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철강산업의 환경성과평가 - 포스코 사례

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Measuring Environmental Performance Toward Sustainable Steel Works: A Case of POSCO in Korea

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ABSTRACT

In line with growing importance of environmental management in business circles, the implementation of a system for measuring and evaluating corporate environmental performance becomes one of key agenda for both internal management purposes and for external relations with a wide range of stakeholders. To deal with this subject, academia, practitioners and many international organizations like UNEP, OECD, ISO, WBCSD have elaborated appropriate schemes and indicators to implement environmental performance evaluation. Among them, ISO 14031 document was published in the end of 1999 and the subsequent document ISO/TR 14032, which incorporates seventeen industrial cases from different countries, is also at the finalizing stage.

The paper examines a relevant case of measuring environmental performance at the POSCO, a the world largest steel maker mainly operated in Korea. The case was developed in accordance with ISO 14031 scheme, which requires planning, selecting indicators, using data and information, reviewing and improving. POSCO established its environmental management system based on ISO 14001. Through running this system, the company realized the necessity to re-identify its environmental aspects and effects and to revise its environmental objectives and targets. At the stage, the company decided to adopt the environmental performance evaluation scheme based on ISO 14031 for developing new indicators and is now trying to integrate the environment into all of its business activities to enhance the company's eco-efficiency.

요 약 문

환경경영이 기업경영에 차지하는 비중이 커짐에 따라, 기업의 환경성과를 측정하는 시스템의 이행 필요성이 대내적으로는 효과적인 경영활동을 목적으로, 대외적으로는 다양한 이해관계자와 원만한 관계형성을 위하여 주요한 수단 가운데 하나로 대두되고 있다. 본 주제와 관련하여 학계, 전문가, UNEP, OECD, ISO, WBCSD와 같은 많은 국제기관들이 환경성과평가를 이행하기 위한 적절한 시스템과 지표들을 개발하여 왔다. 이들 가운데 ISO는 환경성과평가의 국제표준규격으로 활용될 ISO 14031 규격을 1999년 말에 공표하였으며, 또한 ISO 14031에 기초하여 여러 국가에서 제출한 17개 예제를 담고 있는 ISO TR 14032 문서를 2000년 중반에 공개하였다.

본 논문는 세계 최대 규모의 철강회사인 포스코를 대상으로 환경성과평가 관련 사례조사를 한 것이다. 사례분석은 계획, 지표 선정, 자료 및 정보의 사용, 검토 및 개선이라는 절차에 준하여 환경성과 평가를 요구하고 있는 ISO 14031 규격에 준하여 이루어졌다. 포스코는 1996년도에 ISO 14001에 준하여 환경경영체제를 이미 구축하였다. 환경경영체제를 운영하는 과정에서 포스코는 환경측면과 환경영향을 재파악하고 환경목표와 세부목표를 재개정할 필요성을 느끼게 되었다. 이러한 상황에서 포스코는 새로운 지표를 개발하기 위하여 ISO 14031에 기초한 환경성과평가 체계구축을 결정하였다. 그리고 기업의 생태-효율을 지속적으로 향상시키기 위하여 환경활동과 일반 경영활동과의 통합을 계속적으로 추진하고 있다.

Ⅰ. Introduction

The measure and evaluation of corporate environmental performance have become increasingly important in the past years as an instrument for successful environmental management and securing the existence of a company in the long run. In order to implement environmental performance evaluation, academia, practitioners and many international organizations like UNEP, OECD, ISO, WBCSD have elaborated appropriate schemes and indicators, considering reduction of environmental pollution and economic opportunity and perspectives.

Environmental performance indicators are used as a managerial tool to provide decision-makers with important information, summarized to concise and illustrative statements, for continuously decreasing environmental pollution, and for communicating with a range of external stakeholders. And they are very valuable for implementation of EMAS Regulation and ISO 14001(Environmental Management Systems) which do not require the development of indicators. Therefore, ISO/TC 207 has worked on its own standard for indicators for environmental performance evaluation (ISO 14031). This international standard was published by at the end of last year.

