



PREVENTING CORROSION WITH IMPROVED COATINGS

**Dr. Martin Molberg,
DENSO GmbH,
Germany, introduces
an effective corrosion
protection system
for buried steel
pipelines in HDD.**

Trenchless installation creates a specific set of requirements for corrosion prevention. It is essential that the protection system is flexible for an easy absorption of pipeline movement, especially during the drilling process. The system must also have an exceptionally high abrasion and shear strength. DENSOLID®-HDD, an innovative polyurethane (PUR) coating, is designed for trenchless pipelaying by horizontal directional drilling (HDD).

Pipeline sections of up to 3000 m and with diameters of up to 60 in. can be laid using trenchless methods. Over 7500 km of pipelines are laid using these trenchless technologies worldwide, each year. Trenchless construction includes tunnelling, micro-tunnelling, pipe ramming, pipe jacking, pipe boring and HDD.

Steel pipes are protected against corrosion and mechanical impact by using a factory (mill) coating. However, some parts of a pipeline, such as welded joints, have to be coated on the construction site. The range of field joint coatings for trenchless pipelaying, which resist high mechanical stresses while also showing a remarkable flexibility, is limited. Field joint

coating for conventional pipelaying methods, such as tape systems or heat shrinkable sleeves, would fail under these severe conditions without reinforcement. The field coating for trenchless pipelaying must withstand enormous abrasion forces and high shear forces compared to coatings laid in an open trench.

Operators and contractors focus on security, reliability and ease of application for field joint coatings that are used at HDD projects. Application faults or inappropriate material selection can cause tremendous damage, high costs and project delays. Moreover, coating systems for HDD projects tend to be applied, in relation to the conditions at each specific construction site.

Glass fibre reinforced plastics (GRP systems) based on epoxy resins show advanced mechanical properties. However, the application of these GRP systems has proven to be problematic as they have to be executed in several layers and working processes, which either caused many application faults on the site or resulted in an execution by specially trained service companies.

Another important aspect is the geometry of the applied field joint coating. Only field joint coatings in line with the factory coating (Figure 1) propose a high security field joint coating.

The aim is to achieve an equal technical performance level to the factory coating, but by the field joint coating. This will, in turn, provide an unbroken chain of quality and security – a requirement that is not fulfilled by reinforced heat shrinkable sleeves, which are also in use for trenchless measurements.

Therefore, field joint coatings for trenchless pipelaying methods should be used in line with the adjacent factory (mill) coating to provide optimal sliding friction. Besides this optimal sliding friction, coatings should also provide



Figure 1. Field joint coating on top of the factory coating (left) and inline with factory coating (right).



Figure 2. Application of DENSOLID-HDD with the two chambers cartridge.

extremely hard and flexible properties, characterised by high abrasion and shear resistance. For the field joint coating, a PUR resin-based system is to be preferred since the mechanical properties of a (polyamide) factory coating and the PUR coatings without reinforcement coated field joint coating will show the same high level technical performance. The PUR coating is applied by casting, injecting or spraying onto the prior grit blasted and cleaned steel surface.

While providing a high technical performance level onsite by the field coatings, the ease of onsite applicability has to be considered too. This, alongside reducing the risk of human mistakes and a providing a high standard of corrosive and mechanical protection, is a key characteristic for field coatings. DENSO GmbH Germany offers an improved system for the field coating of welded joint areas of steel pipes with PUR reactive resins, DENSOLID-HDD.

The DENSO solution

DENSOLID-HDD is a two component PUR coating for permanent corrosion prevention of field joints at pipes for trenchless installation processes. The material features a high hardness and abrasion resistance, good stretchability and bending strength. Therefore, this PUR compound is qualified for the coating of welding seams at pipes and pipelines that are installed using the HDD or the pipe plow method.

DENSOLID-HDD requires a one step application. The two components of the material are provided in two chamber cartridges so that there is no need for manual stirring of components. This ensures the correct mixing ratio of the components and enables a fast working progress.

DENSOLID-HDD is easily applied by a special application process, guaranteeing high quality coating. Before the application, a casing of transparent polypropylene (PP) is installed above the cut back area and overlapping on the mill coating. The PP casing is perforated with a driller to get openings in which DENSOLID-HDD is injected (Figure 2). The drilling holes in the casing are subsequently closed by adhesive labels.

The casing can be removed as soon as the PUR compound is tack free, approximately after 2 hrs 30 mins at 20°C. The average application time per joint is around 20 - 30 mins. The pipe can be pulled-in 24 hrs after the installation of the coating. During the curing process, the coating material will be protected from the influence of water, contamination, moisture, impact and other negative effects due to the applied casing.

In comparison to reinforced heat shrinkable sleeves and glass fibre reinforced materials (which must be applied in several layers), DENSOLID-HDD, as an one single layer application, will be applied in half the time.

One of the greatest advantages of the DENSOLID-HDD coating is its thickness. As the thickness of the product coating corresponds to the thickness of the factory (mill) coating, no shearing will occur. In addition, it can be used for operating temperatures of up to 80°C (176°F) and

is compatible with factory coatings made of PE, PP, PUR, PA and EP with GRP reinforcement. An equal and smooth surface will be achieved in the requested thickness, even above the welding bead.

Case studies

In 2013, in the region of Krasnodar (Russia), part of the pipeline extension of the unified gas supply system (UGGS) for gas supply to the South Stream gas pipeline had to be buried in a trenchless system. The welding seams of the pipe, with a diameter of 1400 mm (56 in.), were successfully coated with DENSOLID-HDD in a thickness of 8 - 12 mm.

Additionally, in 2015, an Israel Natural Gas Lines (INGL) gas pipeline had to be buried from Hagit to Vad Hanna. The pipeline had a diameter of 900 cm (36 in.) and was 68 km in length. During construction, DENSOLID-HDD was successfully applied under temperatures of 35°C - 40°C (95°F - 104°F).

Conclusion

DENSOLID-HDD allows for effective corrosion prevention with great mechanical protection. It withstands the impact (severe shear, abrasion and bending stresses) on construction materials used in trenchless pipelaying.

Advantages of DENSOLID-HDD include usage at operating temperatures up to 80°C (176°F) and alignment of the thickness of the field joint to the factory coating, within



Figure 3. A pipeline with welding areas protected by DENSOLID-HDD.

one working step. Additionally, easy application with tailored cartridges enables construction staff to execute drilling jobs in a quick and secure way.

Compared to glass fibre compounds and reinforced heat shrinkable sleeves, the application time is reduced by at least 40%, such that a great overall cost reduction is achieved. Denso offers an effective solution for protecting pipelines from corrosion and other parts that are installed using HDD. 