Efforts for Cooling Fans that Contribute to the Global Environment

Minoru Fujiwara　Kakuhiko Hata　Jirou Watanabe

1. Introduction

In recent years, one serious topic of discussion has been CO_2 emissions, which leads to global warming, destruction of the environment, loss of natural energy resources, and other environmental problems.

Our company sells cooling products around the world, and environmentally conscious products is becoming more and more important.

This report introduces our company's main product, cooling fans (referred to below as simply "fans"), from the aspect of how the fans can contribute to the environment.

2. Efforts for Contributing to the Global Environment

As a manufacturer, our company takes responsibility to provide customers with products that contribute to the environment by implementing the following two activities:

(1) Elimination of environmentally harmful chemicals from the products

(2) Reduction of burdens on the environment from the products The following section explains specifics about the environmental activities.

3. Concrete Examples of Activities

3.1 Elimination of environmentally harmful chemicals from the products

Our company is working as quickly as possible to eliminate the chemicals defined by the RoHS directive in the EU as having a detrimental effect on human health and global environment.

We have reduced or completely eliminated the use of these chemicals in order to comply with the July 2006 implementation of the RoHS directive. Starting in 2003, our company products have undergone careful inspection and have gained complete compliance with the RoHS directive from January 2006 (excluding a select few models).

3.2 Reduction of burdens on the environment from the products

Our company has worked to reduce our fans' burden on the environment, from the production to use to the disposal. The following two main activities have been undertaken:

(1) Reduction of resource usage

(2) Reduction of energy usage

3.2.1 Reduction of resource usage

The efforts made towards reducing the amount of resources used by the fans can be divided into two main categories: change towards long life and change towards low weight.

Standard fans have an expected life [*1] of 40,000 hours, while fans with a long life have an expected life of 100,000 hours. By comparing the results from both types of fans with Life Cycle Assessment (referred to below as LCA [*2]), we can see that a move towards long life cycles also helps reduce the amount of resources that are used. For the sake of comparison, assume that the two types of fans are the same size and have equal cooling performance.

Let us take an example where the equipment is used for 100,000 hours. While the long life fan can be used without maintenance, the standard fan must be replaced every 40,000 hours. Therefore, in the time that it takes to use one long life fan, 2.5 standard fans are required. Therefore, in a real operating environment, this translates to 3 standard fans compared to the 1 long life fan. To get an idea of the environmental impact during this time (100,000 hours of use), take a look at the amount of CO_2 emissions and compare the results from the LCA inventory analysis in Fig. 1.

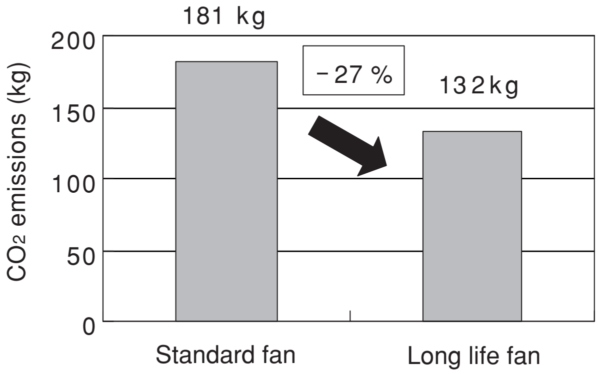

Fig. 1: CO_2 emissions comparison

The long life fan noted in this technical report is the "San Ace 40L". Compared to the 3 standard fans (conventional models) that are required to work the same amount of time, CO_2 emissions decrease 27% with the long life fan, which greatly reduces the overall effect of the fan on the environment. Since only one fan is required during this long period of time, we can also say that the long life fan is virtually maintenance free. Fig. 2 shows a photograph of the "San Ace 40L" fan.

Fig. 2: Long life fan "San Ace 40L"

Meanwhile, the movement towards low weight fans has increased efforts to make the fans both smaller and thinner. If a fan with a smaller size can provide the same amount of cooling performance, then the amount of materials used for the frame and fan blades can be reduced accordingly.

At the same time, the production of low weight fans provides an opportunity to reduce the transportation costs for materials and the final products. Furthermore, low weight fans reduce the size and thickness of the overall installation, providing a great opportunity to reduce the burden on the environment.

Table 1 compares the volume and weight of the conventional blower fan to the counter rotating fan that is merely 40 mm square by 56 mm thick.

Table 1: Volume and mass comparison with conventional model

	Conventional model	New model	% of Reduction
Volume	$597cm^3$	$89.6cm^3$	−85%
Mass	320g	90g	−71%

As you can see, the volume is reduced to approximately 1/7 of the conventional model, while the weight is approximately 1/4.

This new model fan has two impeller that can rotate in inverse directions in order to create a counter rotating structure that allows the fan to produce landmark high pressure and high air flow. Plans are being made to introduce a series of counter rotating fans in other sizes beyond 40 mm square.

3.2.2 Reduction of energy usage

When using fans, the power consumption (energy consumption) during operation is a major part of the burden on the environment. Therefore, reducing the energy requirements makes a major impact on reducing the overall environmental burden.

