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# Use of QC Methods to Improve the Utilization Efficiency of Condensate Water

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***Abstract***

*Condensation of water use for energy saving and emission reduction is of great significance, and QC methods is an effective method to improve the utilization of condensate management. This article will be the empirical study on the condensation water in the target enterprise workshop as objects, study how to use QC method to improve the recovery rate, and to adopt effective measures to improve the production process of condensation water, eventually able to resolve their energy-saving emission reduction issues.*

***Key words:*** *QC method, condensation water, utilization efficiency, empirical research*



## 1. Introduction

Saving water resources is of great significance for human existence and development, the party and Government have always attached great importance to in this. In 1979, the State Science and Technology Commission held its first Forum on energy policy, it clearly pointed out that our country is faced with an energy shortage, must be nation-wide energy conservation. "Eleven-Five" during 20% less energy per unit of GDP, energy conservation has become "Twelve-Five" focus of planning. Currently many industries to improve energy efficiency in a prominent location, QC is an effective approach to improving energy utilization management. English Quality Control QC is short for, is the significance of Chinese quality control, its definition of ISO8402 in 1994 is "taken to meet the quality requirements of working techniques and activities". QC in 1962, pioneered the concept in Japan in 1978, China, after more than 30 years of development. This article to SCSY empirical study on the condensation water in the production workshop as objects, study how to use QC method to improve the recovery rate, realizing Enterprise energy saving and emission reduction.

## 2. Investigation and Goal Setting

### 2.1. Introduction to Procedures

1—1 Primary condensate pump diagram is shown as Figure 1. The steam of the steam from the boiler room to the workshop, circulated through the heating part of the thermal energy collected to the condensed water pipe after back into storage tanks, when at a certain level, through steam-driven soft tank alternate pump into the boiler room. While inside the water reservoir of gas condensate drain pipe emptying if coagulation of reservoir water level is too high, you exclude through the overflow pipe (related node is equipped with measurement).

### 2.2. Related Data and Statistics

Boiler room conveying to workshop of steam (average 100.34 tons/days), by workshop the with steam points, is divided into not recycling part, this part about accounted for 30%, main is production technology consumption, about 30.82 tons/days; also part is can recycling part about 70%, the thermal Manager in the of condensation water is confined loop of, can recycling again using, about 69.52 tons/days.

Condensate overflow pipe overflow, overflow level 28.59 tons/day. About 6.84 tons/day of steam water tube directly after emptying of State (commonly known as the exhaust). Waste of water resources and energy loss caused by condensate water. Waste of water resources and

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energy loss caused by condensate drain. As long as the overflow of condensate recovery, substantially improving condensate recovery.

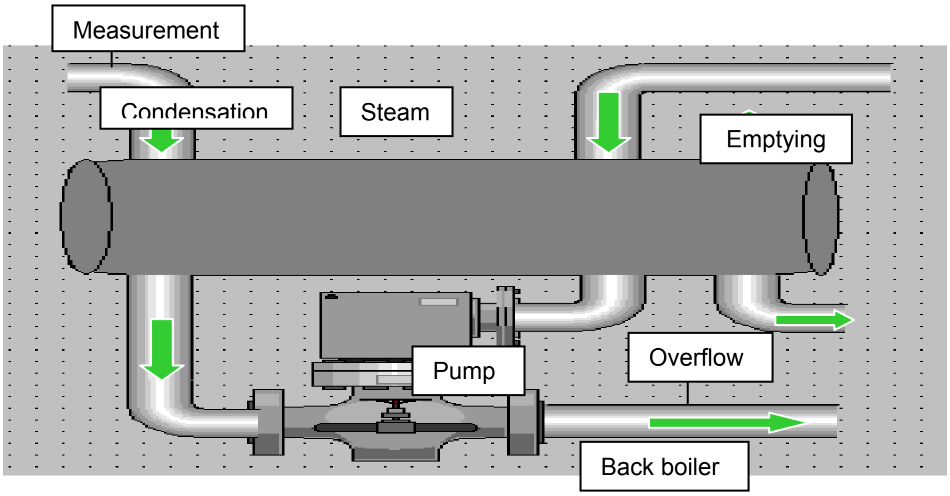


Figure 1. 1—1 Primary condensate pump diagram

We can reclaim part of data recorded are as Table 1.

