TCR Advanced Engineering P. Ltd

Experts in Metallography, Failure Investigation and RLA

Metallurgy for Industries

Power | Petrochemical |Fertilizer| Chemical | Refinery| Engineering| Automobile

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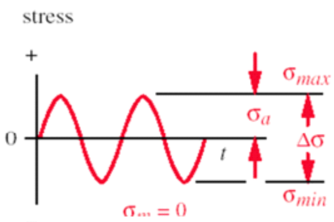
Fatigue testing

An introduction.

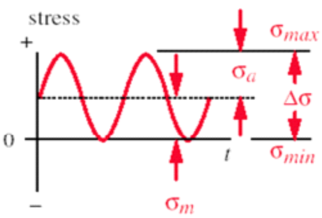
The majority of engineering failures are caused by fatigue. Fatigue failure is defined as the tendency of a material to fracture by means of progressive brittle cracking under repeated alternating or cyclic stresses. Although the fracture is of a brittle type, it may take some time to propagate, depending on both the intensity and frequency of the stress cycles. Nevertheless, there is very little, if any, warning before failure if the crack is not noticed. The number of cycles required to cause fatigue failure at a particular peak stress is generally quite large, but it decreases as the stress is increased. Fatigue testing utilizes cyclic loading to predict the life components under fluctuating loads. Determining fatigue life can support R&D efforts for new materials as well as prevent failures and recalls when used to ensure material properties.

Understanding fatigue life is critical in a wide range of industries such as Aerospace, Medical Device and Oil & Gas and power generation to ensure safety and reliability as well as determine the longevity of a component under operation.

Fatigue may occur when a member is subjected to repeated cyclic loadings; it can undergo progressive damage such a propagation of cracks. This phenomenon is called fatigue damage.



Fully Reversed



Repeated

TCR News

- Received NABL accreditation for Scanning electron Microscopy (SEM), Energy dispersive spectrum of X-Ray (EDS), Surface roughness, ferrite measurement and Visual Inspection testing.

CERTIFICATE OF ACCREDITATION

TCR ADVANCED ENGINEERING PRIVATE LIMITED

ISO/IEC 17025:2005

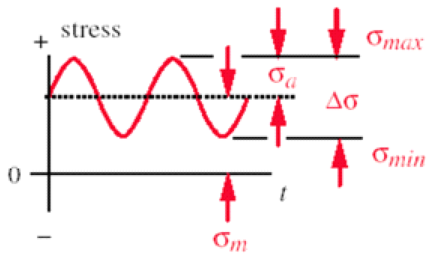
TESTING

- Executing Remaining Life assessment assignment of 16 critical Equipment for a chemical plant in Ankleshwar.

EVOLVE by TCR

- Conducted Two days Training course on Low temperature service: Concepts on metal properties, manufacturing & testing., PAUT-Introduction, calibration & interpretation. Participants from various industries sector participated in the programs.

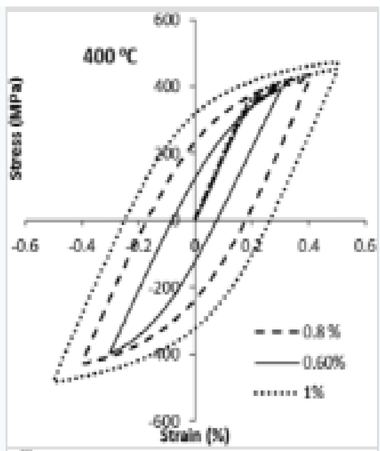
- Planned 4 trainings on in upcoming month on Basics of metallurgy for engineers, intensive training on preparation of WPS, PQR and WPQ, and intensive training on reformer tube damage mechanism, Inspection and RLA.



Fluctuating

Fatigue testing comprises of various modes of testing the commonly used fatigue testing involves following

Low Cycle Fatigue testing (LCF)



In Low Cycle Fatigue (LCF) Testing, i.e. Strain-controlled fatigue, the specimen is cycled to strain levels in elastic-plastic region to generate the strain-life (ε-N curves). This test is conducted in strain-control mode using an extensometer attached to the specimen.

