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Validation of Fracture Parameters using MTS Technology on certain Material.

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Abstract *It is important to work with new innovations and technologies with change of time. In similarmanner new technologies can be used for carrying out validation of certain problems. It was conducted to investigate the effect of specimen size on fracture toughness of mild steel. In this experiment, the specimen geometry was taken as a main parameter to calculate the fracture toughness of mild steel. Thickness and Notch depth ratio these two parameters were considered under specimen size. Specimen Geometry was referred from ASTM 1820 Standard code*

Keywords: *J Intergral, ASTM 1820, SENB, MTS*

1. Introduction

Fracture Mechanics includes the part of the science of materials and structures. It is important to note that science as the classical theory of elasticity, the theories of plasticity and creep are sufficiently clearly formulated and well studied by the present time, the innovations of fracture is still far from its completion. Steel is one of the major inventions that has helped humans progress with time. It is one of the most used material. Hence major study related to fracture toughness can be carried out. The evolution of study of fracture mechanics came into existence during Second World War, where major catastrophic failure occurred due to material failure. The usage of steel gave the industries the much needed time to grow and expand. Steel is now available in many grades and specifications. From all the types of steel, mild steel is the commonly found form. As shown below a three point bending set up has been adopted on a mild steel specimen with required specifications for ASTM 1820 code.

2. Materials and Methodology

Figure 1. Three Point bending specimen

This setup is used on MTS machine having load capacity of 10 tones which is operated by software called station manager using multipurpose test work and test work for two different types of loading one is load control and another is displacement control. Figure 2 shows the window of multipurpose work which was used during testing. Using this peak load is calculated for different types of material here mild steel is used.

Crack tip opening displacement (CTOD) is another parameter suitable to characterize a crack. Unlike parameters G and K, it can be used for both linear elastic fracture mechanics (LEFM) and elastic plastic fracture mechanics (EPFM). ltwas formulated by Wells and Cottrell and became more popular in Europe, at least in the initial stages. In fact, the parameter was formulated about a decade before it was realized that the J-Integral could be used for EPFM. The material cannotwithstand very high stresses within the plastic zone, and the usual stress field of the square root singularity no longer exists. However, rigorous analysis is complex andit was important to explore a simple model.