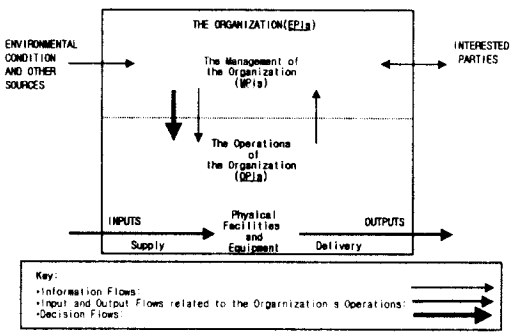
This paper examines a relevant case of measuring environmental performance at the POSCO, a the world largest steel maker mainly operated in Korea. The case was developed in accordance with ISO 14031 scheme, which requires planning, selecting indicators, using data and information, reviewing and improving.

Ⅱ. Approach Methodology

A variety of approaches like cause and effect, (probabilistic, human health, financial, sustainability) risk-base approach, life cycle approach, and regulatory or voluntary initiative approach may be considered in order to evaluate corporate environmental performance and to select indicators for environmental performance evaluation.

In accordance with ISO 14031, POSCO adopted life cycle approach to selecting indicators for environmental performance evaluation, especially focusing on life cycle activities of Also, it separated its activities into management efforts, operation activity, and the condition of the environment, and considered the interrelation among them (See Figure 1).

Life cycle approach considers the inputs and outputs associated with a particular activity or product, and the significant environmental aspects and impacts at any stage of a activity's or a product's life cycle.



Source: ISO 14031: 1999

Fig. 1. Approach Methodology for Selecting Indicators for EPE

Accordingly, in accordance with life cycle approach, POSCO developed and selected

indicators for EPE like environmental performance indicators (MPIs), operational performance indicators (OPIs), and environmental condition indicators (ECIs) by activity of corporate. The definition and usage of these indicators are as the following.

- ECIs, which provide information about the condition of the environment, may help an organization to better understand the real impact or potential impact of its environmental aspects, and thus assist in the planning and implementation of EPE.
- MPIs, which provide information about management efforts, may influence the environmental performance of the organization's operations. The decision and actions of an organization's management are closely related to the performance of its operations.
- OPIs may provide information about the environmental performance of the organization's operations.

Ⅲ. Case Study: POSCO

1. Introduction

POSCO (Pohang Iron & Steel Co., Ltd.) is the world largest steel maker with 1998 crude steel production of 25.6 million tons and employees of over 19,000 people. The company manufactures a wide range of steel products including wire rods, hot and cold-rolled coil, plates, galvanizing steel, and stainless steel products at its two steelworks at Pohang and Kwangyang located on the East and South coasts of the Korean peninsula.

POSCO has continued to increase the production capacity since its founding in 1968. In April 1997, a 1.8 million tons per year (tpy) No. 4 cold rolling mill, the world's largest of its kind, was dedicated at Kwangyang Works. It was followed by the completion of the 1 million tpy No. 3 plate mill at Pohang Works in September 1997. Accordingly, the proportion of cold-rolled products grew from 35.6% in 1996 to 38.8% in 1997. These facilities have been instrumental in increasing the company's capabilities to generate high value-added products. The company's successful operations are evidenced by the 9.7 trillion won turnover in 1997, with net profit of 729 billion won.

Both steelworks of POSCO are equipped with integrated steel-making processes. The key

