Analysis and Solutions of Three Combined Test Chamber’s Malfunction Based on the Working Process

Jinchun Feng a, Bo Chen b, Junlin Teng c, a*

a,b,c Sichuan Engineering technical college, DeYang 618000, China

Abstract

In order to found out the reason that return-air overheated in the main preceding refrigeration compressor of three combined test chamber, and for trouble shooting effectively, carried out the analysis and searching fault based on course of work. At first, analyzed and judged the possible reasons that caused overheat base on experiment and common practice, but couldn’t determine it, then, inspected the compressor and adjusted valves, but couldn’t solve problem yet, finally through efforts and depth profile analysis, the real causes of malfunction were founded: there were some micronic leakage points in one of the manual valves and unloading valve of compressor in the high-pressure part of the system. The freezing medium in the system gradually missed from it on the high pressure line during long time operation, so when the leakage points were handled, the problem is properly settled. In this paper, methods and process of malfunction elimination as well as malfunction features and manifestation of the equipment in every maintenance procedure and the key to the final solutions are elaborated, which hopefully provides reference value and meaning for the maintenance of equipment of the same kind.

© 2011 Published by Elsevier Ltd. Selection and/or peer-review under responsibility of ICAE2011.

Open access under CC BY-NC-ND license.

Key words: Malfunction, ACS Three Combined Test Chamber, Compressor, Return-air temperature, Investigation

1. Introduction

Three combined test chamber is the chamber that can exert the temperature, humidity, and stress at the same time. If combine with the vibro-bench, we can set up an integrated test system. Three combined test chamber consists of cooling system, heating system, control system, humidity systems, air circulation systems, sensor systems and other components etc., as follow Fig.1. With the development of our country’s economy, in recent years China has introduced large quantities of integrated testing system from overseas to meet the needs of industrial products development[1]. However, due to the complexity of the combined test chamber, making the synthesis chamber in the operation of a number
of problems, and problems cannot be solved in time, greatly extending the trial period, affecting product development work. There was an ACS three combined test chamber, which had been in use for years. Because of heavy workloads, this equipment had been frequently used, leading in equipment failure occasionally, especially with a high malfunction rate during the past two years. This time, the warning and shutdown of the equipment resulted from the high temperature of return-air in the main preceding refrigeration compressor, whose caused hadn’t been spotted and solved effectively.

![Fig.1. the system block diagram of combined test chamber](image)

2. Initial analysis and judgment of malfunction

Fig.2 is the system construction drawing of the main preceding compressor. According to related date and maintenance experience, generally speaking, there are some reasons that contribute to the high temperatures in the return-air in the main preceding refrigeration compressor as follows:

1. Pipelines are blocked, one of which fails to form a loop, causing an imbalance in the system. Pipelines blockade, in specific analysis, contains plugged lines and plugged magnet valve [2].

2. Severe leak of Freon reaches the minimal dose of non-refrigeration. Heat generated by compressor that is working is transmitted back to the muffler.

Based on the situation analyzed above, we started investigating the system. Firstly, compressor was investigated by examining suck-exhale pressure, suck-exhale temperature and running current to eliminate the possibility of compressor malfunction; then on-off simulation of each valve was examined to confirm that its working status was normal; finally manual bypass valve and hydraulic bypass expansion valve were adjusted (turn down manual bypass valve to reduce heat; turn up hydraulic bypass expansion valve to increase coldness) [3] [4].

Through the adjustment of manual bypass valve and hydraulic bypass expansion valve, heat emission has been relieved to some extent. But as time goes by, the ‘abnormal’ phenomenon reappears constantly and even more seriously [4]. The muffler that used to be cold becomes hot, accompanied by low suction pressure. According to past experience, we examined the static balance pressure of the system to find out that static balance pressure was sufficient and even slightly higher than our empirical value, which indicated that there was no leak in freezing medium; if the system pressure balanced too fast, it implied that there was something wrong with the elements of the freezing medium, but the pipelines were clear [5].

Through the analytic process of malfunction above, we can preliminarily conclude that the malfunction cause may be that the elements of the freezing medium has changed, which requires a further experiment to confirm. With regards to this, we decided to refer to another set of preceding refrigeration compressor and compare the exhaust pressure, back pressure and pipeline temperature in details and find out that the
flowing liquid refrigerant charge level in the level glass at the back of the filter was different and the flow rate of freezing medium in the compressor with higher temperature was clearly lower than the next one. The freezing medium released was not liquid but gaseous instead. Even with enough freezing medium, why didn’t it condense into liquidness? Therefore it is certain that the freezing medium has changed. So far we haven’t heard of deterioration of freezing medium [6] [7]. Thus, we looked up relevant information and consulted our peers but understanding on the specific features of R402A (HP80), the environment-friendly freezing medium, haven’t been comprehensive enough. We only know that it is a type of environment-friendly liquid freezing medium combined with three substances, whose causes of deterioration are not clear at the moment.

