinc concentrate in November 1995, environmental measures were strengthened, and increases in zinc and lead production were achieved. The sulfuric acid plant was upgraded to a double-contact type since with the previous one-contact type, the concentration of SO₂ in exhaust gas was high. This change allowed gas from the sulfuric acid plant to be released into the air without SO₂ treatment. With regard to the residue dryer, the existing rotary dryer used heavy oil with 3.5% sulfur content for fuel, which generated exhaust gas containing SO₂ and high concentrations of dust. Replacement of this system with a high-pressure dehydration system was implemented in order to reduce the environmental load. In addition, installation of the weak acid neutralization plant and replacement of the bag filters for treatment of exhaust gas (lead plant) reduced emissions of harmful substances.

Table 2. Operation of Anti-Exhaust Gas and Wastewater Facilities

| | Plan | Actual |
|---|--|---|
| (1) Roasting plant for zinc concentrate | Smelting capacity: 14.3 tons/h Emission concentration: no emission SO ₂ concentration: Must be above 7% Zinc production volume: 48,000 tons/yr (production capacity: 60,000 tons/yr) (Lead production volume: 32,000 tons/yr (production capacity: 40,000 tons) | Smelting capacity: 14.3-18.6 tons/h Emission concentration: no emission SO ₂ concentration: Above 8-9% Actual zinc production volume: 76,000 tons/yr (FY2004) Actual lead production volume: 54,000 tons/yr (FY2004) |
| (2) SO ₂ gas cleaning facilities and Hg removal system | Exhaust gas treatment capacity: 54,000Nm ³ /h SO ₂ concentration: Held to 7.5% | Exhaust gas treatment capacity: 40,000-56,000Nm ³ /h SO ₂ concentration: 7.2-8.5% |
| (3) Sulfuric acid plant | Sulfuric acid production volume: 17.3 tons /h (98% sulfuric acid) Exhaust gas treatment capacity: 54,000Nm ³ /h SO ₂ concentration: Held to 7.5% | Sulfuric acid production volume: 16-18.5 tons/h (95-98% sulfuric acid) Exhaust gas treatment capacity: Maximum 56,000Nm ³ /h SO ₂ concentration: Held to 6.5-7.5% |
| (4) Residue dryer | Treatment capacity: 7.5 tons/h (completely dried) 500mg/Nm ³ by weight | Treatment capacity: Overall, 12.8 tons/h, each unit, 3.2 tons/h (completely dried) Maximum 280mg/Nm ³ by weight Harmful substance discharge reduction effect: lead, 12.5 tons/yr, zinc, 22 tons/yr, cadmium, 0.7 tons/yr, dust, 62 tons/yr |
| (5) Weak acid neutralization plant | Treatment capacity: 10m ³ /h | Treatment capacity: (1) Weak acid neutralization 8-12 m ³ /h (2) Wastewater neutralization 10-12 m ³ /h Harmful substance discharge reduction effect: Sulfuric acid 1400 tons/yr, lead 0.35tons/yr, zinc 8.5 tons/yr, cadmium 0.1 tons/yr |
| (6) Bag filters for exhaust gas treatment (lead plant) | 1) Jet-type filter for sintering machine 2) Jet-type filter for blast furnace 3) Jet-type filter for fuming furnace (no particular planned figures) | 1) 120,000 Nm ³ /h 2) 100,000 Nm ³ /h 3) 60,000 Nm ³ /h Harmful substance discharge reduction effect: From 35-50mg/nm ³ to 4-6mg/nm ³ Dust 72 tons/yr, lead 26 tons/yr, zinc 8.2 tons/yr |

2.3.2 Compliance with environmental standards

At present, KCM is generally in compliance with EU environmental standards¹. This was

¹ Compliance with EU standards concerning wastes generated by the facilities and equipment that was introduced or replaced through the Yen loan has been confirmed. However, the actual amount of SO₂ released from the sintering machine (in the lead smelting plant), which was not covered under the Yen loan, was approximately 1000 mg/Nm³, in contrast to the EU standard of 500 mg/Nm³, providing no improvement. The reason for this was a

verified in this ex-post evaluation from (1) data provided by KCM, (2) an interview with the Ministry of Environment of Bulgaria, (3) a report by Prof. Dombalev of the Balkan Science and Education Center of Ecology and Environment (BSECEE). Also the environmental standards have been revised in more strict way, and there are a few items which exceed the standards during the transition period.