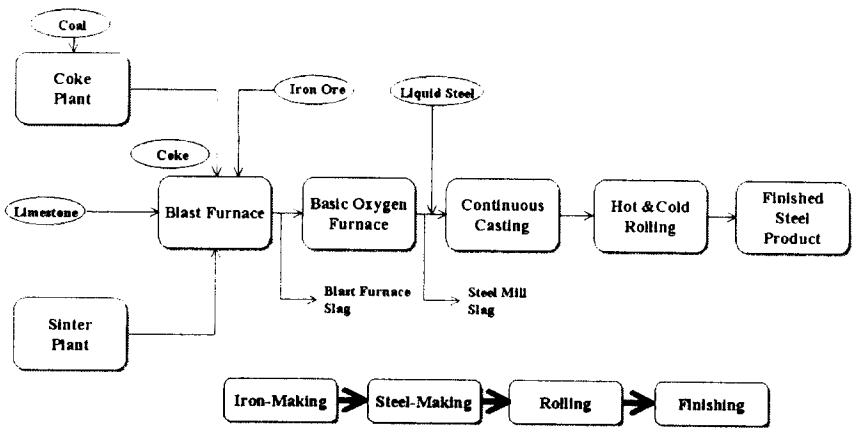


Fig. 2. Flowchart of Principal Operations in Integrated Steel Mill

processes in the integrated steelworks consist of five stages (See Figure 1). POSCO imported the majority of its raw materials and mineral resources from South America, Australia etc. About 70% of POSCO's products are sold domestically, and the remaining 30% are exported to the rest of Asia, North America, and Europe etc.

Due to its specific production processes and the natural resources involved, the integrated steel mill invariably impacts the environment at each stage of the process. Table 1 summarizes some typical pollutants released from the steelworks of POSCO.

POSCO introduced its environmental management system based on ISO 14001 specification requirements and was certified in 1996. The company's environmental policy, consisting of a preamble and nine clauses, dictates that the conservation and protection of natural environment is a fundamental consideration in management decision-making, and pledges to contribute to continued efforts toward the prevention of pollution and the improvement of environmental quality, with an underlying recognition of the environmental impact in all activities.

2. Planning EPE

As a part of developing an environmental management system, the company identified its stakeholders, significant environmental aspects, and then set environmental performance criteria (objective and targets). The most important stakeholders were identified through the establishment of ISO 14001 as follows:

- management, environmental management committee, and employees
- local community including neighbors

Table 1. Key Pollutants from Steel Making Process

	Process	Pollutants
Air	Coke Oven Plant	Particles and gases(PAHs), SOx, NOx
	Sintering Plant	Mainly particulates, SOx, NOx
	Refractory Material Plant	Mainly particulates
	Steel Melting	Mainly particulates
Water	Coke Ovens Plant	Phenol, cyanide, ammonia, oil grease, SS
	Sintering Plant	SS
	Steel Melting	SS
	Blast Furnace	SS, cyanide
	Rolling Mill	Oil and grease, acids
Solid Waste	Coke Oven Plant	Tar sludge
	Steel Melting	Slag and GCP sludge
	Blast Furnace	Slag and GCP sludge
	Rolling Mills	Mill scale
Noise	Blast Furnace	High level of noise
	Basic Oxygen Furnace	High levels of noise
	Rolling Mills	High levels of noise

- local and national governments
- non-governmental organizations like the Korea Federation of Environment Activity
- customers

POSCO identified its significant environmental aspects in transportation, storage and materials handling, maintenance, manufacturing process, waste treatment, utilities, new projects, off-site activities etc., and carried out a comprehensive environmental effects assessment. The various effects including Dust, SOx, NOx, HCl, HF were identified as significant emissions to air from the generation of energy and different kinds of combustion processes. Fluoride was identified as a significant effluent to water due to surface treatments, cooling and purification in casting process and stainless process. Solid wastes were identified as significant environmental aspects in transportation, storage and material handling, and waste treatment. Soil pollution and other environmental aspects like noise and heat generation were also identified.

Taking the input of stakeholders and the results of environmental effect assessment into account, POSCO established environmental objectives and targets related to its environmental performance in 1996 for the following four areas:.

- Improvement of air quality
- Improvement of water quality
- Enhancement of solid wastes recycling
- Energy conservation

3. Selecting indicators for EPE

In order to monitor and evaluate how its environmental performance compares with the targets established under its EMS, POSCO developed a series of management and operational performance indicators (MPI, OPI), and environmental condition indicators (ECI) based on ISO 14031.

