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Evolution Of Reinforced Resin Composite Repairs For Pipelines

Innovative and quality products for reinforced resin composite pipeline repairs are evolving and available to the pipeline industry. An example of this innovation is the Carbon-Ply Composite Repair System developed by Cross Link Composites LLC. It is unusual in that both the installation method and the resin system qualify for patent protection.

The Carbon-Ply Epoxy Sleeve Repair (ESR) System is a non-metallic, cross linking, monolithic, high-performance, carbon fiber composite repair system developed to repair damaged or corroded pipelines in both high and low risk pipe and pipe work applications. It is a true monolithic cross-linking composite that offers the operator a permanent repair of a pipe that can return to full service within three hours of starting the installation process.

This patent-pending system is designed to repair non-leaking pipe (Type A repair) with up to 70 percent external pipe wall loss due to damage or corrosion. The Carbon-Ply ESR system is comprised of Carbon-Ply DFRE (Defect Filling Repair Epoxy), Carbon-Ply ESR Primer, high modulus carbon fiber and Carbon-Ply ESR Resin.

When pipeline operators look for a repair technology they want a product that will work for their application and resolve problems that are common to pipeline operations. Informed operators do not want repair products that only solve some of the problems or may be the cause of new problems. A technology such as welding a repair product on a pipeline can set up stress or corrosion cells that can accelerate corrosion. These older approaches to pipe repair require a high degree of skill and inspection to limit future corrosion from occurring.

Continuing corrosion concerns have motivated piping operators to steadily adopt the use of reinforced resin composites for Type-A repairs of pipeline defects such as wall loss, corrosion, gouges or dents. Composite pipeline repairs have been available in the market-place for over15 years.

Operator needs

Pipeline operator's are generally interested in repair products that can meet all of their requirements for the total pipeline repair. The criteria of needs goes beyond just a spot repair or reinforcement of a weakened area found on a section of pipe. Issues typically addressed by the operator, when selecting a repair product or method typically include, performance, ease of installation, installer's safety, high temperature applications, high modulus, preventing future corrosion, pressure cycling, excavation size, labor required, impact resistance, return to full service time, UV resistance, training requirements, special equipment needs and no noxious odors or environmental impact. Few repair systems satisfactorily address all of these needs.

The ESR system was developed specifically to provide a comprehensive solution for a fast composite monolithic pipeline repair. Some key aspects include:

- Cross-Link Composites has developed a carbon fiber technology with new special surface treatments that rapidly promote wetting the carbon fiber;
- The Carbon-Ply resins have very low surface tension which, in combination with the carbon fiber surface treatment, allows for rapid wet out of the composite fiber;
- The Carbon-Ply ESR Resin elevates in temperature during its exothermic reaction as it cures. During the elevated temperatures, the viscosity drops significantly, causing a rapid wet out of the carbon fiber and a high temperature cure;
- The combination of the extraordinary wet-out and the high temperature curing results in a high-quality permanent reinforced resin composite pipeline repair with a high operating temperature limit;
- The system is a truly monolithic repair system that is stronger than the MAOP of the pipe, is easy and quick to install and has a high operating temperature; and
- The system will permanently repair external pipeline damage such as dents, gouges, fretting, wear and external corrosion, restoring its full structural integrity and preventing further deterioration.

Variations of the CARBON-PLY ESR System can be applied to curved pipe and to all pipe fittings. The heat distortion temperature of the composite repair is greater than 400 degress F when tested according to ASTM D-6604.

For internal pipe repair, the ESR should be considered as a temporary repair unless the operator can be positively assured that the internal corrosion process has been stopped. Internal pipe repair against corrosion

System advantages

Advantages to the system include:

- Typically only a small excavation is required;
- Fast curing usually in three hours;
- No heavy equipment needed;
- UV resistant for above ground applications;
- No welding required;
- Impact resistant;
- Can be installed while pipe remains pressurized;
- Light weight;
- High operating temperature;
- Will not corrode;
- Requires minimal training;
- No noxious odors;
- Minimal cleanup needed;
- High modulus repair;
- Easy to install dry-wrap method; and
- Monolithic, cross-linked reinforced resin composite repair.

Pipeline preparation includes:

- Grit blasting the defective area;
- Application of a Carbon-Ply Defect Filling Repair Epoxy (DFRE);
- Application of a Carbon-Ply ESR Primer;
- Wrapping the affected area with high modulus carbon fiber cloth; and
- Pressure laminating the cloth with Carbon-Ply ESR Resin using a unique, patented installation procedure.

