Abstract of Main Thesis

Title of Thesis

Study on the Loading Frequency Effect on the Fatigue Properties of Metallic Materials Mainly Focused on Low Carbon Steel

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Abstract on the Content of the Applicant's Thesis

Ultrasonic testing method is undoubtedly the most convenient way to study the very high cyclic fatigue property of metallic materials. Instead of carrying fatigue tests out for one year long with usual testing methods, ultrasonic tests reach the same number of cycles within one day. However, the loading frequency of the ultrasonic tests is 100 to 1,000 times higher than the loading frequency driven by usual methods. Therefore, a discussion of the effect of the loading frequency on the fatigue properties of metallic materials can be engaged.

The aim of this thesis is to better grasp the effect of the loading frequency on the fatigue properties of metallic materials by undertaking mainly two totally different studies. First one consists of an overall viewpoint based on numerous results from literatures. The second study is based on results from fatigue experiments for JIS S15C low carbon steel, which is usually reported to be particularly sensitive to the loading frequency.

According to the first study, as a general trend, high strength steels and aluminum alloys do not reveal a so significant frequency effect, even though some slight differences can be detected in the case of structural steels. Nevertheless, the high frequency sensitivity of low carbon steels was pointed out.

The second study has clearly reconfirmed the frequency effect on the *S-N* properties of S15C low carbon steel. In addition to a change of the fatigue lives, several other fatigue properties are affected by the loading frequency as the slip band formation, the crack initiation mechanism and the dislocation structure. Such characteristics phenomena are close to the iron placed into a particular behavior of B.C.C. ferrite. Thus, it was found that ultrasonic fatigue tests, unlike the usual ones, induce also this particular behavior due to its high strain rate. Some discussions were also dedicated to explain the low frequency effect in the case of high strength steels.