The indicators were finally examined at the POSCO Environmental Management committee, which is composed of senior managers from headquarters and both steelworks. The committee regularly reviews comprehensive environmental issues such as significant environmental aspects and environmental effect assessment, environmental objectives, and

Table 2. Environmental Condition Indicators

Indicators		Envtal Standards	Results in 1996		Results in 1997		Remarks
			Pohang	Kwangyang	Pohang	Kwangyang	
Air Quality	PM_{10}(ug/m')	LT 150	-	-	42.1	45.3	Compliance with environmental standards
	SO_2(ppm)	LT 30	-	-	22.6	12.7	
Neighboring Ocean Quality	COD_{mn}	LT 2	-	-	1.5	1.7	
	SS	LT 25	-	-	4.3	8.4	
	DO	-	-	-	9.8	9.3	
	T-P	0.015	-	-	0.02	0.01	
	T-N	0.1	-	-	0.06	0.94	

Note: LT = lower than.

indicators for EPE, as well as international environmental requirements.

Table 3. Operational Performance Indicators

Indicators	Result in 1996		Result in 1997		Increase/Decrease		Remarks
	Pohang	Kwangyang	Pohang	Kwangyang	P	G	
Total Thermal Value(Mcal/T-S)	5,996	5,226	5,698	4,905	-298	-321	
Coal(Kg/T-S)	715.6	698.4	667.1	618.5	-48.5	-79.9	
Electricity(Kwh/T-S)	551.9	542.2	541.7	565.8	+10.2	+23.6	
B-C(l/T-S)	30.7	24.4	20.8	23.8	-9.9	-0.6	
Water(ton/T-S)	3.8	3.6	3.5	3.5	-0.3	-0.1	
Scrap Purchased(1,000ton/yr)	322	225	996	1,057	+674	+832	
CFC Used(kg/yr)	918	201	689	315	-229	+114	
Toxic Chemical(ton/yr)	51,000	57,000	40,600	46,500	+6000	+5900	
Water Recycled (1,000ton/day)	22.0	35.1	13.4	37.9	-8.6	+2.8	
Electricity Recovered(MW)	46.4	52.1	42.6	47.6	-3.8	-4.5	
Steam Recovered(ton/Hr)	240.0	329.2	268.8	348.5	+28.8	+19.3	
Waste Recycling Rate(%)	82	77	79	75	-3	-2	
Slag of BOF(%)	100	100	100	100	-	-	
Slag of BOF Converter(%)	48.5	33.8	44.0	34.7	-4.5	+0.9	
Dust(%)	98.7	90.4	97.2	86.2	-1.5	-4.2	
Sludge(%)	40.4	10.1	39.9	28.3	-0.5	+18.2	
Sox (Nm^3/Hr)	1,176	1,040	806	751	-370	-289	
Dust Avg. intensity [(mg/Sm^3)/(Kg/Hr)]	20/644	36/-	19/558	29/721	-1	-7	
CODmn(Kg/day)	1,043	122	1,197	162	+154	+40	
Waste Generated(1,000ton/yr)	7,718	8,043	7,939	8,603	+221	+560	
Waste Disposed(1,000ton/yr)	1,396	1,887	1,661	2,137	+265	+250	
Incinerator(1,000ton/yr)	33	42	37.6	40.1	+4.6	-1.9	
Landfill(1,000ton/yr)	1,353	1,845	1,614	2,097	+261	+252	
Commission(1,000ton/yr)	10	0	9.3	0	-0.7	-	

Table 4. Management Performance Indicators

Indicators		Result in 1996		Result in 1997		Inc./Dec.		Remarks
		Pohang	Kwangyang	Pohang	Kwangyang	P	G	
EMS	NO. of NCR by Internal Auditor	22	20	35	39	+13	+19	
	No. of NCR by External Auditor	56		10		-46		
	No. of Envtal Program for Improvement	81	66	83	71	+2	+5	
Envt'al Facility Cost		708	986	637	760	-71	-226	
Envt'al Investment/Total Investment		8.6	11.0	7.8	5.8	-0.8	+30.5	
Envt'al R & D investment		78.3		108.8		+30.5		
Envt'al Operation Unit Cost		-	-	14,071	11,342	-	-	
	Air Quality	468	492	609	510	+141	+18	
	Water Quality	228	227	253	267	+25	+40	
	Waste Management	201	143	302	109	+101	-34	
	Others	10	55	1,165	996	+1155	+941	

