Applied Inspection Ltd

DEFECT DETECTION WITHIN CORRODED AXLE BODY SURFACES

Technical Committee 24 Seminar - Railway Axle Fatigue and Inspection at TWI 25 October 2012

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DEFECT DETECTION WITHIN CORRODED AXLE BODY SURFACES

- Defects identified within corroded axle body surfaces
- Use of different MPI processes and their effectiveness regarding defect detection
- Eddy Current inspection of corroded axle surfaces and its effectiveness

DEFECT DETECTION WITHIN CORRODED AXLE BODY SURFACES

- Currently corrosion fatigue mid-span axle body and wheel seat transition radius defects only found occasionally. The NDT techniques employed are MPI / Eddy Current inspection.

- A vast amount of axles are put to scrap because of corrosion without MPI being carried out and many others are reclaimed, therefore data evidence of the amount of cracked axles available is highly distorted.

- The detection capability of MPI using the general overhaul process with the open coil technique using the fluorescent ink detection medium on corroded (shot blast cleaned surfaces) is under review, as major defects outside the current validation of 5 mm long x 0.5 mm deep may not be detected by this technique.

- Enhanced sensitivity Eddy Current Inspection using different probes has proven to be far more successful regarding defect detection on lightly corroded surfaces, where the general level of corrosion pitting is not greater than the average 0.3 mm deep and in these circumstances a defect length down to 2 mm long can be readily detected.

DEFECT DETECTION WITHIN CORRODED AXLE BODY SURFACES

- Within the trials that have been carried out for WOLAXIM on two wheelsets with many corroded body areas available, one passenger and one freight type. Eddy Current Inspection, MPI Inspection using both a wrap round coil and yoke and different ink mediums were applied to corrosion patches on the axle body. Also a microscope was used to identify defects in the defective areas. These wheelsets were Eddy Current failures and have not been through any overhaul MPI process.

- Regarding MPI the techniques above only identified 1 in 4 of the defects found by the microscope and nothing less than 5 mm long, but Eddy Current indentified 3 in 4 defects and the microscope defects down to a minute level. The MPI testing was carried out with a yoke and also a wrap round coil and not by the recognised method at overhaul.

- The above situation caused concern regarding MPI particularly when we know that very few body defects are being identified currently on axles at overhaul, with some overhaul sites that we know have not identified body cracks in corrosion by MPI for years, whereas thousands are rejected for minor corrosion every year.

- Therefore I have started to look at different defect types on small cracked sample sections i.e. corrosion and fretting types and the detectability regarding different MPI techniques.

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- The most effective method regarding MPI of corroded surfaces is the yoke with a white background paint applied and the worst is by using the overhaul open coil fluorescent ink technique. More work is required but the shot blasted axle surfaces do also seem to have some impact on the sensitivity of the test. Many cracks were identified in the early days of MPI, but cleaning was usually with non abrasive pads and a lot more yoke testing was carried out.

- The amount of amperage required to detect corrosion cracking is more than double that needed regarding a fretting type crack using the open coil method and indeed the major crack (9mm long x 1 mm deep) in the sample that is shown in the next slides could not be detected even at maximum amperage.

- The current amperages used at wheelset overhaul seem adequate regarding fretting type cracks in non blasted seat areas and a cracked test piece with 5 mm long fretting cracks x 0.5 mm deep works well to the current validation for this type of defect. However regarding a corroded cracked axle sample piece a crack 9 mm long x 1 mm deep could not be detected with this technique even at maximum coil amperage of 3676 amps rms positioned about 100 mm from the coils, but could be identified using a yoke. It must be stressed that each plant and the amperages required must be validated individually.

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- It is my intention to put the two Applied Inspection wheelsets used in the WOLAXIM trials through a production process MPI split coil plant, but I anticipate that few defects will be identified and probably only the major cracked area with a defect 10 mm long x 2 mm deep in the coach axle , as per the following photograph will be detected at best.

- If this is the case or greatly additional amperage is required to identify this defect then the MPI validation when testing corroded axles, regarding the use of open bench or split coils will have to be downgraded accordingly. It is probable regarding MPI defect detection that we will have to treat corrosion cracking and fretting cracking differently.

- Each MPI plant has its own capabilities regarding detection depending on the coil arrangements and we know that much higher amperages are required when using square coils as opposed to round coil arrangements. Water based ink systems can be a constant headache to testing and human factors issues are high regarding MPI Inspection. It is a hard work and soul destroying particularly when operators may not identify defects on a regular basis.

- However if NDT is to be applied on corroded axles with a view in releasing them back in-service then it is highly recommended that Eddy Current Inspection is carried out as the primary technique, as it is a more sensitive and reliable process.

