Vibration Signal Analysis by Defect Type of Heat Exchanger

Sun-Hwi Park¹, Jung-Pil Noh¹, Sun-Chul Huh¹ and Byeong-Keun Choi¹,∗

¹Department of Energy & Mechanical Engineering, Gyeongsang National University, Tongyeong City, Republic of Korea
∗Corresponding author

Keywords: Molten carbonate fuel cell, Modal test, Frequency analysis, Heat exchanger, Crack.

Abstract. The dynamic characteristic was changed due to Young's modulus when the temperature of the heat exchanger changed. The case is often destroyed due to the heat exchanger tube, such as SCC occurs. Therefore, there is a need to predict using the FEM model. In this paper measured the vibration signal to Crack type of tubes the tube was classified attributes for each defect. And by conducting the Modal Test at the room temperature stated by using a dynamic characteristic of the hold and the predicted flow rate were compared Tube room temperature state and the dynamic characteristics of the operation state. In addition, when driving through the eigenvalue analysis, the changes in the eigenvalues component defect by types, also with respect to the heat exchanger by analyzing approached by Frequency analysis.

Introduction

There are many kinds of machine facility failures. Especially, leakage of heat exchanger, boiler and pressure vessel are common examples of failures.

Leakage of tube that is used for boiler and heat exchanger, it seemed to have diversities on causes such as internal pressure, corrosion, erosion, external impact as well as types. But usually these failures are fixed immediately depends on types of system and it must be kept as operating status due to system protection or economic reason. If failures such as tube leakage occurs and causes are possible to be found out by external signal that provides critical information to operator for deciding operation mode such as reduced rated operation, idle operation and emergency shutdown. Recently, many diagnosis techniques by using vibration signal has been researched. This research use faulty tubes that happened by different causes and controllable flux such as supply amount and leaked amount to measure released vibration signal. Also it figures out characteristics of the signal by temperature. Therefore, this research had experiments that similar to real field by using faulty pipe in heat exchanger and get vibration signal that occurs. Also it analyzes frequency correlation to have characteristics of signal due to fault or normal status.

Experiment Equipment and Model

Research Model that the molten carbonate required equipment is a heat exchanger of a fuel cell system, the horizontal direction of the diameter compared to the pitch of the pipe value (T / D) was 1.8, and the vertical direction to tube diameter value of contrast pitch (P / D) is 4.5 be. Inlet and outlet of the Cold Side has been fixed to the manifold, Hot Side inlet is the value of square Flange, the fluid moves around the tube at the rate of average 13 meters / s. The heat exchanger was supported by a wire, Figure 1 was set as shown. Gave the temperature to the temperature change by installing the temperature control on the inlet to determine the signal characteristic of the amount of leakage, using the valve provided in the outlet was adjusted to leakage.
Data Measurement Process

Location of getting vibration data about faulty pipe of heat exchanger is like Figure 2. all data is gathered from 3 directions and flux was inserted by air compressor. Insertion temperature was 30°C and 60 °C. It was possible to checked increase of vibration amplitude due to leakage of flux from cracked part when valve was opened or closed.

Result of Experiment

Figure 3 and Figure 4 is comparison between vibration amplitude and openness of valve in each temperature. Figure 3 shows that estimated unique vibration amplitude seemed to decrease by increasing temperature. Figure 4 shows that opening valve seemed to decrease estimated unique vibration amplitude.
Conclusion

When the valve is closed, it was possible to confirm increase of vibration amplitude by more flux leakage progress for opening the valve. Increasing temperature seemed to decrease unique vibration amplitude (54, 96, 133Hz). However weight of pipe, hardness and decrement effects by flow of flux seemed to effect on the unique value, so verification of this research model should be compared and analyzed with conditioned operation experiment result and actual experiment result. Also, analysis of vibration caused by amount of flux and temperature seemed to be necessary.

Acknowledgement

This research was partially supported by Korea Electronic Power Corporation (KEPCO) and Hyosung Goodsprings. I would like to thank everyone involved.

References