Therefore we decided to drop the deteriorated freezing medium in the system and pressurize the system. Pressurization is necessary before refrigeration system re-injects freezing medium. In the process of pressurization, we found there were some micronic leak spots in one of the manual valves and unloading valve of compressor in the high-pressure part of the system, which resulted in insufficiency in pressurization. So the leak sources were handled. After that, the system worked normally in pressurization and was vacuumized for 8 hours. Finally about 30kg of R402A was injected and each valve in the system was set back to its original state before startup [7]. After several circles of high and low temperatures, the system finally worked correctly and return-air pipelines became cool with a decrease in temperatures [8] [9].

3. Analysis of the real causes of malfunction

In the system’s long time operation, the micronic leakage point in the high pressure line gradually missed the freezing medium in the system, which caused the absolute number of the freezing medium in the system to drop to the critical state. Meanwhile, due to the leak of unloading electromagnetic valve in the low pressure pipeline of the system, a small portion of air entered the system, which led to the system...
pressure to stay relatively stable for a while with static pressure slightly higher than the normal value. All this indicates that the entry of air into the system is the reason for the ‘deteriorated’ freezing medium. The phenomenon that the freeing medium leaks accompanied by air entering from the low end while the pressure of the system is kept normal is a rare case. Thus the reading pressure on the pressure gauge is not always accurate [10]. The real problems can only be discovered through meticulous observation and analysis so that malfunction can be solved successfully.

4. Conclusion

Through the work above, we have deepened our understanding as well as accumulated experience, which hopefully can be applied to the maintenance of other equipment.

1) Equipment maintenance is an active job. Even when the maintenance man has encountered difficult and complicated situations, they should investigate them step by step to find the keys to the problems so that effective solutions can be applied to complete maintenance work with high quality.

2) Knowledge level, persistence, high sense of responsibilities is necessary in equipment maintenance. Without them, it will be impossible to continue maintenance.

3) Maintenance is a serious and complicated process. Don’t ignore or fear no matter it is a major malfunction or a minor one. In the process of maintenance, all sorts of difficulties will be in the way. To solve them, every channel should be taken into consideration to find out the solutions so that machines can work correctly again.

4) Maintenance is honorable but arduous. Maintenance men should not be self-satisfied because a minor problem is solved but summize and analyze with modesty and cautiousness.

5) With the development of times and upgrade of equipment, there are many unknown fields for us to explore. The maintenance men should explore and study with superb skills, high sense of responsibilities to adjust to the requirements of maintenance in new era [10][11].

References

[1] Song Guoqing. The Differences between three combined test chambers and ordinary climatic test chambers. *Aviation Inspection Technology*, 1999(04): 47-48

[2] Su Pei. *The Hydraulic and Pneumatic Technology*. Chengdu: University of Electronic Science and Technology Press; 2008

[3] Lei Tianjue. *New Handbook for Hydraulic Pressure Engineering*. Beijing: Beijing Institute of Technology Press; 1988

[4] Wang Xiaohua, Zhao Zhonglin. *The Applications and maintenance of Pneumatic Elements and system*. Beijing: Mechanic Industry Press; 1996

[5] Lu Yongxiang. *Handbook for Hydropneumatic Technology*. Beijing: Mechanic Industry Press; 2002

[6] Chinese Mechanical Engineering Society. *Maintaining Question and Answers of Hydraulics & Pneumatics Equipment Maintenance*. Beijing: Mechanic Industry Press; 2004.

[7] Heinonen, Martti. Humidity generator with a test chamber system. *Journal of the International Measurement Confederation*, 1999,6(25), n 4, p 307-313

[8] Benson, T.M. Application to test chamber problems. *IEE Colloquium (Digest)*, n 49, 1996

[9] Ji Guangguo. *Malfunction Diagnosis and Elimination of Hydraulic System.* Beijing: Ocean Publishing House; 1992

[10] Information on [http://wenku.baidu.com/view/69ead52b3169a4517723a3b3.html?from=rec&pos=0&weight =4&lastweight= 1&count=5](http://wenku.baidu.com/view/69ead52b3169a4517723a3b3.html?from=rec&pos=0&weight =4&lastweight= 1&count=5)

[11] Information on [http://wenku.baidu.com/view/a70b631dfe4ffe473368ab66.html](http://wenku.baidu.com/view/a70b631dfe4ffe473368ab66.html)