2004 Prize of the Chairman of ECCJ

Reduction of Steam Loss by Establishing Criteria for Inspection and Replacement of Steam Trap

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Manufacturing Department, Power Division, Diet Club

◎ Keyword: Prevention of heat loss caused by radiation and conduction, etc.

◎ Outline of Theme

Following the “Voluntary Maintenance Activities” performed by all staff members of the Manufacturing Department, the inspection and replacement criteria of steam trap were established, and traps were replaced with high-performance, energy-saving traps. We successfully achieved positive results in the reduction of leakage steam. Through theseactivities, we strove to reduce the time required for inspection and leaking time caused by trap failures, and effective results were also achieved in terms of reduction.

◎ Implementation Period of the said Example

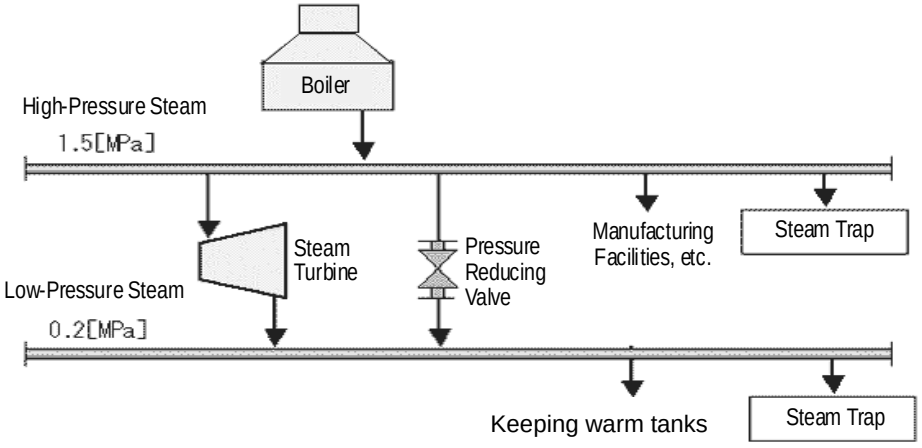
October 2002 to December 2003

- Project Planning Period October 2002 to December 2002 (3 months in total)
- Measures Implementation Period January 2003 to December 2003 (12 months in total)
- Measures Effect Confirmation Period January 2004 to June 2004 (6 months in total)

◎ Outline of Business Establishment

- Production Items: LPG, Gasoline, Kerosene, Light Oil, Heavy Oil, Asphalt, Chemical Products
- Number of Employee: 324
- Annual Energy Consumption (Actual record in 2003)
  Fuel: 537,778 kL/year
  Power: 331,947 MWh/year

◎ Process of Target Facility



1. Reason for Theme Selection

The inspection and management of steam traps in the refinery started in 1982. In 1988, the Management Register Book was prepared to standardize the judgment for the inspections and failures of traps, and it has been in use ever since. The traps we were using from the start of the operation of our refinery were made by two makers. Since around 1990, many makers started to sell traps under the catch-phrase of “high performance and low price.” We experimentally started to adopt some of those traps at our refinery. However, specific traps started to have problems from around 2001, and the frequency of the leakage steam and replacement of the traps increased sharply. In response to this situation, we completely reviewed the selection and management procedures of the trap, and promoted “Voluntary Maintenance Activities” to reduce the leakage steam of the traps.

2. Understanding and Analysis of Current Situation

(1) Understanding of Current Situation

A series of problems on specific traps started from around 2001. With this in mind, we started to measure the amount of drainage from the traps at more than 100 locations throughout the refinery from 2002 and also installed various traps of different makers at the same place and repeatedly conducted performance tests on the same.

1) Test procedure

[1] Measuring the amount of water and temperature before the test.

[2] Collecting drain.

[3] Measuring the amount of water and temperature of the drain collected.

[4] Estimating the amounts of steam and drainage based on the enthalpy difference.

2) Test results

The results showed that more than 10% of newly-purchased products had steam loss when steam drain was discharged. Meanwhile, the steam loss of disk traps ranged from 0 to 9 % depending on types, revealing a difference in performance, even though they were the same makers. To verify the correctness of these results, we visited steam trap makers and performed the same trap tests as ours using an automatic leakage test device. The results were identical to those of our tests (Table 1).

