3 Environmental Conservation Activities

Development of Environmentally Conscious Products

Product Technology Subcommittee Activities

Today we reap the benefits of a civilization rich with various commodities as a result of our massive consumption of resources and energy. However, this has put us face-to-face with serious environmental problems on a global level.

It has been Toyota Industries' mission to supply products which contribute to improving the convenience and satisfaction of our customers. But in recent years, we have realized the need to deal with environmental issues.

We are developing technologies to deal with these issues which will help enable everyone to achieve sustainable growth. We now acknowledge that our greatest mission is to supply our customers with environmentally conscious products.

To accomplish our goal, we do our utmost to understand all environmental impacts and are aggressively working to develop products with lower environmental impact.

LCA

To reduce the environmental impact of products, it is important to assess the impact of a product over its entire life cycle. One such system is the Life Cycle Assessment (LCA).*1 Since 1999, our Product Technology Subcommittee has surveyed various applications related to LCA.

In the course of the trial, the subcommittee researched the composition of materials and units of each material per production and made a life cycle assessment of engine exhaust aftertreatments, the results of which were published in the Environmental Report 2001. This year we performed a life cycle analysis (inventory analysis*2) of a forklift truck.

Life Cycle Assessment of Forklift Truck

Forklift Truck Specification

We assessed a diesel engine-powered forklift truck (rated loading 2.5 tons), currently our core model, (hereinafter, “internal combustion forklift”) as well as an electric-powered model (hereinafter, “electric forklift”) of the same class.

Specifications of Forklift Trucks Analyzed

<table>
<thead>
<tr>
<th>Type</th>
<th>Weight</th>
<th>Power Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal Combustion Forklift</td>
<td>3,840 kg</td>
<td>Engine Capacity: $2,486 \times 10^{-6}$ m$^3$ four-cylinder Rated power: 40 kw/2,400 min$^{-1}$</td>
</tr>
<tr>
<td>Electric Forklift</td>
<td>3,865 kg</td>
<td>Rated power: 10.7 kw/48 V</td>
</tr>
</tbody>
</table>

Toyota Industries’ LCA History

<table>
<thead>
<tr>
<th>Year</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td>Research of LCA</td>
</tr>
<tr>
<td></td>
<td>Research of Material Composition of Main Parts</td>
</tr>
<tr>
<td>2000</td>
<td>Application of LCA to Engine Exhaust Aftertreatments</td>
</tr>
<tr>
<td>2001</td>
<td>Application of LCA to Forklift Trucks</td>
</tr>
</tbody>
</table>

Forklifts Subject to Assessment

- Internal Combustion Forklift (7FD)
- Electric Forklift (7FB)

*1 Life Cycle Assessment: Assessment of the overall environmental impact of a product from its manufacture to use and disposal

*2 Inventory Analysis: Analysis of the gases that affect the environment such as CO$_2$, SOx, etc., emitted during a product’s life cycle
Scope of Analysis

As indicated in the right-hand diagram, the analysis encompassed the product’s entire life cycle from the mining of resources to the dismantling and sorting of the finished product. The inventory analysis focused on CO₂ and air pollutants, which have a particularly high impact on the environment once the forklift truck begins operation.

Conditions for LCA Comparison

As indicated in the following table, we selected a fixed set of conditions so that the comparison could be carried out using a common measure for capabilities and operations. We also compared operating conditions the same number of times as we did for our evaluation method for forklift truck operation. Operating life was based on market data. Consequently, this does not always reflect a comparison with actual operational conditions.

Conditions for Comparing Operations

- Work cycle carried out 410,000 times
- 2 battery changes
- 55 engine oil changes
(14 years operation; model calculation based on market data)

Results of Inventory Analysis

The results of the inventory analysis indicated that a large proportion of CO₂ and air pollutants were generated during operation of both the internal combustion and electric forklifts. In addition, it was observed that under these conditions, the electric forklift emitted around 50% less CO₂ than its internal combustion counterpart.

It should be noted that the amount of CO₂ and air pollutants generated during use of an electric forklift includes the amount arising from the power station, which generates power to recharge the battery’s electricity, as well as that arising from the mining and processing of fuel for power generation. These amounts vary depending on the type of power generated. The data for such calculations were based on averages taken from JEMAI-LCA.*3

Future Issues

LCA requires a large amount of inventory data and comparisons of units per production, which means that the final outcome of the analysis varies depending on the units per production. To resolve this problem, we plan to gather related data and establish our own LCA method.

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*3 JEMAI-LCA: LCA software developed by the National Institute of Advanced Industrial Science and Technology. Japan Environmental Management Association for Industry has developed and sold the software under license.
Development of Environmentally Conscious Products

3 Environmental Conservation Activities

Control and Reduction of Content of Substances of Concern

We at Toyota Industries are working to manage and reduce substances of concern in product design and development. Owing to the differences between our automobile and industrial businesses, the content of environmental regulations that apply to these products also changes. Reflecting the rapid enactment of environmental regulations aimed at automobile-related products and owing to the acknowledgment of the fact that such regulations will eventually be applied to other products, we are promoting a company-wide effort to manage and reduce the content of substances of concern in our products.