Bulgaria's Ministry of Environment issues KCM an Integrated Permit based on the country's environment law, and KCM continues to operate under this permit (An Integrated Permit corresponds to an operation permit certificate and is renewed every five years. Under this permit, each zinc and lead smelting company is subject to a separate appraisal for each company and is instructed as to which environmental standards that must be complied and monitored.). After Bulgaria's environmental standards were replaced by EU standards, KCM was the first company which was granted the Integrated Permit in 2004 after examination by the Ministry of Environment.

Under the above permit, KCM performs environmental monitoring, and the Ministry of Environment authorities oversee compliance with standards. The harmful substances that must be monitored are specified in the permit by the Ministry of Environment, which is determined based on the constituents of the raw materials used by KCM. When raw materials change, KCM is required by law to report the change to the Ministry of Environment. According to an interview with the Department of Industrial Pollution Prevention of the Ministry of Environment, compliance by KCM with environmental standards after issuance of the permit has been highly satisfactory, and it was confirmed that government authorities highly regard the environmental facilities and technologies introduced by KCM through the Yen loan.

Table 3. Changes in Environmental Standard Indexes

| EU Standard (2005) | | Actual | | | | |
|---|-------------------|---------------------------|--------------|-------|--------|-------|
| (1) Emissions of Flue gas | | (1) Emissions of Flue gas | | | | |
| SO2 (acid plant) | 500mg/Nm3 or less | | 2002 | 2003 | 2004 | 2005 |
| Dust (lead plant) | 10mg/Nm3 or less | SO2 | n.a | 244 | 190 | 452 |
| Hg, Cd, Tl | 0.2mg/Nm3 or less | Dust | 6.00 | 8.13 | 5.50 | 6.21 |
| As, Co, Ni, Se, Te | 1mg/Nm3 or less | Hg | Not included | | | |
| Sr, Cu, Mn, Pb, Pd, Pt, F2, Sb, V, SiO2, Rn, Cr, CN | 5mg/Nm3 or less | Cd | 0.03 | 0.02 | 0.03 | 0.04 |
| H2SO4 | 5mg/l or less | Pb | 2.40 | 1.46 | 2.20 | 1.85 |
| (2) Wastewater | | (2) Wastewater | | | | |
| pH | 6.0-9.0 or less | | 2002 | 2003 | 2004 | 2005 |
| US | 100mg/l or less | pH | 7.05 | 7.10 | 7.65 | 7.33 |
| BOD | 25mg/l or less | US | 38.00 | 25.00 | 25.00 | 15.00 |
| | | BOD | n.a | 5.6 | 8.0 | 12.0 |
| | | As | n.a | 0.003 | <0.001 | 0.002 |

delay in replacing the aging sintering machine. However, in Dec. 2006 KCM informed that it had decided to introduce new technology to replace the sintering machine through a new facility investment plan. It is indeed an important decision in terms of the environmental management improvement of KCM and the compliance with EU standards.