Table 1. The part of data recorded

| 2009 | overflow (ton/day) | drain (ton/day) | water temperature (° c) | recycling (ton/day) |
|---|---|---|---|---|
| January | 28.17 | 7.26 | 94 | 33.90 |
| February | 27.98 | 6.60 | 94.5 | 34.45 |
| May | 28.59 | 6.61 | 95.5 | 34.32 |
| September | 28.61 | 6.44 | 95 | 33.87 |
| October | 29.02 | 7.09 | 95 | 34.09 |
| November | 28.58 | 6.68 | 94.5 | 34.26 |
| December | 29.21 | 7.17 | 94 | 33.74 |
| average | 28.59 | 6.84 | 93 | 34.09 |
| proportion | 41.13% | 9.83% | 94.4 | 49.04% |

Note: the 2009 season are: 1, 2, 5, 9, 10, and 11.

### 2.3. Goal Setting

According to surveys, condensate recovery rate is above 90% outstanding enterprises in the same industry, so we set to target: recovery of condensation water from 49.04% per cent.

## 3. Reason Analysis

For the causes of condensation water recovery rate is too low, we are from the people, equipment, materials, measurement and other aspects to analyze. Through the actual validation, we confirmed one by one to the factors affecting the recovery of, discovered in-situ testing condensation temperatures above the boiling point of water (greater than 93 degrees) and poor condensate recovery network installation location, two key problems.

## 4. Strategies to Develop and Implement

Two key factors for the above, we came up with three solutions:

Scenario one: follow the same regional elite dig pits in the thermal power station in tobacco enterprises (3-4 meters below ground level), then install the recycling pump for condensed water recycling.

Scenario two: more capable replacement recycling double pump for condensed water recovery.

Scenario three: according to the condensation of water, make a suitable volume of the water tank to collect condensate, also access soft water cooling at room temperature in a water tank, then by the automatic control of the pump to the boiler room.

Three programmers from economic investment, address the problem, a reliable, working hours, is expected to be the implementation, serviceability analysis of several aspects such as justification, chose the third option. After the selection, we decided to lower the condensate water temperature around 85 degrees centigrade. Because evaporation of condensation water will have some of the 85°C condensate water recovery as far as possible, while also taking into account the terrain allows, we use orthogonal experimental method to determine the size, emptying bins pipe diameter and pipe length. After the programmer, we have developed the following strategies and initiatives:

1) For the installation of unreasonable critical factors, specific measures for the production of water tanks to collect condensate, and automatic control of pumps carry condensate back to the boiler room. Specific safeguards designed mechanical and electrical drawings; auditing, reporting, acquisition of materials; according to the drawing make installation and commissioning.

2) For condensate water temperature high critical factors, specific responses to access soft water at room temperature on the condensation water in the water reservoir for cooling treatment. Specific security measures have access soft water at room temperature in the storage tanks; and valve, ensure the water temperature is about 85 degrees centigrade of hot-swap.

## 5. Results Validation

In September, we validate the effect, collecting the relevant data, as Table 2. Before the event Tobacco: X3L commissioned by the processing unit: Zhejiang tobacco

Table 2. Before the event Tobacco: X3L commissioned by the processing unit: Zhejiang tobacco

| 2009 | production (ton/day) | before the pump gauge Capacity (ton/day) | after the pump meter Capacity (ton/day) | the wastage rate |
|---|---|---|---|---|
| August | 96.40 | 69.53 | 33.91 | 51.2% |
| 23-28 | 115.00 | 69.21 | 34.49 | 50.2% |
| | 120.12 | 69.62 | 33.70 | 51.6% |
| | 105.90 | 69.45 | 34.35 | 50.5% |
| | 117.40 | 69.00 | 33.87 | 50.9% |
| | 113.20 | 69.87 | 34.00 | 51.3% |
| September | 106.89 | 69.67 | 34.31 | 50.8% |
| 12-20 | 97.20 | 69.50 | 33.74 | 51.5% |
| | 112.00 | 69.81 | 34.01 | 51.3% |
| | 110.90 | 69.55 | 33.79 | 51.4% |
| | 110.10 | 69.44 | 34.25 | 50.7% |
| | 112.70 | 69.12 | 34.56 | 50% |
| | 112.20 | 69.70 | 34.06 | 51.1% |
| | 116.89 | 69.67 | 34.13 | 51% |
| | 111.12 | 69.02 | 34.16 | 50.5% |
| Average | 110.70 | 69.48 | 34.09 | 50.9% |

After the activity Tobacco: X3L commissioned by the processing unit: Zhejiang tobacco. After 2009 and 2010 in the above manufacturers are the same, the product level similar to production made much of the comparison; we can see that reducing the average loss rate of 50.9% from 2009 advance to the year of 2010 the average 2.9%. By QC activities, condensed water recovery rate of 97.02%, the results reached and exceeded the preset goals.