Complying with EU ELV*1

Investigation of Use of Four Banned Substances and Use of Alternatives

Under the EU’s end-of-life vehicle directive (EU ELV), the use of lead, mercury, cadmium, and hexavalent chromium are to be banned in vehicles sold from July 2003. In preparation for this, we examined our own use of these substances and their content in our vehicles, engines, compressors, and electronic components as well as the use of alternatives. The results revealed no instances that would constitute an infringement of regulations at the time of their enforcement.

We are currently examining what effect the use of alternatives have on capital investment and product pricing and will make necessary design adjustments and switch to use of alternative substances in 2002.

Company-wide Effort to Eliminate Use of Hexavalent Chromium

Of the four substances prohibited under EU ELV, the phasing out of hexavalent chromium will require the most stringent effort. Hexavalent chromium is widely used throughout the company in the chromate surface treatment of zinc plated nuts and bolts.

As a comprehensive effort against the use of hexavalent chromium, the headquarters took the initiative to examine our eight surface finishers and suppliers of plating solutions regarding the use and content of hexavalent chromium and presented the results to various departments within the company via the intranet. In addition, we had our hexavalent chromium solution suppliers give presentations three times on the latest developments in plating technology. The talks were attended by twenty-nine engineers in concerned departments.

Presentation on Complying with EU ELV

We attended a total of five information sessions on responding to EU ELV held by our customers in FY 2001. We also held a total of eleven similar presentations in-house, directed at our employees in our automotive-related departments.

Seminars on Environmentally Conscious Design

As a follow-up to the seminars of FY 2000 we held environmental seminars, including presentations by guest speakers, on two occasions. The guest speakers gave presentations on the latest industry trends, including regulations on the use of hexavalent chromium and the development of lead-free soldering, etc., which proved to be very useful to the designers and engineers of automotive and auto component technical departments.

Providing Employees with Information on Environmental Regulations via the Intranet

We established a Web site concerning environmental issues on the company intranet to allow our designers and engineers to view the results of the activities of the Product Technology Subcommittee in FY 2000. We regularly summarized our findings on environmental trends pertaining to our products and published them in five separate news reports during FY 2001. Company employees may also access information concerning such environmental seminars and the results of our surveys on surface finishing companies.

Sharing of Environmental Information over the Intranet

*1 EU’s end-of-life vehicle directive (EU ELV): EU directive for reducing environmental impact and improving recyclability when scrapping used vehicles
Improving Recyclability

From the design and development stage, we make assessments of our products at various stages of the life cycle to improve their recyclability and have established a method to evaluate the recyclability rate of used products.

Compliance with EU ELV

Under EU ELV, all vehicles sold as of 2005 will be regulated to meet the recycling requirements in the directive. As Toyota Industries only handles assembly and parts manufacturing and is not a manufacturer of complete vehicles, its role is to continually improve the recyclability of components it designs and develops.

Owing to the fact that automobiles will need to be certified for marketing in Europe under EU ELV, the International Organization for Standardization (ISO) is also considering establishing a similar set of standards. In line with the ISO’s considerations, we are also reviewing our plans for recycling guidelines. In December 2001, our Product Technology Subcommittee examined our plans and has decided to revise our recycling design guidelines.

Surveying the Disposal of ELV

FY 2001 was the second consecutive year in which we conducted a survey on the disposal of ELV, a subject closely related to our operations. During the period, we surveyed the disassembly of automobiles, shredder waste emissions, and the reuse of parts.

The survey was conducted in January 2002, and fifteen members from various divisions participated. We focused on the distribution of reused parts via the Internet, and discovered that this is a rapidly growing business. In addition, we ascertained various other key aspects related to product design for better recyclability. This included the recovery of CFC gases, which deplete the ozone layer, and the removable of unused airbags, to prevent the sudden inflation of airbags during disassembly.

Survey Related to the Automobile Recycling Law*2

Legislation is under consideration for the recycling of automobiles. We began a study on the effect of such a law in April 2000. In FY 2001, by attending symposiums on automobile recycling and interviewing many experts in this field, we studied global trends and made our findings available to our designers and engineers via our intranet environmental site.

Automobile Recycling Symposia

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>May 2001</td>
<td>JSAE Annual Congress &amp; Exposition</td>
</tr>
<tr>
<td>December 2001</td>
<td>JSAE Symposium</td>
</tr>
</tbody>
</table>

Survey Results on Forklift Truck Recycling

We released the results of our survey on forklift truck recycling in the 43rd edition of our in-house technological bulletin, Toyota Industries Technical Report, published in August 2001. The survey covered recycling-conscious design efforts, the dismantling of forklift trucks after they are put on the market, reuse of parts, and recycling. This information proved effective for our forklift truck designers. For example, over 98% of our scrapped forklift trucks are recycled. We found that the parts not being recycled were made from materials such as plastic or rubber. For this reason, we discovered it is necessary to clearly label, mark or code the plastic and rubber parts used in newly designed forklift trucks.