Before the company selected its indicators for EPE, a long list of indicators was prepared, and the relevance of each indicator was reviewed in consideration of the technological and economic circumstances of the company. Finally, the company selected 42 indicators for evaluating its environmental performance as follows:

- ECI: air quality, (neighboring) ocean water quality
- OPI: input, emission, and waste recycling
- MPI: indicators for EMS, and financial performance

4. Using Data and Information

Data and information for measurement of the selected indicators will be collected as part of the EMS in both steelworks. The information generated by the EPE scheme was communicated internally as part of the EMS communication activities for making all employees aware of the results of its environmental performance evaluation to motivate employee participation. POSCO has published an annual environmental report since 1995, and the reports are available in the on POSCO web site (http://www.posco.co.kr).

5. Reviewing and Improving for EPE

The selected indicators for EPE were reviewed as a part of the internal environmental reporting process and the management system review in 1998. These indicators cover a whole range of legal standards as set forth by the Ministry of Environment. Although the indicators for EPE were developed on the basis of ISO 14031 guidelines, they have not developed enough to evaluate environmental performance of the company, especially for purposes of comparison with the performance of competing companies and supporting the decision-making of top management. Accordingly, the company's Environmental Management Committee decided to amend the weak points in the current indicators for EPE; for example:

- The majority of indicators for EPE are absolute or simple indicators. Therefore, there are some concern that the use of absolute or simple indicators could lead to misinterpretations of the environmental performance of the company, especially when production volume changes and the size of works is different.

- The indicators for EPE are limited in their ability to fully explain the environmental performance of the company's activities. Therefore, it was decided to expand the scope of indicators by sector. In particular, POSCO lacked sufficient indicators to assess and evaluate managerial efforts, despite implementing EMS since 1996. So it will develop the EMS self-assessment sheets for evaluating EMS implementation level.

- Eventually, it will integrate management efforts, operational activities, and environmental condition into one indicator by means of weighted-value. Perhaps, we will call it POSEPI (Environmental Performance Index).

- The environmental data collected do not support indicators to evaluate activities on a company-wide basis. Also, they are not fully categorized and are stored in different disconnected databases or even discarded after a short period of time, as long as legal

requirements are met. However, the recent environmental issues are related to the life cycle of the company activities. Therefore, the environmental database system covers all kinds of data related to the company-wide activities, which is to say that environmental data should be linked with routine business data such as accounting systems, production planning systems or employee databases. Fortunately, the company already has computerized systems to collect these data. Accordingly, the collection of environmental data for use in constructing indicators for EPE can be simplified, if the company connects these systems with an environmental database system.

Ⅳ. Summary and Conclusion

POSCO reviews and revises indicators for EPE each year. In particular, POSCO, which has implemented EMS based on ISO 14001 since 1996, must identify environmental aspects and effects, and set new environmental objectives and targets every 3 years according to EMS procedures. At the same time, it must develop new indicators for EPE to track environmental objectives and targets.

ISO 14031 will be still on the basis of its indicator scheme for EPE in the future. And it will try to integrate the environment into all of its business activities to enhance the company's eco-efficiency.

For managing and improving proper indicators for EPE, firstly, it should select indicators for EPE considering life cycle approach of a product or a process. In particular, this approach can be appropriate for emission indicators among OPIs. Secondly, it must identify the trend related to indicators for EPE, and stakeholders' information needs for its environmental performance, and thirdly, it should strengthen its environment and energy team by increasing its members and promoting to higher status. Fourthly, it should try to make efforts so that all the employees can have an interest in its indicators for EPE.

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