| | | | | | | |
|----------|------------------|---|-------|--------|--------|--------|
| As | 0.1mg/ or less | Pb | 0.25 | 0.34 | 0.30 | 0.12 |
| Pb | 0.3mg/1 or less | Cd | 0.12 | 0.18 | 0.15 | 0.14 |
| Cd | 0.1mg/1 or less | Fe | n.a. | 2.25 | 0.89 | 0.65 |
| Cr5+ | 1.0mg/1 or less | Cu | n.a. | 0.15 | 0.16 | 0.22 |
| Cr6+ | 0.1mg/1 or less | Zn | 2.75 | 5.53 | 2.52 | 0.95 |
| CN | 1.0mg/1 or less | Hg | n.a. | <0.001 | <0.001 | <0.001 |
| Fe | 3.5mg/1 or less | Oil | n.a. | 0.38 | 0.22 | 0.15 |
| Cu | 0.5mg/1 or less | Solubles | 15.13 | 28.3 | 11.50 | 22.35 |
| Ni | 0.5mg/1 or less | Notes: (1) Units of figures are the same as those of EU standard stated at left; (2) Figures are yearly averages; (3) The harmful substance items that must be monitored under the Integrated Permit granted to KCM by the Ministry of Environment were assessed under this ex-post evaluation. | | | | |
| Hg | 0.01mg/1 or less | | | | | |
| Zn | 3.0mg/1 or less | | | | | |
| Oil | 0.5mg/1 or less | | | | | |
| Mg | 0.8mg/1 or less | | | | | |
| Solubles | 35mg/1 or less | | | | | |

Source: Evaluation of the Effectiveness of the Industrial Pollution Improvement Project in Plovdiv, KCM S.A.

2.4 Impact

2.4.1 Improvements in residents' health and in environmental pollution affecting agricultural land and livestock

Following implementation of this project, the concentration of lead in the blood of children living in the surrounding area tended to decline, and the level of cadmium was harmless.

According to the report by Prof. Dombalev mentioned above, a survey performed in 2003 found that pollution due to heavy metals (lead, cadmium, copper, zinc, arsenic, and nickel) in the soil surrounding KCM remained at serious levels². After implementation of the Yen loan project, however, a definite downward trend in the levels of lead, zinc, and cadmium in the soil was observed. The report concluded that although the process of removing heavy metals from the soil was slow, the Yen loan project contributed to reducing soil contamination in this area.

With respect to vegetation and crops, pollution of agricultural land continues today, and there are zones where farming is prohibited. The perception that the farmland in the area is polluted affects sales of farm products. However, it was ascertained from survey data that lead and cadmium concentration in hay, livestock feed, grass, and maize, etc., has been declining since implementation of the Yen loan project.

With respect to the impact on livestock, a heavy metal content investigation of fresh milk performed between 2002 and 2003 found that levels were below the maximum permissible concentration (MPC).

2.4.2 Air and water pollution in the surrounding area

This ex-post evaluation survey verified data concerning the concentration of air pollutants measured at three locations near KCM (Assenovgrad, Kuklen, Dolni Voden) between 1995

² Compared with the average concentration in soil in Bulgaria, levels of lead were 4.6-230 times higher, cadmium 6.2-250 times higher, and arsenic 0.6-11.5 times higher.

and 2005. The results found that the concentration of air pollutants such as dust, lead, cadmium, and SO₂ had declined. During the period from 2004 and 2005 following the introduction of environmental equipment through the Yen loan in 2003, a particularly sharp reduction in the concentration of these substances in emissions was observed, and the concentration of lead in emissions declined despite production increases. These findings support the effectiveness of the Yen loan project.

2.4.3 Contribution to the local community and public relations activities by KCM and the accompanying effect of publicity on Yen loan projects

KCM has shown its commitment to local community as a part of their policy. For example, KCM supports microfinance projects (lavender cultivation³) to local residents and contributes in a variety of ways to the community.

KCM's public relations activities include the publication of the monthly PR magazine "Bulletin KCM" and the semi-annual "Ecology and Sustainable Development." As an example of KCM's commitment to information disclosure, there is an article on the concentration of lead in the blood of employees by doctors who work at KCM's health center in the latter magazine. These activities are good examples to show their Corporate Social Responsibility, and local newspapers speak highly of them.

