Environment Compatibility Design Approaches and Products

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1. Introduction

Why are we riddled with such serious global environmental problems? The fundamental problem is the historically large-scale consumption of resources, often accounted for by the resources wasted by advanced nations and inefficient resource management by developing countries. There is a widespread perception around the globe that the earth will reach its limit in the early 21st century of any more environmental stress, should resource depletion continue as it does now. "Sustainable growth" has been proposed to avoid the path that would lead to the total collapse. "Growth" as it is used here does not mean quantitative growth but qualitative growth, which could be re-phrased as "further expansion of sustainable growth". Sustainability relates to the enormous energy flow that places stress on the environment and is greatly affected by the activities of manufacturing industries.

This has led to the realization that a shift from a resource-wasting, mass production-oriented operation to an environmentally oriented operation is the urgent task placed on those engaged in manufacturing. One challenge we have address here is the environmental concern, “Design for Environment” (hereafter abbreviated as DFE).

The following chapter outlines DFE.

2. Introduction of DFE

Products and services provided by business enterprises have a considerable effect on the global environment. Reducing the effect of production activities is certainly one effective way of reducing stress on the environment. However, it is more important for business enterprises to take on the task of designing products and services with fewer harmful effects on environment and building a recycling society.

The concept of DFE is based on a comprehensive approach to the life of a product, from design, procurement, production, distribution, use, and services, to disposal in order to "design products and services with fewer harmful effects the environment".

The DFE in Japan is still at the developmental stage with no standard method. The Japan Industrial Standards set up JIS Q 0064, "The Guideline on Introducing Environmental Aspects to Product Standards," in March 1998. This is a faithful translation of the international standard ISO Guide 64 issued in 1997. "Appendix: 1995," which was not included in ISO Guide 64, has its translated version as JIS Q 0064 Appendix B (Reference) " The Guideline on the Principles on Design for Environmental Compatibility (DFE) for Electronics Equipment," which is used as the guideline on specific items.

The DFE is expected to develop as a result of each business' actual experiences as well as the progress in the life cycle assessment method. Advances in recycling technology and changes in mindset of customers, consumers, and citizens will largely determine the way this will develop.

Corporate commitment and philosophy as well as the responsibility of the product designer/developer are critical.

3. Approach to DFE

3.1 Setting Product Assessment Items and Evaluation by DR

As part of the effort to get ourselves ISO14001-certified, we started out by choosing the assessment items that would be checked in when evaluating the products to be developed in terms of their environmental effects. We chose 8 product-evaluation items, each with a specific description. It was decided that the evaluation would be conducted at the time of design review (DR).

The 8 evaluation items adopted for product assessment are as follows:

①Materials (Specifying and selecting materials, and controlling harmful substances)
②Resource saving (Reducing weight, recycling resources, and making product life longer)
③Facilitating decomposition process
④Labeling
⑤Energy saving
⑥Packaging materials (structure, materials, and labeling)
⑦Ease of disposal
⑧Recycling/disposal method

Each product was evaluated using these 8 items and appraised in terms of the improvement ratio.

3.2 Discussion of Life Cycle Assessment: hereafter referred to as LCA

LCA is one method (environment management tools) of evaluating the effects (environmental aspect and potential effects) of a product on the environment throughout its entire life from material gathering, designing, production, use, to disposal. The environments concerned include resource utilization and effects on human health and the ecosystem.

(1) Current LCA situation and its limitations

For LCA to be useful in understanding a product in terms of the effects it has on environment, it must be flexible, practicable, and cost-effective in its application while maintaining technical credibility. There is no scientific basis for one single comprehensive evaluation criteria or figure that represents the result of LCA.

There is no methodological or scientific framework on the evaluation of the effects with all different models for different environments at different developmental stages. There is no widely accepted method that can correlate inventory data consistently and accurately with some specific potential environmental effect.

LCA has the following limitations:

- With prerequisites for LCA all subjective (in boundary setting, data source selection, and effect categorization),

the LCA model limited by prerequisites cannot be used for all potential environmental effects or applications.
- The accuracy of LCA investigation is limited by the accessibility to relevant data, availability, and quality of the data.
- The inventory data lacking in space and time dimensions leads to inaccuracy of effect assessment results.

(2) Our LCA

Although LCA has not yet been adequately established across the board, it must be evaluated, as it is important item for environmental assessment. In order to use various, latest data, we have decided to use the Internet type LCA service. Following are some of the results of LCA assessment of our products conducted using this service.

The example of the product evaluated is a 1 kVA small capacity UPS. Table 1 shows the prerequisites for assessment, and Fig. 1 is a photo showing the product appearance.

Table 1 Prerequisites for Assessment

	Item	Prerequisite
1	Operating time	24 hours/day
2	Power consumption	130W (for 8 operating hours) 48W(16 hours in wait mode)
3	Operating rate	365 days/year
4	Service life	10 years
5	Shipment	80 2-t trucks

