Investigation of Critical Stress Intensity Factors for AISI 4340 and ASTM A533 Alloy Steels at Different Murakami Area Parameters

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***Abstract*—This study's main goal is to find out how minor defects affect the development of fatigue cracks in metallic materials by examining the Murakami area parameter's ($\sqrt{area}$) effect on the spread of fatigue cracks in ASTM A533-B1 and AISI 4340 steel alloys. The threshold stress intensity factor (ΔK_{th}) is analyzed at two loading ratios (R = 0.1 and R = 0.5). The findings indicated that the ΔK_{th} increases for a range of $\sqrt{area}$ values and then tends to be constant. At low ΔK values, the ΔK_{th} change is effective on the fatigue crack growth range and disappears gradually as ΔK increases at ΔK_{th} = 7.80 MPa√m (no defect) or ΔK_{th} = 4.78 MPa√m (small defect). For the AISI 4340 steel, the crack growth rate response (in case of no defects) compared with the crack growth rate response (with minimal defect). Unlike the case of AISI 4340 alloy steel, there is no correlation between the values and an increase in the value of ΔK for ASTM A533-B1 alloy steel. According to their critical values, the ASTM A533-B1 alloy steel has a lower value than the AISI 4340 alloy steel, where the critical values are the value of (ΔK) at which the crack growth response curves with and without impurities start to match. These values remained constant for each material regardless of changes in (ΔK_{th}) but decreased as the R ratio increased.**

***Keywords*—stress intensity factor, murakami area parameter, crack growth rate, fatigue, AISI 4340, ASTM A533**