- The use of the microscope shall be available as a confirmatory technique on suspect areas.

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- At this stage the Eddy Current validation feasible on open bodied areas of un-painted lightly corroded shot blasted axles at overhaul, is 2 mm long x 0.3 mm deep. This will be a better detection level than that currently in place on corroded axles and give an additional temporary safety factor when the axles may be released off a light overhaul until they are rectified on a heavy overhaul where there is still life in the wheels.

- A maximum level of generally assessed average corrosion 0.3 mm deep shall apply and test samples shall be available at this level. The noise regarding the corrosion is minimal at this level when using both the enhanced sensitivity Array Probe and confirmatory localised application pencil probe. This alternative equipment including array probes for the T72 transition radii would have to be used rather than the current probes used for the testing of freight axles at overhaul.

- The measurement of individual pit depths cannot be undertaken by Eddy Current and a general level of corrosion shall be assessed prior to testing.

- Where the pencil probe confirms the likelihood of a defect then this shall be further confirmed with the portable microscope, which shall be used a confirmatory tool.

- Any axle with deeper corrosion than the nominated level above, that causes excess trace noise, shall not be considered for the above process and the axle shall be re-claimed or put to scrap.

- Regarding in-service Eddy Current Inspection on painted surfaces the current validation in-line with in the main non-corroded axles of 5 mm long x 0.5 mm deep shall still remain.

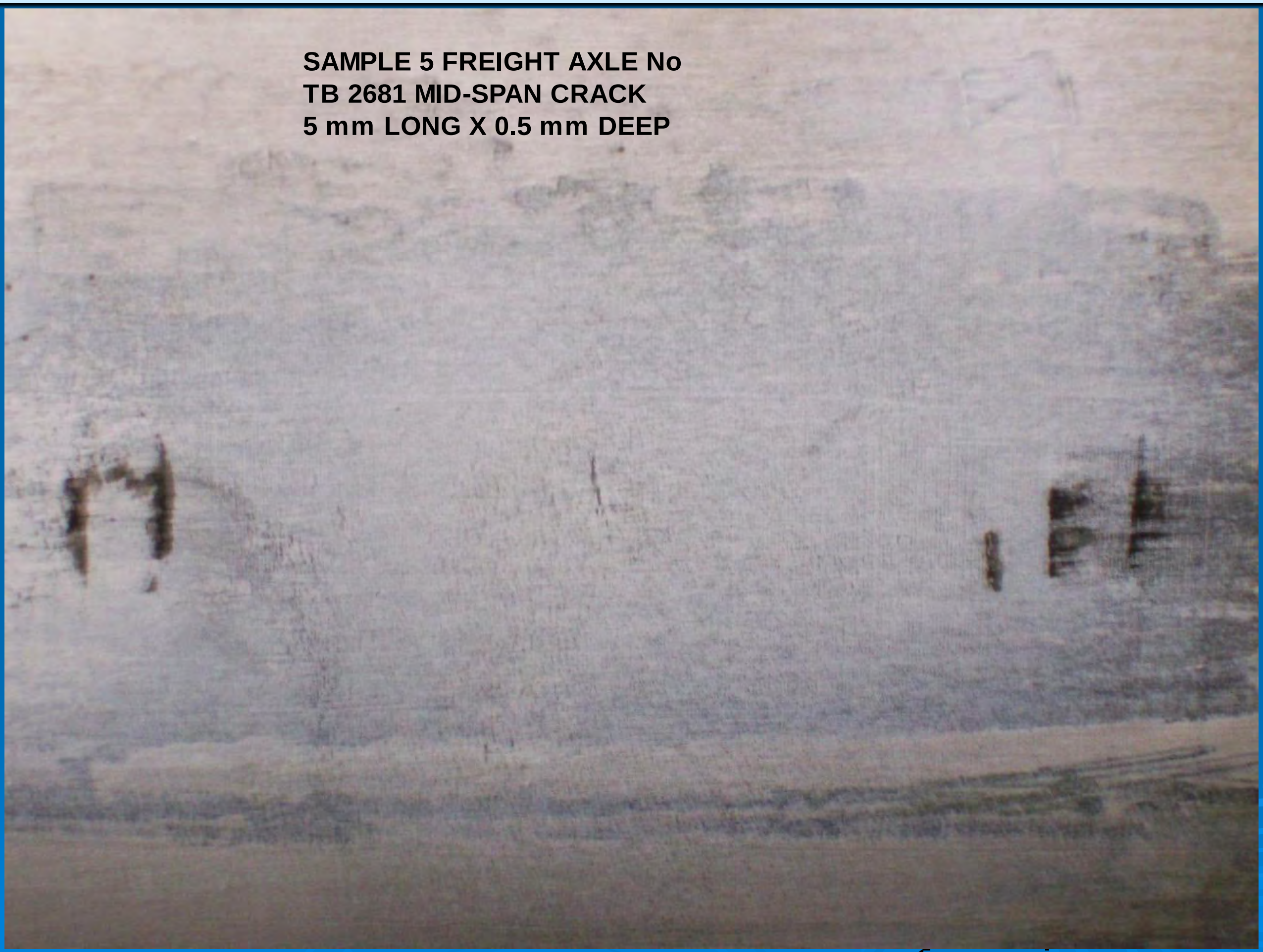
- Regarding testing probes for in-service testing , they may be the same as per overhaul, but the sensitivity shall be reduced because it is not advisable to remove paint whilst the wheelset is under a vehicle, in search of very minute cracks unless the customer requires this. However these probes will identify corrosion pitting under the paint and the customer would have to determine actions in these circumstances.