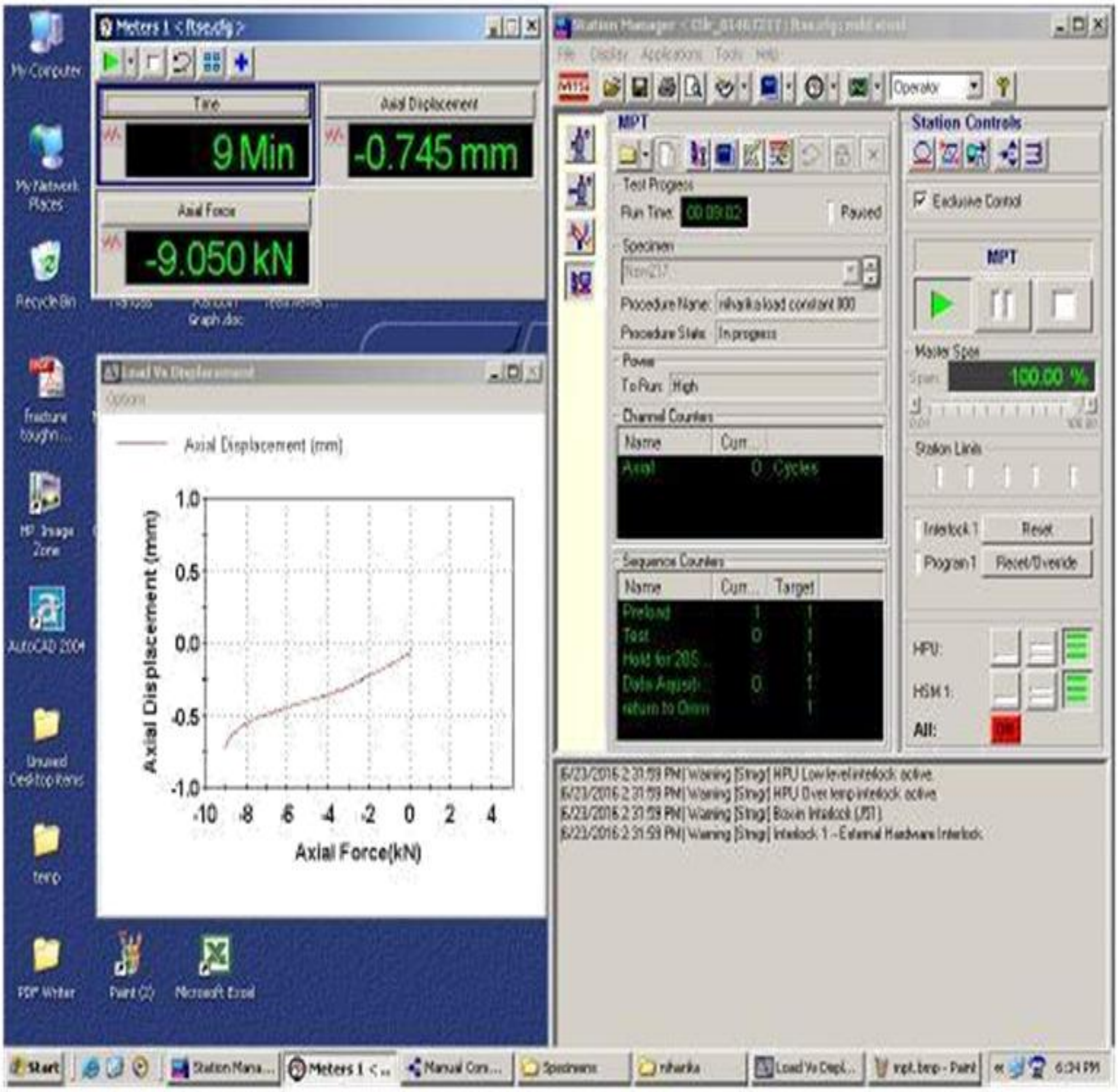

Figure 2. Multipurpose Test works window using station manager software.

Peak Load Test:

In Peak Load Test works Figure 2 Peak Load Control test was carried out on MTS machine using three point bending test using SENB Mild Steel specimen of varying thickness and varying notch to width ratio. For first test 12kN was kept constant and for second test 17kN was kept constant.

Figure 3. Test Setup

3. CMOD TEST:

Total 10 specimens were casted out of which 5 no's of 15mm and 5 no's of 12mm thickness with varying notch to width ratio. Peak load is calculated in MTS machine on Test works. For few trail tests certain amount of extension points were given so that we can get the tentative amount of load capacity these were Extension Point 1 = 10 mm and Extension Point 2 =12 mm. To know the actual load capacity of SENB specimen the extension points were increased to 14 mm and 16 mm. hence we can get the actual load capacity. Figure 3 shows test setup.

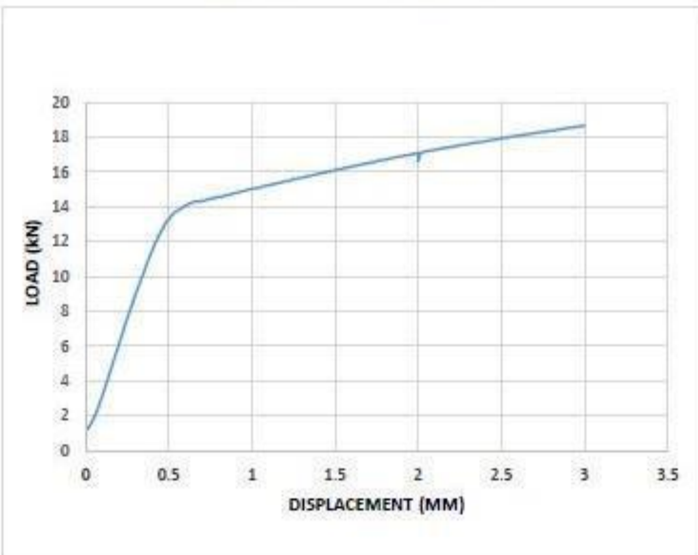

Figure 4. LOAD vs DISPLACEMENTa/w=0.55 Thickness=15mm

KIC($MPa\sqrt{m}$) a/w=0.45	KIC($MPa\sqrt{m}$) a/w=0.50	KIC($MPa\sqrt{m}$) a/w=0.55
Thickness Constant=15mm		
65.72	76.11	88.46
71.72	80.23	90.62
69.75	79.93	93.48
70.06	80.44	94.31
122.70	124.02	130.60

Table 1 : Notch to depth ratio variation

4. Conclusions

From the test results, we can conclude that it is important to validate results experimentally along with analytical calculations. From point of view of technical aspects keeping in mind the thickness if we are reducing material dimensions in the plain strain condition, amount of material used will be less hence economic condition can be achieved.

5. References

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