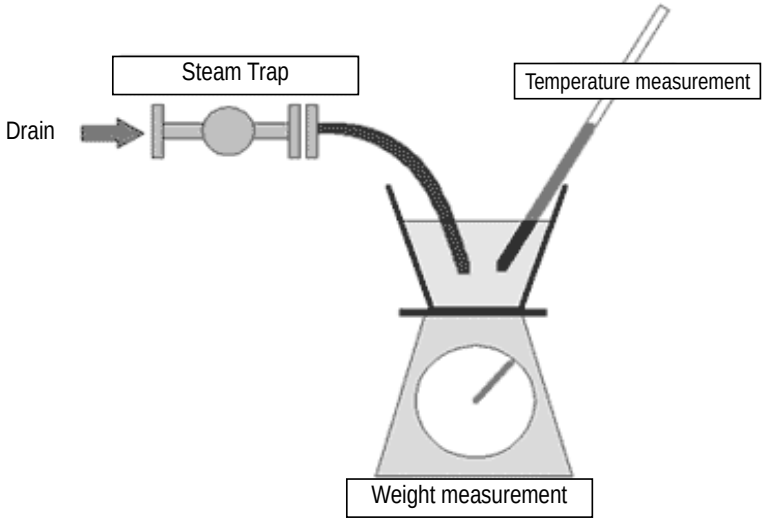


Table 1 Steam Trap Performance Verification Test Results

Maker	Product Name	Period in Use (Year)	In-House Test Steam Discharge Rate (%)	Verification Test Result Steam Discharge Rate (%)
C Maker	C-1	0	9.8	12.0
	C-2	0	10.0	12.1
	C-3	0.2	28.1	26.6
B Maker	B-1	0	0.0	0.7
D Maker	D-1	0	4.7	5.2
	D-2	0.2	7.8	9.0
F Maker	F-1	3	5.0	5.3
	F-2	2.5	0.0	0.6
	F-3	0	9.1	10.5

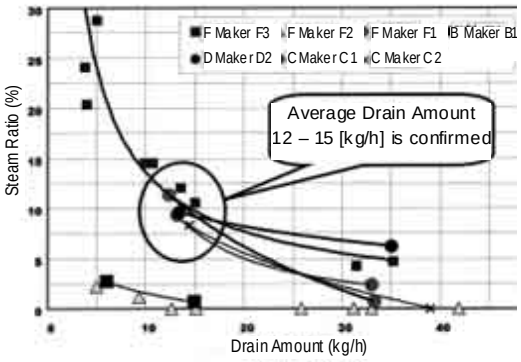


Figure 1 Steam Trap Performance Verification Test Results

(2)Analysis of Current Situation

According to the test results shown in Fig. 1, the amount of drainage ranges from 5 to 40 [kg/h] depending on the type of trap, and the average drainage is 12 to 15 [kg/h]. It also shows that the steam ratio is 13 [%] when the amount of drainage is 13 [kg/h]. If steam loss is calculated with drainage of 13 [kg/h], and a steam ratio of 13 [%], steam cost of 1,000 [yen/ton] and traps of 1000 [unit], it is 14.8 [million yen] annually. Meanwhile, if steam loss is calculated with the trap defective of 20 [%], steam leakage of 15 [kg/h] and 90 [days] before a defective trap is replaced, steam loss is 6.8 [million yen] annually. The total steam loss, amounting to approximately 20 [million yen], will be repeated every year.

3. Progress of Activities

(1) Implementation Structure

Our activities included reviewing the inspection and management criteria for steam traps, and achieving zero steam leakage. The scope of activities involved our entire refinery, so we promoted them in collaboration with all operating staff members of the management division and every division in the Manufacturing Department.

(2) Target Setting

It was intended to establish criteria for judging inspections and problems of fsteam traps for the purpose of standardizing the work of the operating staff members by upgrading their skills. It was also intended to make a list of steam traps which caused steam leakage and troubles, and to replace such steam traps with those of higher efficiency and longer operating life in order to achieve zero steam leakage.