However, the results of a beneficiary survey revealed that such publicity activities are still not necessarily recognized widely by ordinary residents in the area, and the dissemination of information reaches no further than to intellectuals and highly-educated people.

The educational effect on students of the local educational institution (Plovdiv Agricultural University) was also observed. This university encourages site visit to KCM's smelter to study its measures against environmental pollution as a learning model. Students in agricultural environment studies are required to take the course. It is thought that these activities have a significant PR effect relating to Japan's assistance and Yen loans.

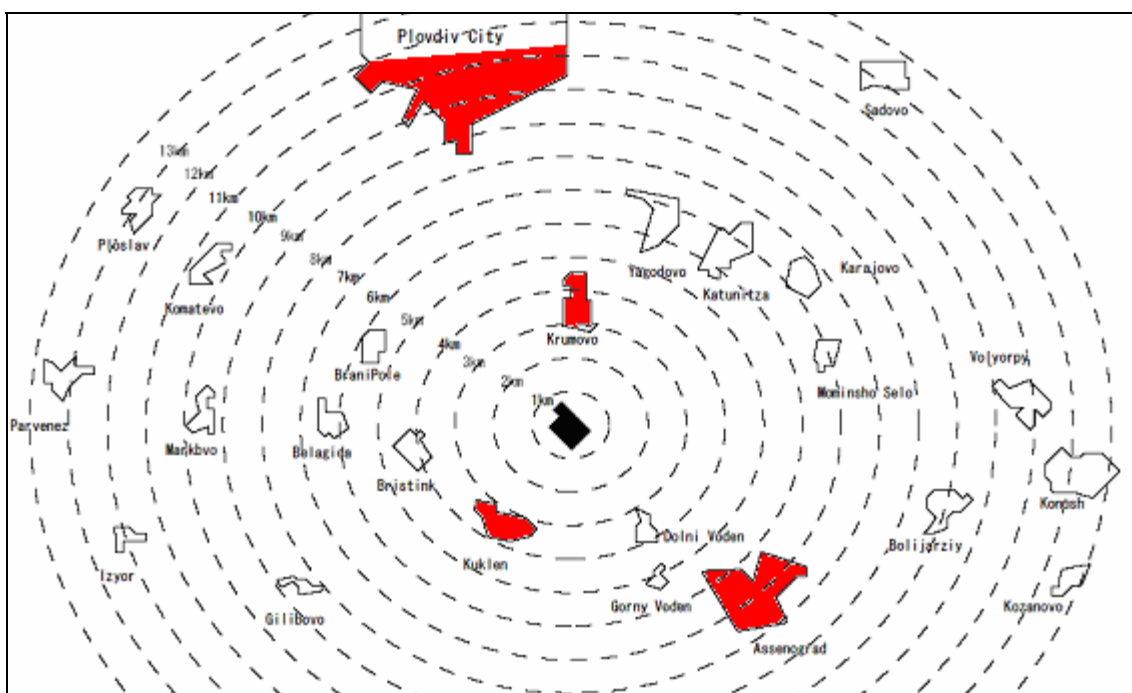
2.4.4 Changes in residents' view of KCM and awareness of Yen loan projects

This ex-post evaluation conducted a beneficiary survey through door-to-door visits to 500 persons selected randomly (400 residents and 100 students living in four districts, Kuklen, Krumovo, Assenovgrad and Plovdiv-South). An in-depth interview survey was also performed to 20 local experts, administrative authorities, farmers and doctors, etc.

(The locations of the four districts where the beneficiary survey was carried out are shown in the diagram below.)

³ Based on a research, the lavender observes polluted substances from the ground. Therefore, KCM plant lavender in the polluted area around its plant. The cultivated lavender is refined within the KCM factory and sold as essential oil. This activity not only encourages farmers to grow commercial crops not for food, but also contributes to income growth of the farmers.