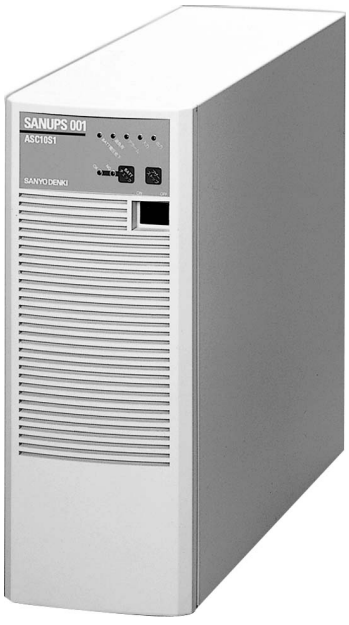

Fig. 1 Product Appearance

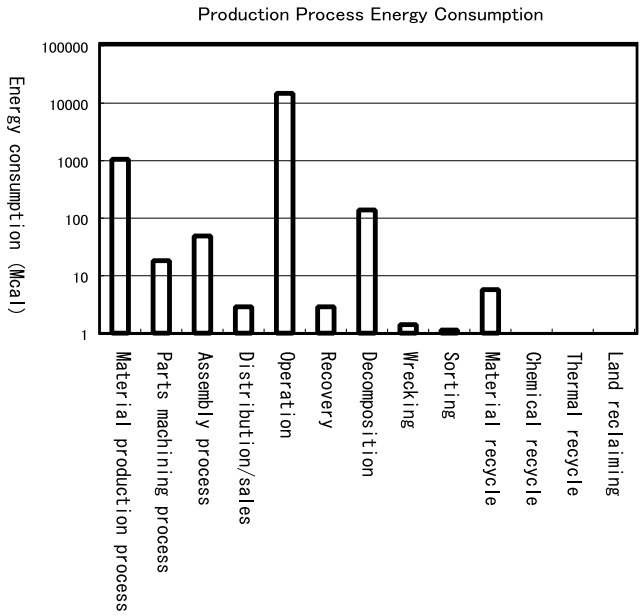

Fig. 2 Inventory Assessment Result

Fig. 2 shows that energy consumption from operation is 10 times more than any other process. It also suggests that the most important priority for this product in reducing environmental stress is to improve operating efficiency.

3.3 Evaluation of Items of Environmental Compatible Design (Energy Consumption)

We have been using the 8-product assessment items since they were established. But in order to further consider the environment, we have reviewed and re-examined these items.

To review the items, we selected the following 3 product characterization methods.

①The 8 items already established and used for environmental assessment.
Materials
Resource saving
Facilitating decomposition process
Labeling
Energy saving
Packaging materials
Facilitating disposal procedure
Recycling/disposal method

②The 14 items set out in the design-for-environment product list published as a guideline by the Industrial Waste Disposal /Recycling Chapter of the Industrial Structure Council Ministry of Trade and Industry (what is now the Ministry of Economy, Trade and Industry).
Compact/light-weight
Long service life
Suitable design
Safety/environment preservation
Recycling
Collection/Shipping
Suitable materials

Suitable sorting
Ease of wrecking
Ease of incineration
Packaging materials
Displaying information
Availability of information
Suppliers of materials and components

③The Japan Environmental Management Association For Industry sets out the following items.
Weight reduction
Long service life
Recycling
Product wrecking
Product decomposition
Retrieval/transport
Product safety
Product packaging
Saving energy/consumables
Information disclosure
Production process
Distribution

Although the above item's categorizations are not well balanced and are without sufficient information, we have decided to differentiate "Product Packaging Material" from "Product Packaging " and adopt the remaining 11 assessment items as our standard.

Particularly important items when related to characterizations of our products are Weight Reduction (making products compact and light) and Energy Saving (high efficiency).

4. Implementation of Design-for-Environment Products

Although the above 12 items have been adopted to assess products, each item must be weighted differently. Therefore, weighting differs with each different business unit or different product line.

Each product is to be assessed according to each item, to which a certain number of points are assigned. The product of the score and the weight (score x weight) is taken for each item, and then the products of all the items are obtained. The product with its total exceeding some specified value will be certified as a design-for-environment product. The certified product will be labeled with the logo and symbol mark as shown in Fig. 3.

Fig. 3 Logo and Symbol Mark

Table 2 is part of the assessment checklist.

Table 2 Sample Certification Evaluation Check List

Item	Description	Assessment Score			Weight
		2	1	0	
Weight reduction	For smaller size Reduction ratio	More than 40% as compared to existing products	10 to 40% as compared to existing product	Less than 10% as compared to existing product	2
	For lighter weight Reduction ratio	More than 40% as compared to existing products	10 to 40% as compared to existing product	Less than 10% as compared to existing product	2
Longer life	Long service life	More than 10 years	5 to 10 years	Less than 5 years	1
Recycling	Recycling ratio	More than 90%	50 to 90 %	Less than 50%	2
Energy saving	Loss reduction ratio	More than 3%	1 to 3 %	Less than 1%	2

If the assessment score is 2 for all the items in Table 2, the total full weighted score will be 18. If the score is 1 for both "Recycling" and "For Lighter Weight", and 2 points for the rest, the total score will be 14 points. With $14/18 \times 100 = 78\%$, this product will not be accepted as a DFE candidate, as 80% must be exceeded for any product to be accepted as such, indicating a considerable amount of efforts required of those involved in product development. Indeed, they are working hard to achieve their targets.

5. Conclusion

It is generally understood that the 3R's (Reduce, Reuse, and Recycle) are the three most important items in designing a product. But, our products are not yet up to the standard due to their nature. Therefore, an intensive and focused approach is necessary to bring them up to standard.

"Product disposal", "Recovery/transport", "Production process", and "Distribution" must be improved by restructuring the data and concentrating efforts by clients and associated companies.

With the LCA data standardization and consolidation expected to materialize through the efforts of associated organizations, we intend to press ahead with development of DFE products with more emphasis on LCA to reduce environmental stress.

References

"Eco-design Best Practices 100" (By Ryoichi Yamamoto, Diamond-sha Publishing, Dec. 1999)

Toshio Koizumi
Joined company in 1966
Engineering Management Division
Worked on engineering control

Hideyuki Takahashi
Joined company in 1984
Engineering Management Division
Worked on components, material technology, and engineering management