Eco-car Manufacturing Activities as Engineering Design Education Subject in Suzuka National College of Technology

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ABSTRACT

“The engineering education program for environmental intention and value creation” has been executed from 2008 to 2010 in Suzuka National College of Technology, which program was promoted as “Good Practice for Education” by Ministry of Education, Culture, Sports, Science and Technology Japan. “Eco-car project” is one of these practical ecology/environment education programs. The project’s members have been learning and researching the environmental managements by the process of design, manufacturing, and assembly of solar car, highly effective fuel consumption car (Eco-run car), electric vehicle and fuel-cell car. Also this project was supported by some professional experts of the local industries and community. The students learned the actual industrial technique, the engineering management and the structure of local industries by this project. In this paper, the environmental intention engineering design education with local industry collaboration is introduced.

Keywords: Engineering design education, Project learning, Eco-car, Environment

I. Introduction

It is important for the student, who aims at the engineer, to have the sense and concerns about worldwide environmental considerations through the innovation of science and technology.

In Suzuka National College of Technology (SNCT), “The engineering education program for environmental intention and value creation” has been executed from 2008 to 2010, which program was promoted as “Program for Promoting High-Quality University Education (Good Practice for Education)” by Ministry of Education, Culture, Sports, Science and Technology Japan (MEXT). This education program was planned based on a human and material resource of the creative technological activity projects (solar car, highly effective fuel consumption car (eco-run car), and fuel cell, etc.). These projects were executed as a unique engineering education and research program in SNCT. In addition, new resources for the engineering education and research such as the wind power generation and biotechnology fuels were introduced into this program. Then, the students came to be able to touch various environmental technologies in our campus.

Fig. 1 shows the outline of this project. This project’s contents consists of three phases: (1) the introduction/fundamental learning of the global ecology and environment for the 1st–3rd grader, (2) the practical ecology project for the 4th grader, (3) the 3R (Reduce, Reuse, Recycle) project as the graduation research for the 5th grader. It will be able to train the engineer who has strongly environment intention by doing a systematic engineering education from 1st to 5th grader.

- In first phase, introduction/fundamental learning for global ecology and environment was executed to the 1st–3rd grader by using the textbook, which was newly edited for this project.
- In second phase, the eco-car development project and the clean energy project as a part of creation engineering education program, which was a unique program in SNCT, was executed to the 4th grader.
- In third phase, the subjects relevant with the ecology and environment were introduced into the graduation research for the 5th grader and the students in the advanced engineering course, and the learning conditions for research and development about the ecology and environment were provided.

The eco-car development contents as a creation activity project have been providing for all graders, too. Moreover, some cooperation with the local automotive industries was attempted through this project, and the outcomes from this project were provided as materials of ecology and environmental learning for the pupils and the citizens in our district by the open lectures.

II. Eco-car Development Project

1. Location of the SNCT and Eco-car Development Project

SNCT is located at Tokai District in the central region in Japan. The industries which they specialize in manufacturing of the automotive, the aerospace and aircraft, the heavy chemicals, the semiconductor and the electronics are clustered in this region. Especially, Suzuka city which SNCT located declare “Motor sports city declaration”, and there are Suzuka works of Honda Motor Co., Ltd., Suzuka Circuit with the international racing course and a lot of local industries having many excellent technologies regarding automotive industry (Fig. 2). The Eco-car development project of SNCT is supported as such the geographic situation.

Four courses which consist of the electric vehicle, the eco-run car, the fuel cell car and the solar car were set as this eco-car development project. The project’s members have been learning and researching the environmental managements by the process of design, manufacturing, and assembly of their vehicles. The projects provide the opportunity of learning synthetically the following engineering.

1) Mechanical engineering (various elemental technologies, design including CAD/CAM, machining work, etc.)
2) Materials engineering (new material such as fiber reinforced plastics (FRP) and carbon fiber reinforced plastics (CFRP))
3) Electric and electronic engineering (kinds and characteristics of motor etc.)
4) Measurements and control engineering (interface, programming and simulation etc.)
5) Information and communications (may be included
6) Electrochemistry (battery, the technology for optimum utilization)
7) Management and planning (goal setting, energy, quality, and delivery date)
8) Safety engineering
9) Cost and economical sense
10) Total quality control and analysis, etc.