- However regarding confirmation of defects, in this instance, the paint shall be removed and testing by an alternative eddy current probe, MPI & the portable microscope shall be applicable.

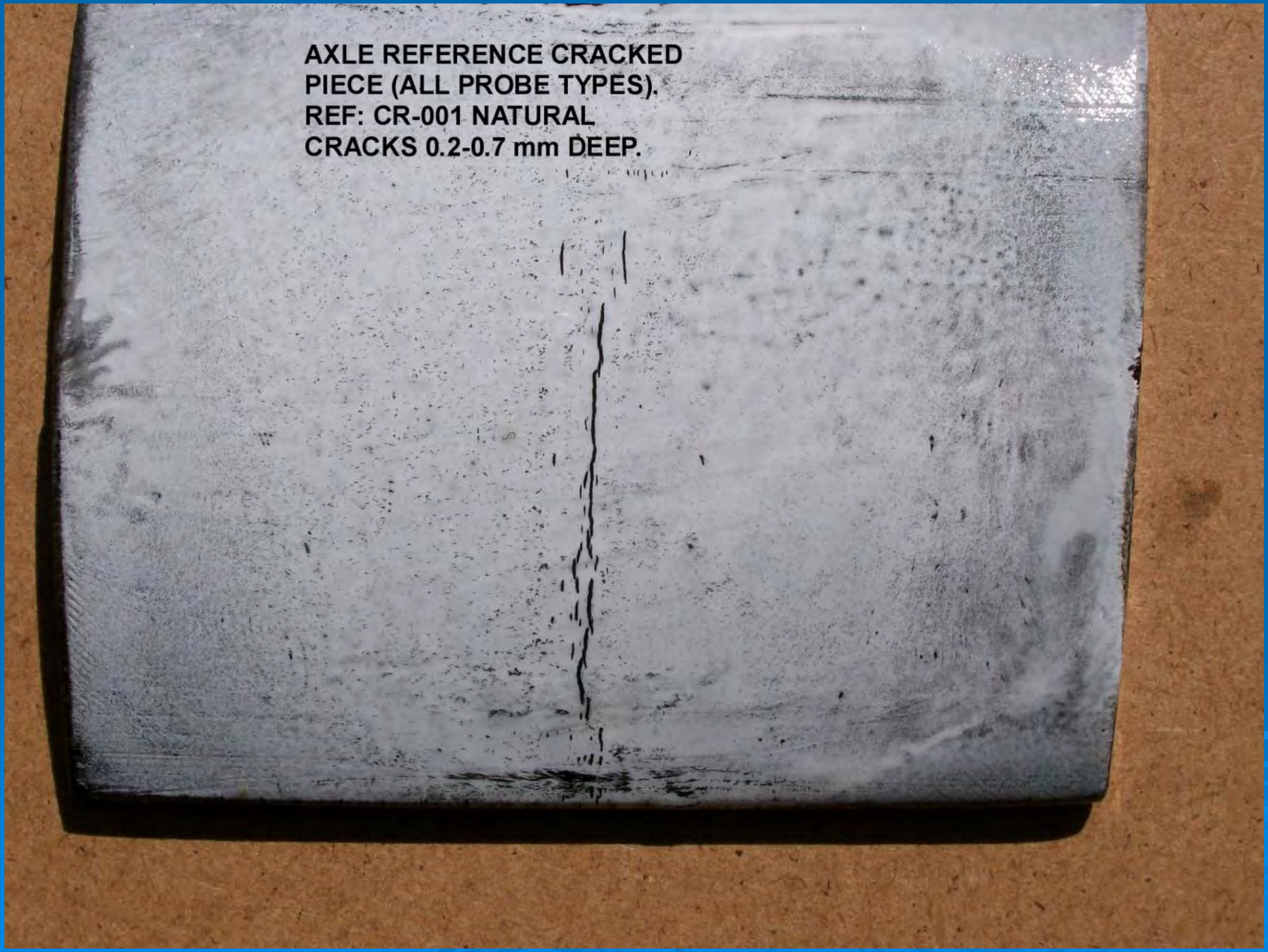
DEFECT DETECTION WITHIN CORRODED AXLE BODY SURFACES (TRIAL WHEELSETS)