LCF tests provide data to generate strain vs. No. of cycles curves and are often performed at elevated temperatures to replicate the thermal environments of components designed with a finite life methodology.

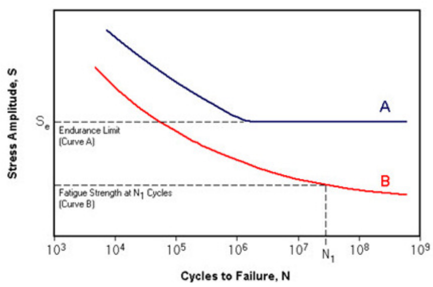
It is important for situations in which components or portions of components undergo either mechanically or thermally induced cyclic plastic strains that cause failure within relatively few (approximately $<10^5$) cycles.

Information obtained from strain controlled fatigue testing may be an important element in the establishment of design criteria to protect against component failure by fatigue.

High Cycle Fatigue testing (HCF)

Fatigue is the process of progressive and permanent structural change in a material subjected to cyclic loading. Cyclic loading may lead to crack formation, propagation and eventually fracture. Laboratory fatigue tests are most commonly conducted on smooth bar specimens. High-cycle fatigue (HCF) tests are typically conducted on smooth bar specimens in force controlled constant amplitude.

These tests determine the number of cycles (Normally $N>10^5$) to fracture for each specimen, and the data can be compiled into stress-life (S-N) curves. Nominal stress levels in HCF tests are generally low, significantly below the material's yield strength.



S-N Curve

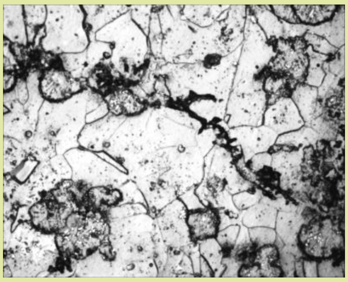
Features of Fatigue testing machine

- High-performance digital controllers and servo-hydraulic components for precise control
- High-lateral-stiffness load frames (50kN & 250kN) and actuators that minimize specimen buckling under high compressive strains.
- Superior alignment system to minimize bending strain and improve accuracy.
- Advanced, user-friendly software for test design, execution and data acquisition
- Extensive selection of grips, extensometers and heating furnace.
- Unique grips and fixtures designed for up to 100 Hz frequency operation.
- Advanced algorithms for maintaining constant load amplitude.

TCR's The Fatigue and Fracture Toughness Division undertake the following tests in a timely, cost-effective manner:

1) Fatigue Test
   - **ASTM E466** : Standard Practice for Conducting Force Controlled Constant Amplitude Axial Fatigue Tests of Metallic Materials.
   - **ASTM E606** : Standard Practice for Strain-Controlled Fatigue Testing
   - **ISO 12106** : Metallic materials — Fatigue testing —Axial-strain-controlled method
   - **ISO 12108** : Metallic materials — Fatigue testing —Fatigue crack growth method
2) **IS 16172-2014** : Reinforcement Couplers for Mechanical Splices of Bars in Concrete
   - Static Tensile Test
   - Cyclic Tensile Test
   - Slip Test
   - High Cycle Fatigue Test

Microstructure of the Month



Magnification: *200X*
MOC: EN-JS1059
Component: Impeller(Vane)
Etchant : Stationary blade casing
Observation: Microstructures after replication metallography shows nodular cast iron in ferrite and pearlite matrix. The crack is observed to have traversed through graphite nodules forming a branched network..
Cause: The network of cracks observed during inspection of the casing were due to effect of graphitic corrosion at the portion of degraded graphite structure limited to surface at depth of up to 500 µm.

Useful hints: Proper foundry practice needs to be followed to ensure damage free nodular graphite throughout the cross section. This can be ascertained by in-situ metallography on actual casting. The purity of steam quality needs to be ascertained. It is also advised to check the water quality used for makeup / steam condensate circuit. Measure of conductivity at exit of steam condenser would provide early warning on contamination.

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