European Technology

Working for Power, Petrochemical, and Process Plant Industries

Petrochemical Plant and Associated Boilers

European Technology Development (ETD) has established expertise in life assessment and condition evaluation of petrochemical plant and associated boilers covering all the major damage mechanisms including:

- *Corrosion and/or erosion*
- *Creep*
- *Fatigue*
- *Defect Assessment*

In addition - should failures occur and repairs be required - ETD is in the ideal position to address :

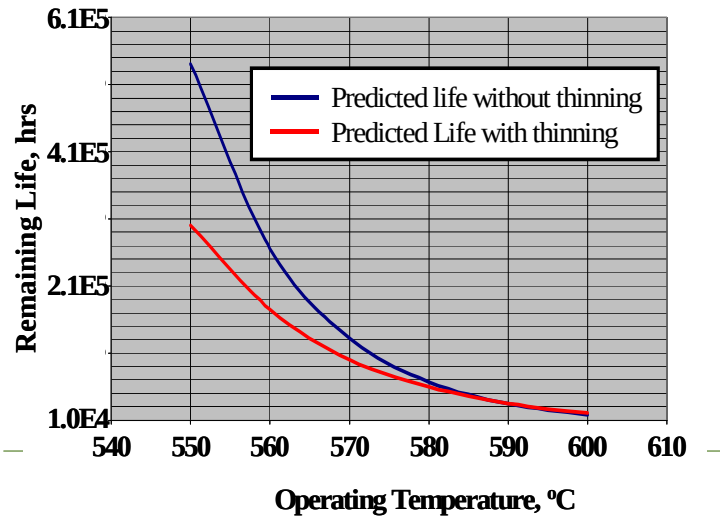
- *Weld assessment and weld repair issues*
- *Failure analysis, and replication assessment*

In addition to their extensive field expertise, ETD is involved in

In many boilers and petrochemical heat exchangers the life of the unit is limited by a variety of issues including:

- Poor fabrication leading to premature failure
- Fatigue damage
- Creep damage accumulation
- Internal/external erosion and/or corrosion

Predicted Life Based on Minimum Creep Data



Normally the designs are robust, however as the plant ages, calculational life assessment backed up

by a limited and focused plant inspection is warranted. This minimises the unpredicted failures that could result in extended plant down time and allows planned repair/replacement of defective components/parts. ETD uses a staged approach to assess this type of boiler as follows:

Stage 1: Preliminary Life Assessment Calculation and Inspection Definition

The life assessment calculations are usually based on design dimensions, any available operating information and whatever trends that can be derived from historic inspection data. Frequently there is a lack of recorded metal temperature data available in which case design operating conditions are used for the assessment. The results of this calculation are

combined with ETD's experience of assessing this type of unit to define the appropriate inspection work scope.

This preliminary assessment should be considered as a ***prioritisation*** exercise for identifying the critical locations to inspect and not a firm life prediction, particularly if limited tube metal temperature data are available and the boiler is approaching design life.

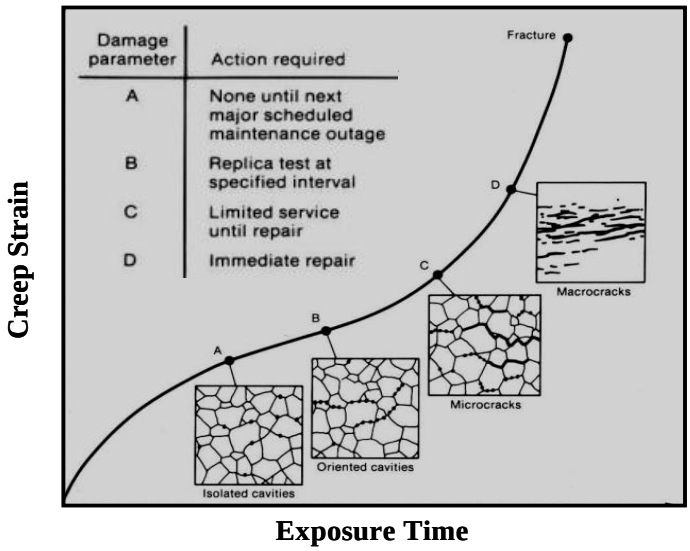
Stage 2: Inspection Programme Implementation

The limited focussed inspection programme defined in Stage 1 is implemented on site by a team supervised by an ETD engineer.

To minimise the number of tube removals the inspection normally uses advanced NDE techniques in addition to conventional inspection.

The inspection data collected are reviewed and preliminary recommendations are made on site

ETD is one of the European leaders in specialist areas such as application of ***defect and probabilistic assessment*** of plant integrity.



identifying immediate actions required to allow the unit to be returned to service safely.

Stage 3: Final Life Assessment

Following completion of the on-site assessment, the data are compiled and a refined life assessment covering the identified damage

Life Fraction versus Replica Assessment

Nordtest (NT NDT010)	VGB TW 507	Neuber And Waddel	Description	Recommendations Nordtest only	Consumed Life Fraction 1¼Cr½Mo-EPRI
	0		as-received		
1	1		no creep cavities	None	0-0.14
2		A	single cavities	Re-examine after 20,000hrs	0.05-0.47
	2a		isolated cavities		
	2b		numerous cavities No preferred orientation		
3			coherent cavities	Re-examine after 15,000hrs	
	3a	B	numerous orientated cavities		0.27-0.53
	3b		chains of cavities		
4		C	creep cracks (micro)	Re-examine after 10,000hrs	0.29-0.84
5		D	Creep cracks (macro)	Issue immediate warning	0.7-1.0

mechanisms is performed. Based on this, a strategy for future inspection and repair/replacement tasks is defined.

Additional Work

There can occasionally be additional work involving for instance: defect assessment, metallographic examination, materials testing etc. These tasks are normally recommended during the Stage 2 site work.

Life Assessment Considerations

Examples of issues to be considered in the life assessment are given below.

In the preliminary assessment, the actual creep properties of the tubing are unknown and careful choice of the nominal properties is required to ensure plant safety while avoiding excessive conservatism, which could result in premature tube replacement. In many cases, plant temperatures may be lower than used in the original design increasing plant life. As the unit approaches its original design life, repeat calculations of the life of the unit, using thinning rates obtained from ultrasonic testing and operating temperatures derived from oxide

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