Our company works towards optimizing the following three aspects of its fans in order to reduce the power consumption.

(1) Shape of the frame and fan blades

(2) Magnetic circuits

(3) Drive circuits

Table 2 compares the power consumption for typical fans.

Table 2: Comparison of fan power consumption

	Conventional model	New model	% of Reduction
Comparison A	4.2W	3.72W	−11%
Comparison B	12W	7.2W	−40%

Comparison A shows the results from comparing the 40 mm square, 28 mm thick, long life fan "San Ace 40L" with a conventional model of the same size. In this example, the power consumption is reduced by 11%. Comparison B shows the results from comparing the 40 mm square, 56 mm thick, counter rotating fan (CRA type) with a conventional model (CR type) of the same size and maximum air flow. In this example, the power consumption is reduced by 40%. Fig. 3 shows a photograph of the above-mentioned counter rotating fan (CRA type).

Fig. 3: "San Ace 40" CRA type

The types of fans that customers require have also begun to change. Recently, there is increasing demand for fans that can be controlled fan speed by PWM signal from the equipment [*3]. When these fans are installed to equipment, it allows the customers to freely perform detailed controls. This allows customers to only output the cooling abilities when they are required, allowing a drastic reduction in energy consumption. Depending on how the customers plan on operating the fans, these controls provide an opportunity to effectively reduce energy. our company is working to provide this system in a wide variety of products.

Fig. 4 shows an example of PWM specifications.

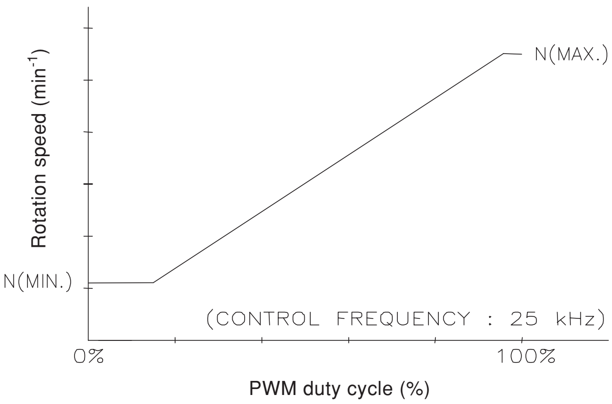

Fig. 4: Example of PWM specifications

When the duty [*4] is between 0% and approximately 20%, the fan rotates constantly at the minimum speed. From this point, the rotation speeds increases with the duty until the fan reaches the rated rotating speed at 100% duty. By varying the fan speed with the variation in duty, the fan can be used as a variable speed temperature fan. The PWM control function can be provided as an option to all newly developed models. Our company is also working to provide this function upon request on all of our conventional models.

4. Conclusion

Our company strives to provide a wide variety of fans that contribute to the wellness of the environment by supplying products that do not use chemicals that may harm the environment in the materials or manufacturing process, by reducing the environmental burden of the products themselves, and by supporting controls that allow customers to reduce energy consumption during operation.

Our company sincerely hopes to continue developing and providing products that can contribute to the global conservation efforts.

We thank the component manufacturers who work to comply with the RoHS directive. We could not continue with our environmental efforts without your aid and cooperation.

References

(1) Kesatsugu Watanabe: Environment Compatibility Technology for Cooling Fans
SANYO DENKI Technical Report No.12 (2001-11)
(2) Yoshihiko Aizawa: Cooling System Technology That Changes the Conventional Trend
SANYO DENKI Technical Report No.16 (2003-11)
(3) Takashi Kaise, et al: High Air Flow Counter Rotating Fan "San Ace 40" CRA Type
SANYO DENKI Technical Report No.21 (2006-05)

Footnotes

*1: Expected life
The life of the fan when measured at the SANYO DENKI standard ambient air temperature of 60°C.
(The conditions include a 90% residual ratio, rated continuous operation, free air and normal humidity.)

*2: Life Cycle Assessment
Abbreviated as LCA. This is one method for investigating and evaluating the product's effects on the environment, from extraction of raw materials to the manufacture, use, and disposal of the product. There are two evaluation points: inventory analysis and impact assessment.
- Inventory analysis:
Calculates and evaluates the total amount of resource consumption and air emissions.
- Impact assessment:
Quantitatively evaluates the effect on the environment.

*3: PWM
Abbreviation for Pulse Width Modulation. PWM is used for operations such as controlling the rotational speed.

*4: Duty
The following formula shows the ratio between the pulse ON time (T1) and the period (T0).
Duty = (T1/T0) × 100 [%]

Minoru Fujiwara
Joined Sanyo Denki in 1981.
Cooling Systems Division, Design Dept.
Worked on the development and design of fan motors.

Hata Kakuhiko
Joined Sanyo Denki in 1997.
Cooling Systems Division, Design Dept.
Worked on the development and design of fan motors.

Watanabe Jirou
Joined Sanyo Denki in 1978.
Cooling Systems Division, Design Dept.
Worked on the development and design of fan motors.