(3) Analysis of Current Situation

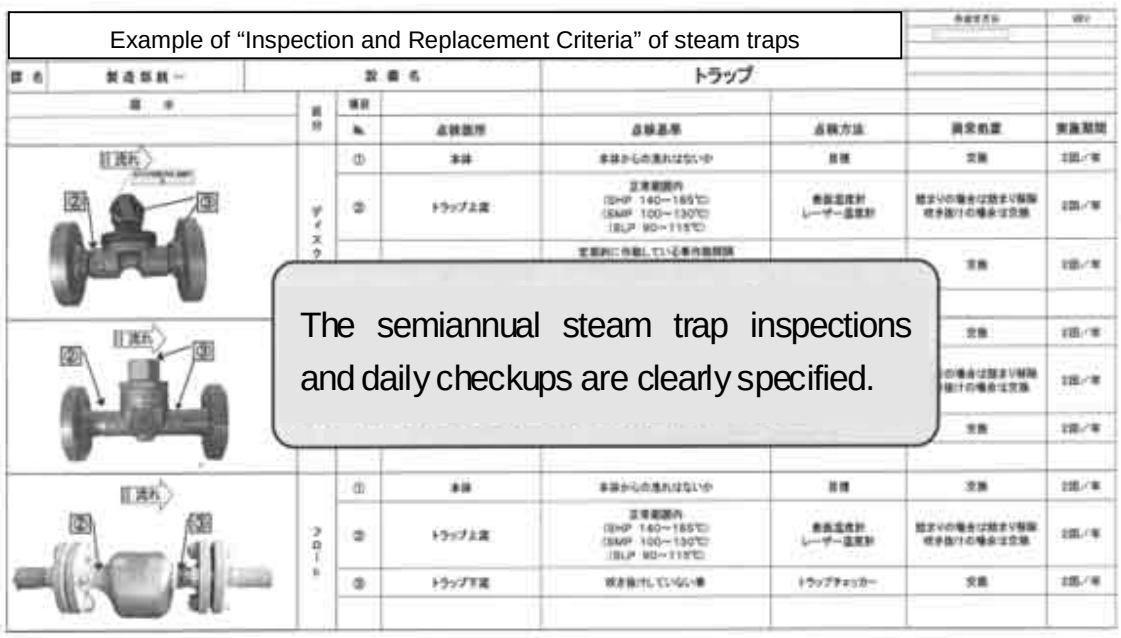
A total of approximately 12,000 steam traps were installed at our refinery. It takes much time to inspect the whole traps. In addition, troubles often occurred during the inspection intervals, which often resulted in steam loss. The purpose of our activities was thus to completely review the inspection and management of steam trap, therefore we decided to examine reductions in the inspection time, failure time, and replacement time of steam traps, as well.

4. Details of Countermeasures

(1) Up-skilling of Operating Staff Members

When the operating staff members have to inspect steam traps and identify their troubles, the extent of their knowledge concerning the structure of a trap is important. During the “Voluntary Maintenance Activities,” therefore, the cut models of an actual trap were manufactured, and all operating staff members were re-trained to understand the working principle of traps and troubleshoot problems. New steam trap leak checking tools were purchased, and used to inspect traps, however there were individual differences in the check results. Consequently, all 217 operating staff members of the Manufacturing Department were retrained to inspect steam traps using this tool. To eliminate the differences among staff members as much as possible, “Inspection and Replacement Criteria” were also compiled newly. This included inspection sites, inspection criteria, inspection procedures, and action against troubles occurred, which enabled all operation staff members to implement trap management of equivalent quality (Table 2).

Table 2 “Inspection and Replacement Criteria”



(2)Reviewing the Steam Trap Selection Procedure

The causes of problems with steam traps in use included non-intermittent blowing and inadequate steam trapping, as well as a short lifespan. In addition, some traps, even those

working properly, were subject to the entrainment of steam, and large amounts of steam leakage when the drainage was discharged. Tests also confirmed that the lower the amount of drainage is, the higher the rates of leaking steam is. For these reasons, we selected high-performance traps which were rarely affected by entrainment of steam, even when the amount of drainage was low.

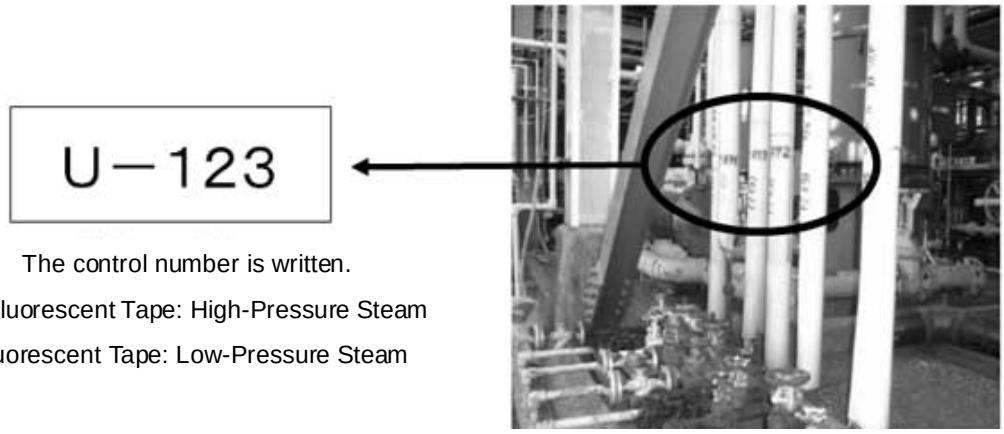
When a steam trap was affected by a problem, it took time to replace the whole set of steam traps, and those with problems had to be discarded. When the disk type steam traps we selected became worn, our work is only to change a disk. These traps also could easily be cleaned or replaced in the event of orifice clogging, which was a major cause of problems with the float and bucket trap. The type of temperature control traps we selected also allowed us to clear clogging of the orifice.

Although the purchase price of the steam trap was two or three times higher than those we purchased before, this price could be paid off in a year. We therefore decided to completely revise the selection criteria of steam trap.