In order to determine whether condensate recovery is normal and stable, we use the X-R control chart for judging. Our September 2010 for 25 days, in hour units, condensate recovery in randomly selected 5 times a day, and statistical records in the same order in the Table 3.

Table 2. After the activity Tobacco (X3L) commissioned by the processing unit (Zhejiang tobacco)

| 2010 | production (ton/day) | before the pump gauge Capacity (ton/day) | after the pump meter Capacity (ton/day) | the wastage rate |
|---|---|---|---|---|
| September 2Day-9th | 106.34 | 69.44 | 67.45 | 2.87% |
| | 115.65 | 69.23 | 67.21 | 2.92% |
| | 114.32 | 69.22 | 67.74 | 2.14% |
| | 105.29 | 69.45 | 67.72 | 2.49% |
| | 112.44 | 69.30 | 67.11 | 3.16% |
| | 116.52 | 69.25 | 68.00 | 1.8% |
| | 106.89 | 69.67 | 66.89 | 3.9% |
| | 102.90 | 69.02 | 66.98 | 2.96% |
| September 17-23 | 112.70 | 69.66 | 67.65 | 2.89% |
| | 113.21 | 68.99 | 67.32 | 2.42% |
| | 108.65 | 69.35 | 67.19 | 3.11% |
| | 112.21 | 69.87 | 67.67 | 3.15% |
| | 114.25 | 69.55 | 67.78 | 2.54% |
| | 107.79 | 69.94 | 67.84 | 3.0% |
| | 108.73 | 69.85 | 67.79 | 2.95% |
| average | 110.06 | 69.53 | 67.45 | 2.9% |

Table 3. Condensate recovery in randomly selected 5 times a day

| Sample number | X1 | X2 | X3 | X4 | X5 | ∑X | X | R |
|---|---|---|---|---|---|---|---|---|
| 1 | 2.8 | 2.817 | 2.833 | 2.799 | 2.837 | 14.086 | 2.817 | 0.038 |
| 2 | 2.823 | 2.877 | 2.853 | 2.815 | 2.863 | 14.231 | 2.846 | 0.062 |
| 3 | 2.822 | 2.826 | 2.82 | 2.846 | 2.853 | 14.167 | 2.833 | 0.033 |
| 4 | 2.796 | 2.865 | 2.841 | 2.871 | 2.824 | 14.197 | 2.839 | 0.075 |
| 5 | 2.825 | 2.836 | 2.784 | 2.841 | 2.876 | 14.162 | 2.832 | 0.092 |
| 6 | 2.787 | 2.856 | 2.822 | 2.837 | 2.815 | 14.117 | 2.823 | 0.069 |
| 7 | 2.841 | 2.829 | 2.838 | 2.831 | 2.846 | 14.185 | 2.837 | 0.019 |
| 8 | 2.86 | 2.817 | 2.833 | 2.798 | 2.821 | 14.129 | 2.826 | 0.062 |
| 9 | 2.831 | 2.825 | 2.784 | 2.833 | 2.817 | 14.09 | 2.818 | 0.049 |
| 10 | 2.878 | 2.842 | 2.842 | 2.867 | 2.832 | 14.261 | 2.852 | 0.046 |
| 11 | 2.828 | 2.816 | 2.844 | 2.851 | 2.825 | 14.164 | 2.833 | 0.035 |
| 12 | 2.854 | 2.82 | 2.848 | 2.786 | 2.833 | 14.141 | 2.828 | 0.068 |
| 13 | 2.796 | 2.844 | 2.821 | 2.827 | 2.809 | 14.097 | 2.819 | 0.048 |
| 14 | 2.827 | 2.831 | 2.827 | 2.879 | 2.816 | 14.18 | 2.836 | 0.063 |
| 15 | 2.851 | 2.812 | 2.785 | 2.828 | 2.817 | 14.093 | 2.819 | 0.066 |
| 16 | 2.82 | 2.86 | 2.837 | 2.818 | 2.852 | 14.187 | 2.837 | 0.042 |
| 17 | 2.866 | 2.846 | 2.827 | 2.803 | 2.831 | 14.173 | 2.835 | 0.063 |
| 18 | 2.847 | 2.844 | 2.852 | 2.816 | 2.847 | 14.206 | 2.841 | 0.058 |
| 19 | 2.819 | 2.83 | 2.821 | 2.806 | 2.849 | 14.125 | 2.825 | 0.043 |
| 20 | 2.824 | 2.788 | 2.851 | 2.837 | 2.841 | 14.141 | 2.828 | 0.063 |
| 21 | 2.853 | 2.85 | 2.833 | 2.841 | 2.828 | 14.205 | 2.841 | 0.025 |
| 22 | 2.796 | 2.848 | 2.861 | 2.824 | 2.8 | 14.129 | 2.826 | 0.065 |
| 23 | 2.821 | 2.827 | 2.833 | 2.817 | 2.862 | 14.16 | 2.832 | 0.045 |
| 24 | 2.882 | 2.836 | 2.862 | 2.848 | 2.816 | 14.244 | 2.849 | 0.066 |
| 25 | 2.85 | 2.808 | 2.816 | 2.842 | 2.847 | 14.163 | 2.833 | 0.042 |
| | | | | | | total | 70.807 | 1.337 |
| | | | | | | average | X=2.832 | R=0.053 |