Diagram: Beneficiary Survey Districts (Kuklen, Krumovo, Assenovgrad, and Plovdiv-South)



Compared to the 1990s, local residents' image toward KCM today has improved gradually and steadily. In the 1990s, demonstrations were held against the environmental pollution caused by KCM, but at present, the stance adopted by KCM up to now toward environmental measures and information disclosure has come to be recognized by local residents.

The degree of awareness of KCM's environmental measures appears to be positively correlated with the educational level of residents. The same correlation observes between educational level and awareness of Yen loans and Japan's assistance. The percentage of residents who were aware that KCM was receiving support from Japan was 41% as indicated by the number of survey respondents.

Approximately 60% of residents agree that KCM is making a major contribution to the local economy (in terms of employment and tax revenues), while 43% recognize that the company shows concern toward its employees' health problems.

Despite these improvements in image, residents still have concerns about environmental pollution. Particularly, there is deeply-rooted worry about the contaminated soil with heavy metal. It has also been reported that farmers are hesitant about revealing the names of the areas

where they grow their crops.

Residents appear, though, to have mixed feelings toward KCM: one-fifth responded that they would be positive about working for KCM but would like the company to relocate elsewhere.

2.4.5 Effect on cultural heritage

KCM's emissions of pollutants, particularly sulfur dioxide and dust, fall on the ground as acid rain and affect archeological monuments and cultural heritage.

This ex-post evaluation requested Prof. Dombalov of BSECEE to analyze the current effect on cultural heritage. His data indicated that the effects due to dust are small and do not require concern. In addition, the results of a test of a sulfur dioxide diffusion model confirmed that the maximum concentration of SO₂ in Plovdiv declined to one-fifth of 1995 levels following implementation of the Yen loan project.

From these findings, Professor Dombalov concluded that the Yen loan project has made a definite contribution to the preservation of historical heritage and architecture.

2.4.6 Health of plant employees

KCM's health center monitors changes in the concentration of lead in the blood of company employees. In the data, changes in the concentration of lead in the blood of KCM employees are recorded in the nine-year period from 1997 to 2005. They reveal that there has been a notable improvement since 2002. The concentration of cadmium in the blood has also declined. These changes coincide with the period of operation of the plant under Yen loan support, and are believed to be attributable to the improvement in the working environment achieved through introduction of environmental technologies.

2.4.7 Impact of the contribution of foreign currency acquisition through exporting

At the time of the appraisal in 1994 KCM did not have adequate technology or facilities to comply with emission standards, and the company responded by reducing its production volume to a level of about 80% of capacity. This consequently had an impact on foreign currency income from exports. Looking at the value of exports of lead and zinc (nominal base) calculated using LME international non-ferrous metal prices, foreign currency income obtained from exports of both products in FY2005 reached US\$146 million, or about 3.5 times compared to 1991. Taking into account that KCM's production capacity itself expanded through the Yen loan (25% increase in the zinc plant), it can be concluded that this project has brought a great impact on foreign currency revenue of Bulgaria.

2.5 Sustainability

2.5.1 Executing agency

2.5.1.1 Technical capacity

In 2000, KCM acquired ISO9001. Later, KCM became the first company in Bulgaria to acquire the Integrated Permit, which, as stated previously, certifies conformance with EU environmental standards. This project is an example in which the Yen loan has successfully led to upgrade the technical capacity of the executing agency; KCM was awarded the Gold Prize at the 59th International Technology Trade Fair held in October 2003 for a new product it developed, zinc sulphate monohydrate. Participants in this fair included 19 overseas companies and 34 domestic companies. These facts show that the company's technological capabilities to the top class in the country. The high purity of this product was unmatched, and there appears to be no other company in the in the entire Balkan region with equivalent manufacturing capability. Manufacture of this new product was made possible by the facilities installed through the Yen loan.

