COMPOSITE REPAIRS AND SEAM-WELD CRACKS

With the development of more accurate in-line inspection tools, the pipeline industry has started to discover a large number of potential defects associated with the pipe's seam weld. Many of these cases are associated with manufacturing defects and are unlikely to pose a threat to operations. However, when they are identified, the conservative approach has been to replace the defected section of pipe or weld a steel sleeve over it as a permanent repair. In many cases, these options provide a large cost burden for a defect with no history of growth or near-term threat. With increasing testing and design capabilities, composite repairs can successfully help remediate the issue and provide owners / operators an additional, reliable tool in crack repair.

TEST HISTORY

In 2015, the Atlas™ composite repair system was thoroughly tested on seam weld cracks of 33% and 75% depth. This program, with PHMSA's involvement, led to the repair of numerous permanent repairs on an Ethylene line with low crack depths – close to the 33% depth tested. This line could not be easily welded on nor de-pressurized without incurring a major expense, but with the use of the Atlas system, conservative repairs were made on the live line with minimal expense. Further testing was performed on the Atlas system in a joint industry project examining cracks of 15% and 50% depth. Again, the results here showed tremendous success in not only burst pressure restoration but also demonstrated the composite's ability to greatly reduce a crack's propagation rate – essentially increase the cyclic life of the pipe.

Beyond just demonstrating pass/fail scenarios, CSNRI has gone even further and developed a predictive tool utilizing classical fracture mechanics and composite theory to determine the remaining capability of a repaired crack defect. A third major test program provided an ideal scenario to test the prediction of this program to actual results. Before testing the pipe samples, material properties such as fracture toughness were determined. After testing and comparing nearly 60 pipe samples in both burst and cyclic failures, this tool has been shown to be very conservative in its assumptions. Now composite repairs can be installed on crack-like seam weld defects with more confidence than ever knowing that a tested fracture mechanics model supports the engineering design.

LIMITATIONS

Having already proven that they can work on crack and crack-like features, there are still many situations where a composite should only be considered as a temporary repair. Current recommendations are that any cracks exceeding 50% penetration or experiencing extreme cycling should only be treated as temporary. A temporary composite repair in this case generally means that a longer-term solution, such as pipe replacement, will be done at a more convenient time. These temporary repairs can be designed to prevent near-term burst and will slow the propagation rate of any cracks experiencing cyclic conditions. Additionally, in the event that a crack does fail under the repair, the mode of failure changes to a lower-risk leak.

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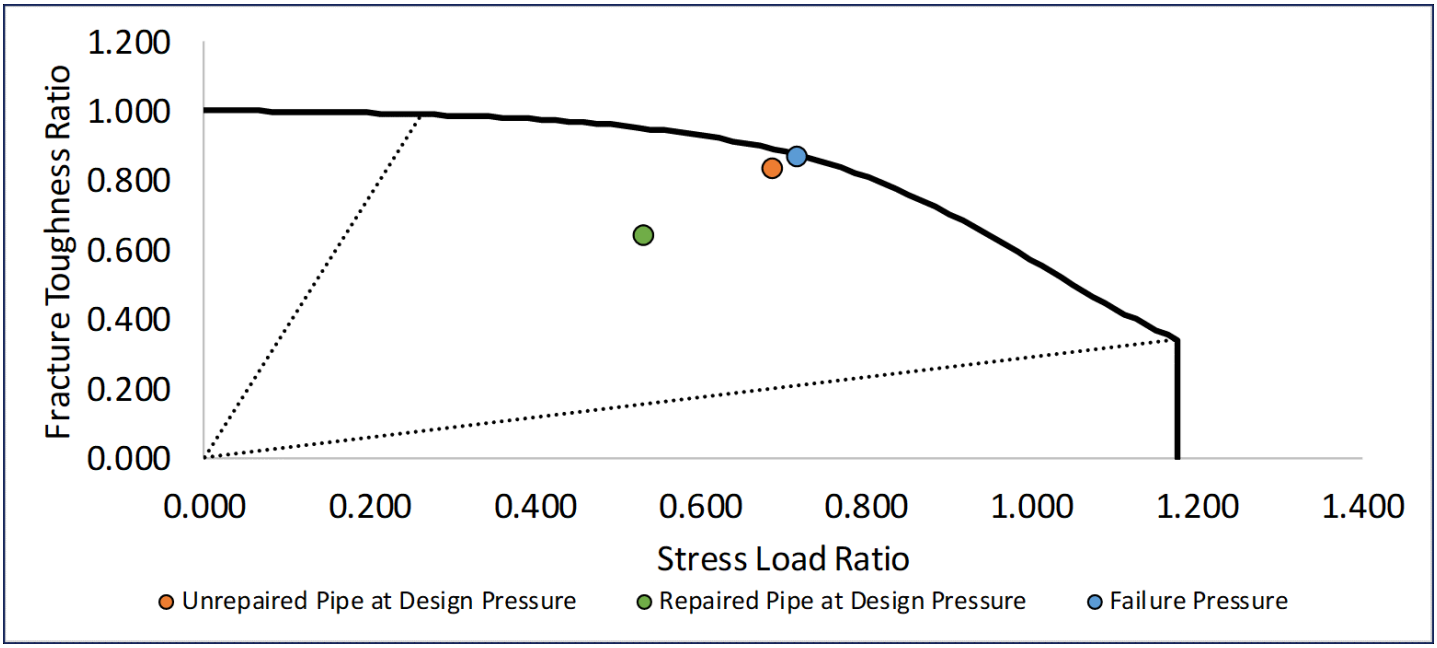
On the other hand, permanent repairs can be installed and supported with documentation in cases with generally low penetration and reasonable cycling conditions. The crack or crack-like feature can then be monitored with standard maintenance and inspection programs to show that an acceptable growth rate, or none, is present.

The Atlas composite repair system is comprised of a bi-directional carbon fiber system and high-strength epoxy resin. Field saturated and applied, this system contours extremely well around any seam or girth welds when combined with high strength load transfer filler helping minimize the strain at the crack tip. Current testing has also shown that excessive reduction in install pressure is not needed although further testing on this matter is on-going. One major benefit of this composite repair system is the elimination of hot-work. Not only does this create a safer repair environment, it eliminates the need to purge Ethylene lines or maintain strict temperature limits during the repair. While it has proven highly capable in repairing cracks as has been discussed here, it also excels in repairing many other defect types such as dents, wrinkle bends, and of course, corrosion defects. For more information on how composite repairs, backed with strong engineering and supported by testing, can help with your crack or crack-like defects, please contact sales@cs-nri.com.



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