According to the Table 3, we produced a mean value-range charts are as Figure 2.

## 6. Benefit Analysis

(1) Savings

Water conservation: water losses averaged 33.36×1.6 Yuan/ton = 53.376 tons/day.

Soft water treatment costs: amount lost daily ×1.0 Yuan/ton = 33.36 tons/day.

Saving gas: because of high temperature condensed water recycling, saving coal consumption of thermal deaerator in boiler house. According to the equipment section and statistics, in 2009 the average coal consumption to 19.14 tons/day; after the 2010 event, the average coal consumption dropped 17.98 tons/day. Average daily coal-saving 1.16 tons/day x969.00 RMB/Mt = 1124.04. Production time is 5 months of 2010 we can save 1210.776x150 = 181616.4.

(2) Investment

Pumps pipes one-time investment of labor, 2,980 9,160 total 12,140 Yuan.

Economic benefits of cost savings: 181616.40-12140.00=169476.40.

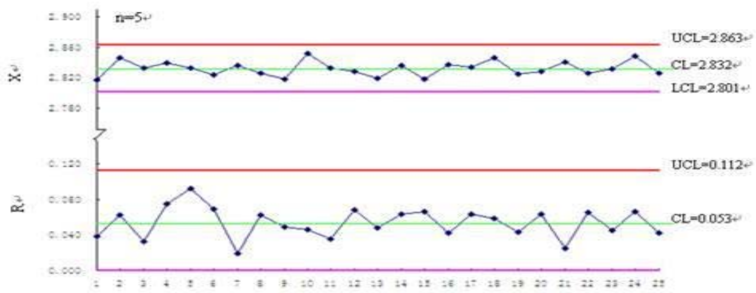


Figure 2. A mean value-range charts

## 7. Consolidation Measures

Establishment of the condensate recovery system of inspection and operation check table ensures the normal recycling of condensed water recovery points. Also require regular maintenance and repair of equipment, ensuring the normal operation of equipment. After the above steps have been taken, QC group in October 2010 for condensed water recovery rate statistics-November, results show an average recovery rate of condensation water is 97.12%, met and exceeded the target 90% and normal operation of equipment, stable. The practice of applying QC method for energy conservation and emission reduction activities had been successful.

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## References

[1] XING Wenying. *QC group activities guide*. China Quality Association, 2003.

[2] XING Wenying, Liao Yongping, Chen Hong sources. *QC team based materials (secondary revision)*. Beijing: China Quality Association, 2008.

[3] Ma Kaijian. *Discussion on QC group activity and the continuing success of Enterprise*. Beijing: ironEngineering Consulting Group, Ltd, 2010.

[4] Su Junjie. Discussion on innovation in the development of QC group in China. *China quality*. 2006.

[5] Activities comments: sincere customer service promotion value. *China quality*. 2007.

[6] Zhou Jingjing. Carry out QC group activities to enhance enterprises vigour. *Jiangsu communication*. 2008.

[7] Xu long. Exploration of the see from knowledge to quality management to promote enterprise development new leap. *China quality*. 2008.

[8] Hong Guobin. Use QC method to improve enterprise performance. *Business culture (the second half)*. 2011.

[9] Yang Liangen, Zheng Lin. Quality Evaluation Methods of Development Process of Complex Electromechanical Device. *TELKOMNIKA Indonesian Journal of Electrical Engineering*. 2012; 10(6).

[10] Feng Tianrui, Ouyang Sen. Design of a Distribution Network Power Quality Monitoring System based on Metering Automation Systems and its Application. *TELKOMNIKA Indonesian Journal of Electrical Engineering*. 2012; 11( 7).