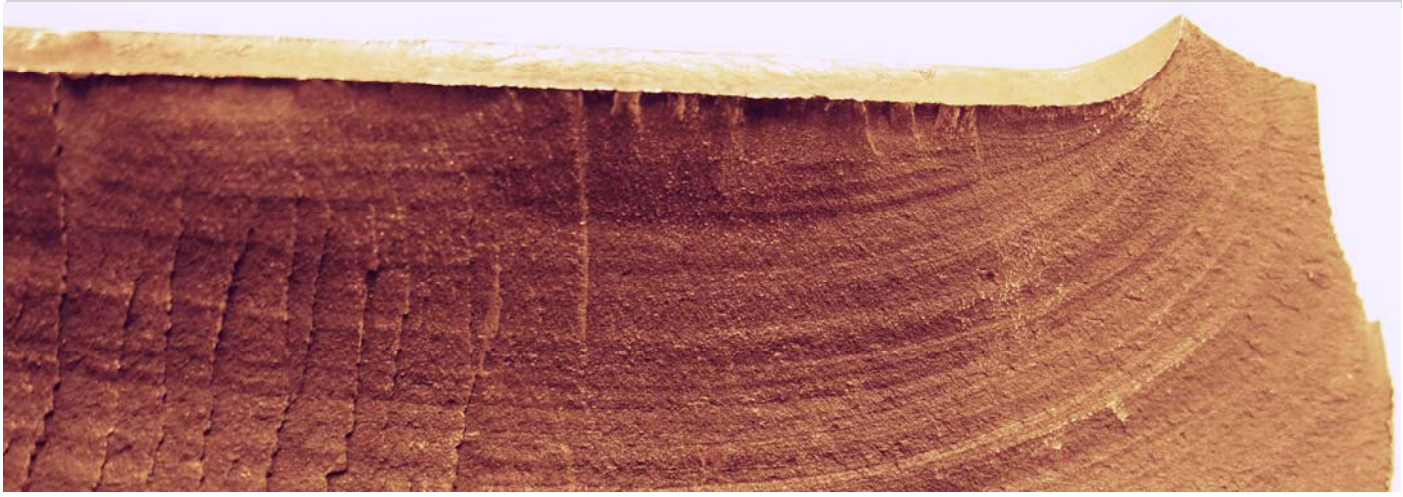
FACTS

December 2015

SINTEF Materials and Chemistry

Failure investigations



Objectives

An industrial failure is an unwanted event, sometimes with very painful consequences. When it first has occurred, it is a rare and valuable source of information. Failure investigation exploits this information to learn and prevent similar failures in the future.

Quickly understanding what has happen is often important in order to safely resume operations.

Discussions will often arise about the responsibility for the failure. An unbiased failure investigation will help minimize conflicts.

A systematic approach

A failure investigation typically involves the following:

- Gather data, in the form of witness data, telemetry, wrecked parts, interviews, site visits etc.
- Have people with relevant technical backgrounds review the data.
- Brainstorm to propose explanations, mechanisms, chains of events that might explain the available data.
- Propose further data gathering, laboratory tests or numerical analyses that can confirm or exclude the proposed explanations.
- Present conclusions supported by detailed justifications.

Services

As a reputable and neutral organisation, SINTEF Materials & Chemistry can be commissioned to provide services to support various aspects of a failure investigation.

When contacted with a request, SINTEF Materials & Chemistry will assemble an internal team to propose the best possible services, and discuss options with the contractor. Where relevant, specialists from other parts of the SINTEF Group or other relevant organisation will be contacted, but not before this is cleared with the customer.

Failures can involve mechanisms that are not covered by design guidelines. Research scientists, which make a profession of studying the physics behind a design can be particularly well suited to propose explanation to unusual events.

SINTEF Materials & Chemistry has capabilities in

- Optical and electron microscopy (SEM,STMEPMA, TEM, EBSD,WDS,...)
- Metallography, Identification of crystalline phases in metallic materials (XRD), hardness mapping
- Chemical analyses, mass spectrometry, in situ IR, UV
- Fatigue, fracture, corrosion, stress corrosion, hydrogen embrittlement of metallic materials
- Tensile and fracture testing of polymers
- Structural analysis, crash analysis

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- Statistical analysis
- Fractography (micro and macro scale)
- Qualitative and quantitative metallography
- Numerical modelling of materials—from the atomistic to the continuum scale

Confidentiality

Failure are particularly sensitive events. As a provider of services, SINTEF maintains strict confidentiality where required, and this is true in particular for failure investigations.

Experience

SINTEF Materials and Chemistry and its personnel have been involved in the investigation of thousands of failures, starting from 1950.

The following presents a few highlights:

- Buckling of steel pipes under internal pressure.
- Cracking in a warm-water tank due to thermal stresses.
- Unwanted chemical processes in the annulus of flexible pipelines.
- Tearing of polymer layers on flexible pipelines
- Torsion of flexible pipes and umbilicals under loadout operations.
- Damaged pressure vessel.
- Fatigue of insulator in high tension electrical lines.
- Fatigue and overload failure of bolts, in regulator of hydropower plant and others.
- Subsurface fatigue damage in case hardened ship gears.
- Failure of water conducting brass pipes.
- HISC failure of Åsgard subsea hub.
- Damage to pipeline from ship anchor impact.
- Fatigue and residual stress analysis in offshore jackets.
- Brittle failure of offshore topside duplex piping system.

SINTEF

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