2. Commercial Electric Vehicle (EV) as an Educational Materials

Some commercial electric vehicles were bought for this course, and they were mainly provided for 4th grade students of Department of Electrical and Electronic Engineering. The student disassembled a vehicle, and they did design the digital speed meter and the data logger for the electric power consumption measurements and control by using USB memory. The student of Electrical and Electronic Engineering had a valuable opportunity to learning the mechanical engineering by the disassembly and/or the re-assembly of an EV shown in Fig. 3. Furthermore, those EVs were used to enlightening of ecology and environment problem for the local community by the demonstration run at the campus festival shown in Fig. 4.

Fig. 3 Disassembled EV and trial models of Electrical and electronic devices (Digital speed meter, Data logger of USB memory)

Fig. 4 Trial run and enlightenment at the campus festival

3. Eco–run car, Electric Car and Fuel–cell Car for Competitions

Next subject is the development of eco–run car for competitions. This subject was mainly providing for the 4th grade students of Mechanical Engineering and the automotive club members.

The students are interested in the electrical motor and the fuel cell from electrochemistry as the zero emission vehicles, not the mechanical engineering with fuel internal combustion engine. They have also concern to the new material such as a CFRP. Here, they challenged the development of electric car and the fuel cell car, which used the CFRP. Fig. 5 shows Eco–run car 2010 edition and the alternating power units and energy source.

Eco–run project team participated in some competitions with the vehicles of various specifications, and achieved good records in 2010. In Eco–mileage Challenge Suzuka, it was ranked to 2nd with 458.166km/l in highly effective fuel consumption car class. In the Econopower Gifu, it was ranked to 2nd with 27 laps at 47’11” in electric car class at the first participation.
4. Solar Car for Competitions

This subject was offered for all students of solar car project as one of the unique engineering educations in SNCT. The solar car is a vehicle of the near future using the renewable energy, and it is highly supported as an engineering contest/competition learning the ecology and engineering management overall from a lot of education organizations such as the MEXT. The solar car project team of SNCT has continually been participating for 19 years from the first time since 1992. Fig. 6 shows the record and the history of the team in “The solar car race Suzuka”. It mainly participated in the challenge class that was specified 800W or less for the photovoltaic with the lead battery), and the lap and the rank had been improved.
step by step every year. The mileage in our top team recorded about 600km in 8 hours, and top speed was over 100km/h. However, their competition vehicles which had very flatness structure with three-wheels were too different from practical vehicles. And they have some problems for safety in a driving position. In the 2008 published regulation in Olympia class, the four-wheels structure with a commercial bucket-sheet was newly specified. This regulation may be equivalent to the specification of practical vehicles, and the solar car made by the specification became familiar than former solar car, except manufacturing cost.

Therefore, according to the Olympia-class regulation from 2008, the solar car project team has been creating the new machine. In the new designed car, new material technologies such as CFRP and the dual rear-driving system from in-wheel motors are used. In addition, a practical drafting, the processing technique, and the subcontract rule of parts were trained by the expert lecturers, who are professional and very special engineer of the local industries and community. Fig. 7 shows the 3-D CAD model of new machine and the parts made by collaborated local industries.

The project team had run the whole time 5 hours, and was ranked 6th of Olympia class at “Solar car race SUZUKA 2011”. (Fig. 8)

IV. Conclusions

“Eco-car development project” in “Engineering education program for an environmental intention and the value creation” of SNCT executed from 2008 to 2010. This is one of the ecology/environmental education programs. The project member learnt, and researched about the environmental management through development of the solar car, the eco-run car, the design of the electric car and fuel cell car, and their processes of manufacturing and assembly. Moreover, this project received the support of the professional specialist in the local industries. The student learnt the working process technology of local actual industries, the engineering management, etc. through this project.

We deeply appreciate sincerely for all professors, lecturers, staffs of Suzuka National College of Technology and the relevant persons for this project in Suzuka-city. Then, we wish to the student who participated in this project have the advantage of the field of ecology and environment technologies in the future, and this project has been useful for the local community.

Reference

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