2.5.1.2 Structure

KCM was privatized in March 2001. At the same time, the company proceeded to split up in order to increase management efficiency. At the end of 2005, there were 11 companies in the entire group, including a holding company. This holding company (KCM2000 S.A.) conducts management as a private-sector corporation independent of government. Dr. Dobrev, the current President and CEO of KCM 2000 S.A., occupies a key position in international industry organizations as a leader of the lead and zinc smelting industry. He has obtained high reputation as a manager, receiving awards and other honors in Bulgaria as an outstanding manager.

2.5.1.3 Financial status

With respect to KCM's asset and liabilities status (see Table 5), its present equity adequacy ratio (38.2%) is at high level, and it is relatively stable. Its liquidity, fixed asset ratio and debt ratio in the first half of 2006 have improved, compared to those in the previous year. There is no problem in its capital turnover, The long-term liability has improved dramatically. Although its long-term solvency still requires some attention, there is no major issues in the current balance sheet⁴.

KCM's profit and loss accounts (see Table 6) are moving unstably, and it needs some careful attention. Its profit margins were declining until 2005, and its closing figure of FY2005 was in red, in spite of sales increase. However, the business situation has recovered remarkably in 2006. Before 2006, KCM had difficulty securing profit from zinc and lead

⁴ From 2000 to 2005, it refers to the balance at the end of December. In 2006, it refers to the balance up to the end of September.

manufacturing (i.e., its principal business). The factors involved are: (1) high raw materials prices, and (2) the weak dollar. Hence, KCM's financial situation is highly influenced by external factors, such as the contraction of international and domestic markets and difficulty of negotiations on price of raw materials. In 2006 (actual figure from January to September), its revenue and operating cash flow (i.e., cash flow of principal business, procurement of raw materials, manufacture and sale of products) are both improved tremendously due to the strong market.

KCM's products are of excellent quality and are internationally competitive, and the current level of production can probably be maintained. However, modernization of business and management efforts are needed in order to secure profits in the company's principal business while continuing to invest in environmental protection, replacement of facilities, and employee measures.

KCM began repayment of the principal of the Yen loan from cash flow in November 2005, and will need to secure yen currency for yearly payments ranging from 300 million to 440 million yen (including repayment of principal and interest payments) until 2025.

Table 5. Balance Sheet Accounts (B/S) (1000 leva)

| | Current assets | Fixed assets | Current liabilities | Long-term liability | Equity |
|------|----------------|--------------|---------------------|---------------------|---------|
| 2000 | 44,210 | 55,604 | 22,723 | 26,701 | 50,390 |
| 2001 | 59,225 | 87,515 | 28,446 | 70,047 | 48,247 |
| 2002 | 48,904 | 164,603 | 31,594 | 110,472 | 71,441 |
| 2003 | 49,237 | 164,985 | 39,725 | 106,089 | 68,408 |
| 2004 | 72,000 | 164,459 | 57,622 | 106,333 | 72,504 |
| 2005 | 85,899 | 160,084 | 63,929 | 117,931 | 64,123 |
| 2006 | 116,883 | 152,820 | 77,067 | 89,598 | 103,038 |

Table 6. Profit and Loss Accounts (1000 leva)

| | Gross sales | Net income | Operating cash flow |
|------|-------------|------------|---------------------|
| 2000 | 204 | 9.3 | 17,089 |
| 2001 | 218 | 2.5 | 9,893 |
| 2002 | 196 | 1.4 | 7,146 |
| 2003 | 219 | 0.1 | 4,385 |
| 2004 | 274 | 4.1 | ▲1,750 |
| 2005 | 352 | ▲2.9 | ▲3,918 |
| 2006 | 366 | 37.4 | 27,398 |

In view of the above, there remain concerns about financial sustainability.

2.5.2 Operation and maintenance

There are no existing problems involving either the condition of facilities or state of operation and maintenance.

3. Feedback

3.1 Lessons Learned

In the Project, there was an unexpected exchange rate fluctuation which was beyond the forecast, and that lead to a shortage of funds. Therefore, in a case which contracts are to be concluded in a currency other than yen, it is expected to have 10% or more contingency portion in the Loan Agreement at the time of appraisal for future projects.

