

Development of Alternating Current Potential Drop Method for Surface and Internal Defects

RE YEON KYEONG

Powerplants such as gas turbine blades or welded regions of steam tubes operating at high temperatures occasionally fail by flaws caused by low cycle fatigue or creep damage. These flaws are classified into two types. One is a surface crack that emerges to free surface and the other is an internal defect in the components without emerging to free surface. Nondestructive evaluation of the flaws is an essential technique for assuring safe operation of machines. This thesis developed a new a. c. potential drop method that can evaluate the two types of flaws nondestructively.

This thesis is comprised of five chapters. Chapter 1 summarized the present state of the art and open questions for nondestructive flaw evaluation by a. c. potential drop method. Chapter 2 stated the research subjects in this study and the contents of the thesis. In chapter 3, a 4-terminal a. c. potential drop technique was developed, which can evaluate the number and depth of surface cracks. Potential ratios had a linear relationship against frequency and the intercept and gradient of the relationship were a function of the number and depth of cracks. The number and depth of multi cracks could be determined by this function. The frequency dependency of the intercept and gradient analyzed by FEM agreed with the experiment results qualitatively. In chapter 4, a 4-terminal a. c. technique was developed for evaluating the size and depth of internal holes. The position of holes was identified as a symmetrical position of the potential-position profile. The size and depth of internal defects were measured from the potential ratio difference between 500 and 6000Hz and the critical frequency that gave a certain potential ratio. The results of FEM analyses well agreed with the experiment results. In chapter 5, a new 2-terminal transmission a. c. potential drop method was developed for evaluating deeper internal holes. The position of holes was determined as the symmetrical point of the potential-position profile in simultaneous scan of 2 terminals. The size of holes was evaluated as the width of two maximum potentials of the profile. The depth of holes was determined by the profile obtained in the test of one terminal scan with the other terminal keeping a quiet position. In the conclusion chapter, the conclusions obtained in this thesis were summarized.