DEFECT DETECTION WITHIN CORRODED AXLE BODY SURFACES (COACH WHEELSET TRIAL MAJOR DEFECTS)

DEFECT DETECTION WITHIN CORRODED AXLE BODY SURFACES TRIAL FREIGHT WHEELSET DEFECT

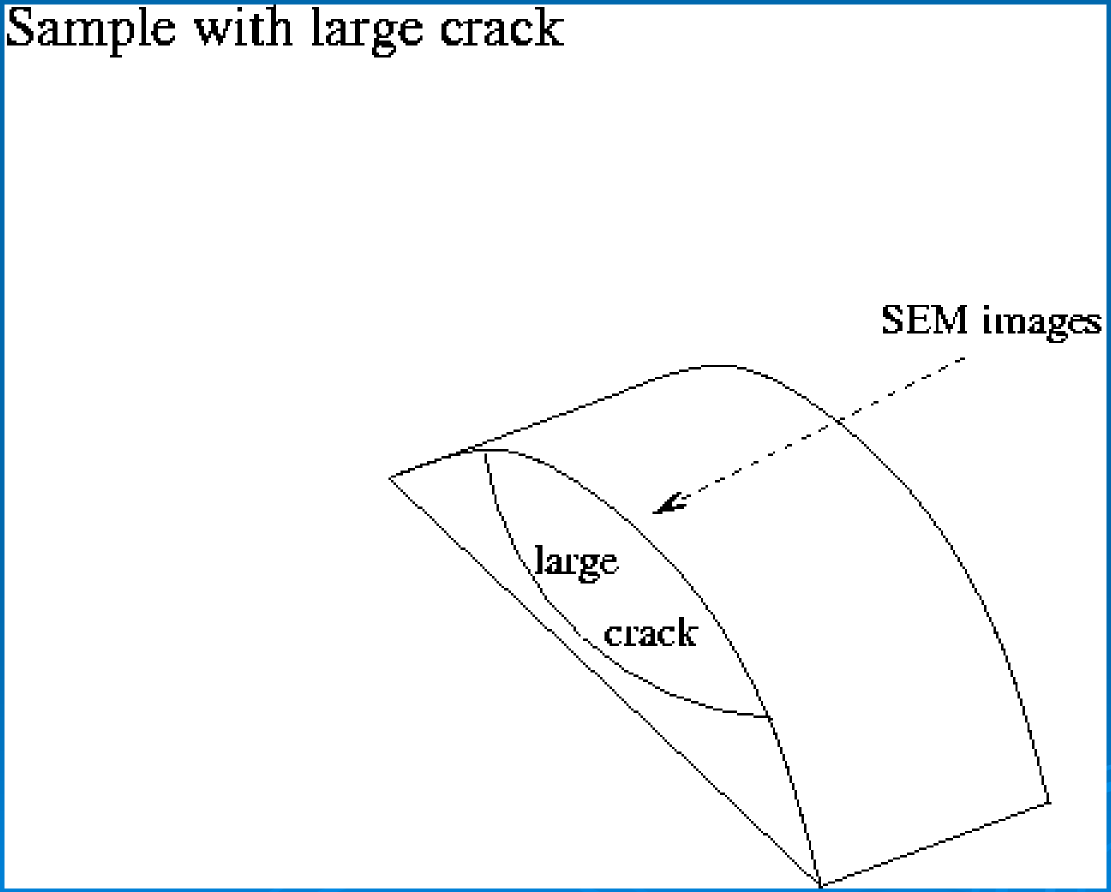


DEFECT DETECTION WITHIN CORRODED AXLE BODY SURFACES (EDDY CURRENT & MPI TEST PIECE FRETTING CRACKS)