3.2 Recommendations

The financial condition of KCM has been improved rapidly in 2006, but it is influenced by the fluctuation of international market price of lead and zinc. This factor is a factor of unstableness for its financial sustainability, which continues to require attention. In this regard, following is recommended:

- (1) In this project, KCM is the borrower of Yen loan, and the Bulgarian government guarantees the repayment of Yen loan. As KCM continues to pay back the loan from its revenue, it is important to monitor the KCM's financial situation continuously.
- (2) If KCM's business condition gets worse in the future, JBIC as a lender should alert the Bulgarian government and KCM, and request to submit a medium and long-term management plan (especially measures and forecasts concerning financial sustainability) through the Bulgarian government, if necessary.

Comparison of Original and Actual Scope

| Item | Plan (at time of appraisal) | Actual |
|---|--|--|
| (1) Outputs | | |
| 1) Exhaust gas measures | | |
| (a) Roasting plant for zinc concentrate | Concentrate treatment capacity: 14.3 tons/h | Concentrate treatment capacity: 14.3 tons-18.6 tons/h |
| (b) SO ₂ gas cleaning facilities (including Hg removal facilities) | Exhaust gas treatment capacity: 54,000Nm ³ /h | Exhaust gas treatment capacity: 40,000-56,000Nm ³ /h |
| (c) Replacement of sulfuric acid plant | Sulfuric acid production volume: 17.3 tons/h Exhaust gas treatment capacity: 54,000Nm ³ /h | Sulfuric acid production volume: 16-18.5 tons/h Exhaust gas treatment capacity: Maximum 56,000Nm ³ /h |
| (d) Replacement of bag filter for exhaust gas treatment | (no particular planned figures) | i) Jet-type for sintering machinery 120,000 Nm ³ /h ii) Jet-type for blast furnace 100,000 Nm ³ /h iii) Jet-type for fuming furnace 60,000 Nm ³ /h |
| 2) Wastewater measures | | Treatment capacity: Overall, 12.8 tons/h (completely dried) |
| (a) Replacement of residue dryer | Treatment capacity: 7.5 tons/h (completely dried) | Treatment capacity: (1) Weak acid neutralization 8-12 m ³ /h (2) Wastewater neutralization 10-12 m ³ /h |
| (b) Weak acid neutralization plant | Treatment capacity: 10m ³ /h | Treatment capacity: 100m ³ /h |
| (c) Installation of complete wastewater treatment facilities | Treatment capacity: 100m ³ /h | As planned |
| 3) Other | | |
| (a) Installation of pollution monitoring equipment, measurement equipment, and analysis equipment, etc. | | As planned |
| (b) Complete renovation of existing foundation and piping accompanying conversion | | A water demineralization plant essential for facilities for countermeasures was installed as an addition |

| | | |
|---|--|---|
| <p>4) Consulting service (a) D/D, tender assistance, construction control, etc.</p> <p>(b) Supervision and advice concerning overall management, accounting, financial affairs, marketing, organization, quality control, and operation</p> | | <p>As planned</p> <p>Limited implementation</p> |
| (2) Project Period | November 1995-December 1999 (50 months) | November 1995-March 2003 (month of completion ceremony) (88 months, or 176% of planned period) |
| <p>(3) Project Cost</p> <p>Foreign currency</p> <p>Local currency</p> <p>Total</p> <p>Yen loan Portion</p> <p>Exchange rate</p> | <p>5.024 billion yen</p> <p>2.916 billion yen (49 million leva)</p> <p>7.94 billion yen</p> <p>5.955 billion yen</p> <p>1 lev=1.81 yen (as of August 1994)</p> | <p>6.96208 billion yen</p> <p>1.23792 billion yen (27 million leva)</p> <p>8.2 billion yen</p> <p>5.95 billion yen</p> <p>1 lev=95 yen (simple average for 1997-2002)</p> |