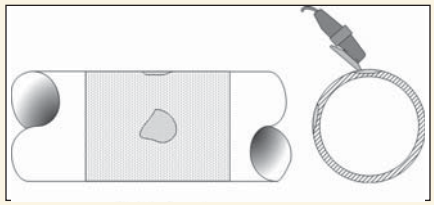
Installation

Installation of the Carbon-Ply ESR System is straightforward:

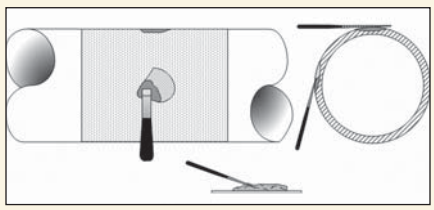
1) Pre-repair conditioning – The system can be installed on pressurized pipe. As a safety precaution, it is recommended that the pressure is reduced by 20 percent or more prior to installation. If buried, the excavation must result in a working clearance of at least 3 feet on the sides and one foot under the pipe;

Pipe surface preparation – All burrs,

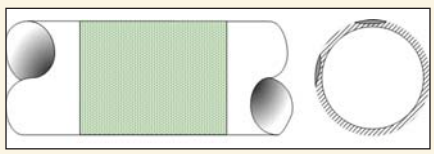
sharp corners and other stress-concentrating defects are removed, leaving smooth contours on any damaged areas. The defective area is grit blasted to a white metal finish in preparation for application of the laminate and epoxy;



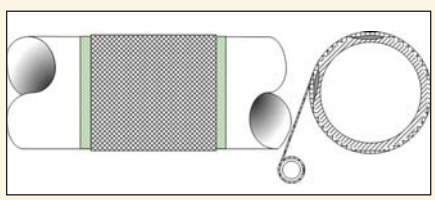
2) Filler application –The Defect Filling Repair Epoxy (DFRE) is mixed and applied to the damaged areas of the pipe so that it is even with the surrounding surface of the pipe;



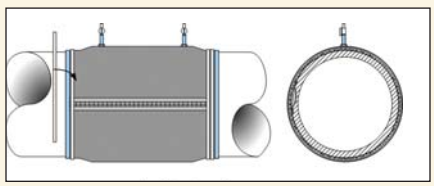
3) Prime repair area – Green in color, the ESR Primer is worked into the surface to maximize the bond strength between the pipe and the Carbon-Ply ESR Resin;



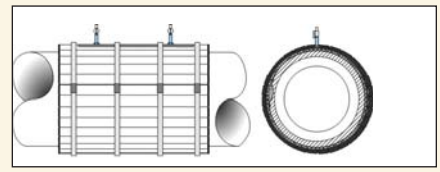
4) Carbon fiber wrap – The carbon fiber cloth is wrapped hand-tight around the pipe and centered over the area to be repaired;



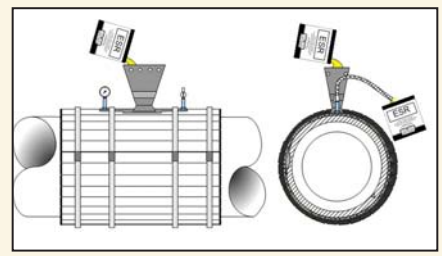
5) Containment system installation – The patented containment system provided by Cross-Link Composites is installed over the carbon fiber cloth;



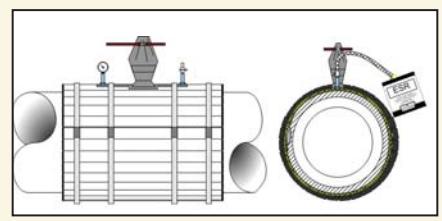
6) Tambour system installation– The tambour system, a specially designed flexible jacket, is installed and used to control the installed resin thickness;



7) Mixing and installing the resin and hardener – the mixing of the resin and hardener must be timed so that all of the required epoxy is poured into the specially designed containment system within ten minutes.



8) Pressurizing the containment system – The fiberglass rod is threaded through the holes in the containment system funnel. The rod is twisted around clockwise to compress the funnel from the top down to pressurize the resin. The twisting is continued until the gauge on the containment system reads around 9 psi. The resin/hardener will heat up to about 350 degrees F as it cures over a period of 30 - 60 minutes. During this cure the pressure may increase to 15 psi. The repair should not be until it has cooled to 130 degrees F; and



9) Inspect and test the repair – The ESR is inspected and any defects noted. Dry areas may be repaired by abrading and cleaning the affected areas, then mixing and applying DFRE to fill the affected areas. The Carbon-Ply Epoxy Sleeve Repair (ESR) wrap can now be buried.

FOR MORE INFORMATION:
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