Our technological bulletin is distributed to other companies as well. We want our peers to know that we are working to improve the recyclability of our products.

*2 Automobile Recycling Law: Legislation for the recycling of used automobiles
Development of Environmentally Conscious Products

Other Environmentally Conscious Products

Toyota Industries is working to introduce LCA, manage and reduce the use of substances of concern, and improve the recyclability of our products. In addition, in accordance with the Third Environmental Action Plan, we are implementing a variety of other steps to develop and supply environmentally conscious products. This section introduces three examples of our endeavors.

Development of the 1HD-FTE Low-Emission Diesel Engine

Owing to high thermal efficiency and low fuel consumption, diesel engines are superior from the standpoint of preventing global warming. However, in recent years, regulations on diesel engine emissions have grown strict. As a result, the quest to create a clean diesel engine has become an important development theme over the years.

The Toyota 1HD-FTE direct-injection diesel engine was developed in 2001, a top-of-the-line SUV engine for the 21st century.

The diesel engine is in compliance with the STEP III (EURO III) European exhaust emissions regulation. NOx and particulate matter (PM) were reduced using a swirl control valve (SCV), a Toyota first, a diesel throttle, and EGR gas electronic control with an EGR cooler.

Over recent years, demand has increased for a quieter diesel engine. We have reduced suction noise by adopting a resonator placed on the intake system and curbed gear noise with the use of scissors gears.

Diesel Engine 1HD-FTE with Lower Air Pollutants

<table>
<thead>
<tr>
<th>STEP III regulatory levels</th>
<th>Conventional models</th>
</tr>
</thead>
<tbody>
<tr>
<td>PM</td>
<td>New models</td>
</tr>
<tr>
<td>NOx</td>
<td>Diesel Engine 1HD-FTE</td>
</tr>
</tbody>
</table>

Energy Efficient Water-Jet Loom

Over its product life cycle, textile machinery consumes an extremely large amount of electric power during use. Consequently, we are continuously striving to find ways to conserve energy in the design and development of our products.

In 2001, we developed a drum without a turbo blower for use in our mass-produced water-jet looms. Owing to this, we achieved overall energy reduction of 25%. For 100 units operating simultaneously, the CO₂ reduction is 250 t-CO₂ per year.

Launching of our North American Compressor Remanufacturer, ACTIS

ACTIS Manufacturing, Ltd. LLC (ACTIS) is a remanufacturer of car air-conditioning compressors in North America jointly established by Toyota Industries, DENSO, and Toyota Tsusho. Operations started up on March 18, 2002 in Grapevine, Texas (U.S.).

ACTIS was established to fulfill environmental needs in North America through the effective use of resources, namely the recycling of automobile parts. In North America there is a growing demand for remanufactured compressors. ACTIS strives to make a contribution to the trend of remanufacturing automobile parts.

Corporate Summary
Established: 2001
Capital: $2 million
Business activities: Remanufacturing of car air-conditioning compressors
Location: Texas, U.S.
Environmentally Preferable Purchasing

To manufacture products that are friendly to both humans and the environment, we implemented environmentally preferable purchasing in March 2001. This requires environmental awareness from the stage of procuring materials and parts.

In FY 2001, the first year of our environmentally preferable purchasing efforts, we performed a survey to check the environmental awareness of our suppliers and held meetings to fully educate those involved on our environmentally preferable purchasing guidelines.

Survey Results on Supplier Environmental Awareness

We surveyed the 847 companies which do business with us (excluding equipment and logistics) on environmentally preferable purchasing guidelines. The average score among suppliers was 53.8 points. (Survey results were tallied on December 25, 2001.)

Because of these results, TOYOTA Material Handling Company held training sessions for its suppliers to allow them to boost their scores. The aim of the company’s training sessions is to improve the average score of its suppliers to above 60 points for the next survey, which was scheduled to be held in July 2002.

Environmentally Preferable Purchasing Guideline Meeting

In the Compressor Division, the Engine Division, and TOYOTA Material Handling Company, we held an explanatory meeting for the environmentally preferable purchasing guidelines.

We explained trends in product environmental regulations which are likely to become stricter and also policies on how each division plans to respond to these laws. In addition, for all business partners, specific requests were made to examine the use of substances of concern and to find alternatives to improve the environmental soundness of the parts we use.

EU ELV is set to be enacted in 2003. To comply with this law, we are asking suppliers to report their use of the four banned substances*1 and submit plans by December 2002 for finding alternative materials.

*1 The four banned substances are lead, mercury, cadmium, and hexavalent chromium (see page 16).