Through negotiation with makers, we were able to shorten the time for trap delivery from one through three months to four through 20 days, in order to reduce the time loss caused by awaiting delivery.

(3)Reductions in Both Steam Trap Inspection Time and Trap Failure Time

The cause of taking considerable time for steam trap inspection was the need to inspect wide areas. In our division’s inspection areas, for example, about 1,400 traps were installed, and the installation sites were widely located throughout the refinery. The inspection list specified the installation sites of traps, and a drawing was also attached, however, it took us time to find out the installation sites. For this reason, we reviewed in order to reduce the inspection time required. Consequently, we decided to examine a mark which enabled staff members to locate their own traps, even from a distance when performing inspections, and to distinguish the type of steam between high and low pressure.



The control number is written.

Orange Fluorescent Tape: High-Pressure Steam

Green Fluorescent Tape: Low-Pressure Steam

Picture-1　A mark to identify the traps to be controlled

This mark enables us to identify at a glance, and to reduce the time taken to locate traps by an average of one minute per trap.

Full trap inspections are regularly performed twice a year. When problems occur between inspections, the amount of leakage steam will increase if the trouble is left unsolved for an extended period until the next inspection. We examined attempts to solve this issue by performing daily visual checks. The major cause of trap failure remaining unsolved for an extended period was the fact that it took time to identify problematic trouble, since the drain pipe we were using at the refinery was a collecting pipe. To solve this problem, we clearly defined the criteria for judging steam emission conditions by checking visually whether it was a case of “all traps stopped,” “the trap working normally” or “trap failure.” All staff members were fully informed of the criteria. Meanwhile, we improved the working environment to facilitate all staff members keeping in prompt contact with each other when problems emerged with traps controlled by other divisions. Accordingly, we were able to reduce the time that problems were left unsolved.

5. Effects achieved after Implemented Measures

The number of replaced steam straps, which were adopted from January 2003 through December 2003, amounted to 1,305 units in our refinery (Fig. 2), while the amount of steam loss reduced by steam trap replacement was 41.9 million yen a year. The steam reduction and CO2 emissions reduction amounted to 28,000 tons, and 6,000 tons a year respectively, meaning a drastic reduction in the environmental burden was successfully achieved (Fig. 3). In addition, the amount of investment, which was 20 million yen, was paid off within 6 months.

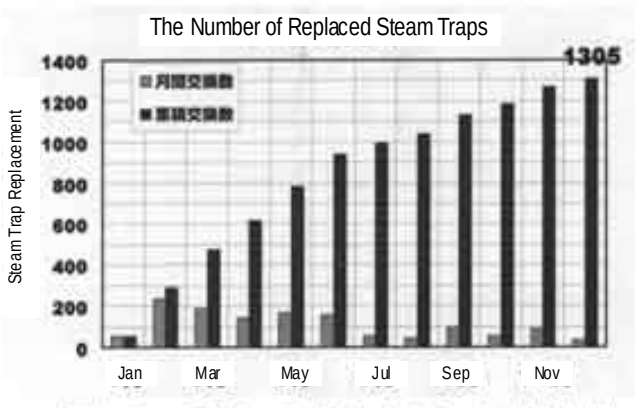


Fig. 2 Steam traps replaced in FY 2003

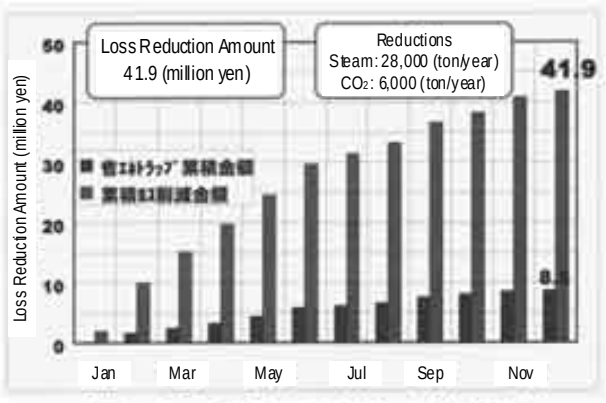


Fig. 3 The loss reduction amount in FY 2003

6. Conclusion

Under “Voluntary Maintenance Activities”, we were able to achieve a drastic reduction of steam loss by adopting high-performance and energy-saving type steam traps, and by selecting traps suitable for each purpose. Following collaboration and repeated examination by all staff members of the Manufacturing Department, we accomplished our activities by establishing the “Inspection and Replacement Criteria of Steam Trap.” As a result, the skills of all operating staff were upgraded, and their attitude toward energy conservation was markedly improved. We believe that these are also outstanding achievements of our activities.

7. Future Plans

Our “Voluntary Maintenance Activities” are still underway. We verified the performance of the steam traps adopted under these activities, although the life of the traps remains under examination. With the aim of reducing the failure rate of steam traps, we are determined to continue with these activities.