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Pipe Repair: Why Replace When You Can Fix In Place?

By Glenn Machado

With production time and cash flow at an all time premium, more and more companies are looking for time- and cost-saving alternatives to replacing slightly damaged assets. In refineries, to cite an example, it is common to find leaks in carbon steel pipes. At first, this may seem like a simple repair, which would normally be fixed by cutting the old leaking section of the pipe and welding in a new section. The majority of the time though, it is not that straightforward. Chances are that the leaking pipe is located 60 feet above the ground on a pipe rack, next to another pipe through which steam flows at 300°F. Besides, creating logistical issues, the leaking pipe is also responsible for supplying water or another fluid to an important part of the plant. If this fluid supply were to be shut down, it could cost the refinery an average of $10,000 per minute in lost production.

Luckily, years of hard work have led to the development of an engineered system which represents a compliant, in situ, cold-curing alternative to traditional cut and weld hot work. This system is a qualified composite repair that restores strength to weakened or holed metallic substrates. Composite pipe repairs are mainly comprised of an epoxy material combined with some type of reinforcement mesh. The epoxy is responsible for the adhesion and sealing of the repair to the substrate, while the reinforcement mesh compresses the epoxy on and around the damaged area. When combined, such a repair can withstand pressure and temperature levels greater than 3,600 psi and 220°F, respectively.

To handle such repairs, the composite repair system's manufacturer must follow one of the compliant standards for composite pipe repairs. The most recognized standard is the ISO/TS 24817 "Petroleum, petrochemical and natural gas industries: Composite repairs for pipe work, qualification and design, installation, testing, and

inspection." This, and similar standards, ensure that all repairs are fit for purpose, completed by a certified Applicator and Designer, performed on a sound and repairable substrate, and are properly supervised and documented. The following steps will help ensure a successful in situ repair:

Repair Execution By A Certified Applicator And Designer

The repair of metallic substrates using a composite repair engineered system differs significantly from other repair procedures, and the quality of the installation depends on competent workmanship. Therefore, the manufacturer of a compliant repair solution must ensure that the applicators and designers making the repairs are properly trained and credentialed. The applicators must complete a standardized test specimen, which shall be subject to a pressure test and achieve a release pressure within a limit specified by the manufacturer. The designer must undertake a series of lectures and successfully pass a standardized exam. Upon fruitful completion, both the applicator and designer shall be issued a certificate providing details of the validation achieved. It is paramount that these steps are followed to guarantee that the repair is executed with the utmost care and precision.

Performance On A Sound And Repairable Substrate

As per composite repair standards, not all substrates are eligible for this type of repair. The substrate must have enough steel to be structurally sound. If the underlying pipe is far too weak to handle the repair, the application does not pass the requirements of the standard; thus, not allowing the application to commence. This is one of the first hold points that a certified designer must ascertain before any calculations are even made. (See Figure 2.)

Application Does Not Exceed The Limits Of The Materials

All materials have a mechanical limit or a common mode of failure and interact differently with the service environment. That is why the next step in the design process is to ensure the application is fit for purpose. The customer is responsible for submitting all the required information and environmental considerations prior to the design of the repair work. Once all this information is collected and reviewed, the substrate is established as repairable. The designer must scrutinize the potential application to verify that it does not exceed the material's mechanical limits specified by the manufacturer. The working pressure and temperature levels must be within the designed limits of the material for the application to proceed.

Recording And Documenting Application

Once all the design criteria are met, the application can commence. The applicator shall abide by the design and

the manufacturer's specification. A supervisor shall be present during the installation to record and document all the application. It is the composite repair manufacturer's responsibility to ensure that the supervisor is trained and possesses the means to properly document the application from start to finish. The supervisor shall take a series of lectures and a standardized exam. Upon successful completion, the supervisor shall be issued a certificate describing the validation achieved.

The supervisor shall ensure that the following items are properly documented:

1. Surface Preparation Records: This is the single most important operation in the achievement of a successful repair. The correct surface profile must be achieved by using media blasting equipment. The time period between the completion of the surface preparation and the application of the composite repair shall be no longer than four hours. The temperature of the substrate, humidity, and dew point shall be recorded as well.
2. Composite Repair Design Records: The most important part of the design is the required repair thickness and axial extent. These two values are calculated based on the working pressure of the substrate and the size of the defect being repaired, among other considerations. The supervisor shall record these two values once the application is complete. The cure procedure must be also documented.
3. Material Records: Details of the repair system used, type and quantity, and batch number of the materials shall be documented by the supervisor.
4. Quality Control Records: Upon completion, the repair shall be permanently marked with its reference number. A visual inspection report shall be completed, and Non Destructive Test results shall be added, if carried out. If an independent inspection party is summoned to the application site, a test report shall be included in the application record file.
5. Service Inspection Records: The application shall be revisited within a time frame specified by the parties involved in the application, and a service inspection report shall be completed. Most important is the fact that the repair must be inspected at the end of the intended lifetime. At that point, the owner shall either remove or revalidate the composite repair system.

Conclusion

A certified composite repair differs considerably from a regular repair wrap system. The compliant repair takes the extra steps by engineering a complete solution, which restores strength to weakened or holed metallic substrates. A certified composite pipe repair is a tremendous tool that all major refineries and industries in general should have in their arsenal. This solution allows for the defective asset to be repaired correctly without the need for cutting and welding. These types of certified user-friendly repairs may be the answer when a costly emergency arrives.

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