DEFECT DETECTION WITHIN CORRODED AXLE BODY SURFACES SECTION SAMPLE OF DEFECTS 0.2 MM DEEP

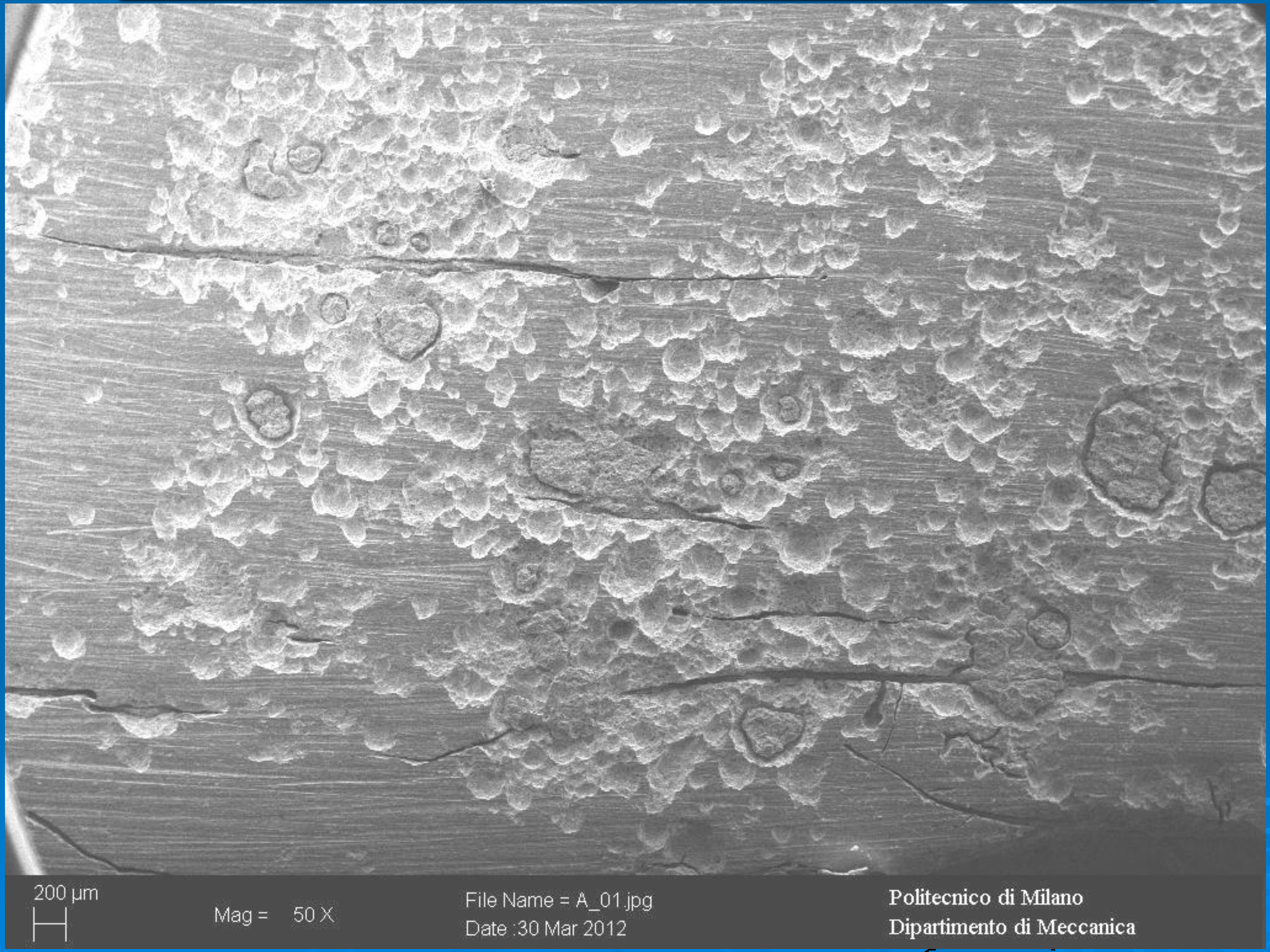
DEFECT DETECTION WITHIN CORRODED AXLE BODY SURFACES



DEFECT DETECTION WITHIN CORRODED AXLE BODY SURFACES

- Large fracture face (mid-span crack)

DEFECT DETECTION WITHIN CORRODED AXLE BODY SURFACES CRACKS MAGNIFIED 50X



DEFECT DETECTION WITHIN CORRODED AXLE BODY SURFACES

CRACKS IDENTIFIED USING A YOKE BUT UNDETECTED WITHIN A COIL ARRANGEMENT USING FLUORESCENT INK

DEFECT DETECTION WITHIN CORRODED AXLE BODY SURFACES

- Eddy current response from potash axle cracks 1.5 mm deep & severe surface corrosion noise and crack
- 0.3 mm deep) on very lightly corroded surface