INSPECTION OF DUPLEX MATERIALS USING ACFM

TSC INSPECTION SYSTEMS

INTRODUCTION

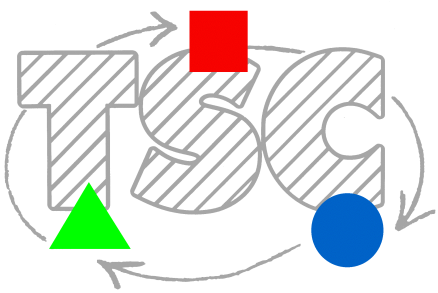
Duplex steels are widely used for elevated temperature applications and corrosion resistance in processing plant on topside. Like all other components used in these situations, integrity, and management of integrity, is an important consideration but these alloys and their welded connection are particularly difficult to inspect. Despite the difficulties, recent work with the ACFM technique has been very successful and could provide a cost-effective solution to the NDT of these components.

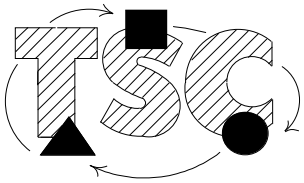
Duplex and super duplex steels are higher strength steels with good parent metal fatigue strength and high ductility/fracture toughness. Like many other higher strength steels however, these improved properties do not include fatigue crack growth resistance so that if the application includes welded joints it is necessary to keep cyclic loading to a minimum and inspect regularly for fatigue cracks. Site NDT has already proved to be effective with ACFM to the point where fatigue cracks have been found and costly shutdown avoided.

To date many thousands of duplex steel welds have been inspected using ACFM and only a small fraction have been identified as being defective. A number of these were examined destructively in the early days of ACFM inspection and these post NDT investigations confirmed the effectiveness of ACFM, and also identified that it may be possible for subsurface flaws to be detected.

NATURE OF DEFECTS REPORTED

Prior to the introduction of ACFM the main inspection system relied on for duplex steels was dye penetrant. This proved to be a slow, laborious technique, which was lacking in sensitivity and was unreliable if the crack was closed for some reason. ACFM proved to be much more sensitive but was also found to be capable of detecting features other than surface cracks, for example root cracks and subsurface flaws and areas of local structural change.





The nature of duplex material is that it is extremely sensitive to heat input during welding and even during grinding. If repairs or difficulties during welding have occurred, the local micro-structure of the material is affected and this can be of significance with respect to structural integrity. Destructive sectioning of areas where ACFM defect signals have been called have shown that defect signals can be produced not only by surface breaking fatigue cracks but also for localised micro cracking, local repairs and subsurface defects.

A joint industry sponsored project was undertaken to develop more advanced measurement/interpretation in order to provide better discrimination between surface and subsurface defects in order to improve identification of the exact nature of the anomaly creating the indication. This has led to improved procedures and probes for use with existing instrumentation and also suggested improvements to be included in future instrumentation.

SUMMARY

ACFM has proved successful in the inspection of duplex material, especially around weldments, and appears to have a number of advantages over existing techniques. The technique has been shown to be capable of detecting fatigue damage in these welded materials and has also been shown to be capable of identifying areas of localised micro structural change. These may be due to micro cracking, local repairs, or additional material phases all of which could be of structural significance and which certainly represents potential problem areas.

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