Langzeiterfahrungen mit Nachumhüllungssystemen für Schweißnähte

Michael Schad

Die vorrangige Aufgabe des passiven Korrosionsschutzes ist der Schutz von Stahlrohrleitungen vor Korrosion durch eine Ummantelung oder Umhüllung.

Nach einer zweijährigen Untersuchung der NACE (Vereinigung der Korrosionsschutzingenieure in den USA) aus dem Jahre 2002 verliert die US Wirtschaft jedes Jahr Bausubstanz im Wert von mehr als 276 Milliarden Dollar durch Korrosionsschäden. Diese Zahl soll sich im vergangenen Jahrzehnt noch deutlich erhöht haben. Weltweit geht man derzeit von einem Verlust von mehr als 1 Billion Dollar pro Jahr an Korrosionsschäden aus. Eine neue weltweite Studie wird im Jahre 2014 erwartet. Davon betroffen sind auch unterirdisch verlegte Stahlrohrleitungen. Deshalb muß ein vorrangiges Ziel sein, diese Leitungen bestmöglich gegen Korrosion und mechanische Beschädigungen zu schützen. Nach den Schäden durch den Einfluss Dritter wie Baggerschäden o.ä, stellen Korrosionsschäden die zweithäufigste Schadensursache dar.
In diesem Beitrag werden die aktuellen Anforderungen an Werkstoffe für Nachumhüllungen für Schweißnähte im Überblick vorgestellt.

Der Fokus des Beitrages liegt dabei auf den gemachten Langzeiterfahrung mit Nachumhüllungssystemen. Diese werden durch eine E.ON Ruhrgas Untersuchung aus dem Jahre 2008 sowie den Erfahrungen aus den Aufgrabungen der ESB Leitung „Isarschiene“ nach über 27 Jahren Betriebsdauer und einer aktuellen Untersuchung eines Nachumhüllungssystems nach 20 jähriger Betriebsdauer auf der STEGAL Pipeline der Wingas/Gascade Transport GmbH im Jahre 2012 dokumentiert.

Advanced technology for 3-ply tape coating systems and long term experiences

Michael Schad

Corrosion protective systems- e.g. tapes, shrink sleeves and liquid coatings (polyurethane and epoxy) have been used for decades on all types and sizes of buried pipelines.

Technical properties of corrosion protective coatings are described in national and international standards-like ASTM standards and DIN EN guidelines.

Buried steel pipes for the transport of liquid and gaseous media are protected against corrosion by coating with thermoplastic material or thermosetting compounds. While coating of the pipe is made in the factory, some parts of a pipeline remain that have to be coated on the construction site.
Depending on pipe laying method employed, trenchless or in open trench, only welded joints or also bends, valves, T-pieces and flanges have to be protected in the field.

The ideal is to achieve an equal technical performance level of standard factory coatings and field coatings thus providing an unbroken chain of quality and security. In fact the resistance for load stresses and peel forces of three layered PE-or PP factory coatings exceeds the performance level of standard field coatings by far.

The different performance level originates from the general demand for easy on site applicability, which makes it necessary to accept lower level of mechanical strength in case of field applied tapes and shrink sleeves.

State of the art three-ply- self-amalgamating plastics tape coatings and 3-ply shrink sleeves have proven their high technical quality on innumerable sites worldwide during the last twenty five years. In case of changing weather conditions, or in cold or windy climate tape coating systems have to be preferred due to their wide range of application from – 40° to + 60 °C .
The highest requirements of EN 12068 class C50 can only be met by heat shrinkable materials and the combination of 3-ply (inner wrap)/2ply (outer wrap) tape systems or 3-ply/3ply systems in which

the corrosion prevention tape (inner wrap) has self amalgamating properties, which will protect for decades the integrity of the pipeline during its entire operation time. For rehabilitation purposes heat shrinkable materials are not suitable as they can only be applied on defined spaces only. 3-ply tape-systems will meet the requirements for rehabilitation and new construction purposes in an excellent way.

The structure of these 3-ply tapes contains a carrier film of stabilised polyethylene, which is coated with a butyl rubber adhesive on both sides. Carrier films of co-extruded 3-ply tapes are manufactured with intermediate adhesive layers, ensuring that no clearly defined interface remains between carrier film and adhesive layer. When 3-ply tapes are wrapped spirally around a pipe, the adhesive layers self-amalgamate in the overlapping areas, forming a homogenous sleeve type coating without any remaining interface. The outstanding feature of butyl rubber is its ability to self-amalgamate in these overlapping areas, resulting in a completely sealed, impermeable and sleeve-type coating.

Incompletely sealed tape overlaps inevitably lead to spiral corrosion followed by complete undermining corrosion. This effect is often shown if a 2-ply tape (PE/PVC carrier with one adhesive side) is used for the corrosion prevention (as inner wrap). Most of the very few cases of bad experience with tape coatings are due to the fact that only a 2-ply tape was used as corrosion prevention tape (inner wrap), which shows no sealing coating. When a 3-ply tape is used as inner wrap for corrosion prevention, damages will never occur.

Therefore as a minimum requirement the inner wrap tape or corrosion prevention tape (i.e. DENSOLEN Tape AS39P) should always have a 3-ply structure with butyl rubber adhesive layer on both sides of a PE carrier-film.

Whenever possible, a field coating with properties close to the performance level of the existing pipeline should be chosen. Therefore a stress-class EN 12068 C50 system should always be used as the higher peel strength and intendation resistance will ensure a higher safety level compared to other tape systems or visco-elastic tapes.

Based on the 4-layer structure (2 tapes wrapped with each 50% overlap), the structure will not loose its inner strength if the damage will get through the first layers based on the self amalgamating

properties of the butyl rubber which is during the application more or less liquid.

For these kind of above mentioned tapes proven track records from operators and manufacturers for more than 35 years are available.

In autumn of 2003 segments of a 27 year old pipeline, running from Moosburg to Straubing/Germany had to be excavated for bypassing. This offered the unique opportunity for assessment of the mill coating and field joint coating performance. The field joints of the polyethylene factory coated pipeline had been wrapped with four layers of real co-extruded self-amalgamating three-ply DENSOLEN® tapes in 1976. At the time of construction of the pipeline in 1976 this four layer coating system was in accordance with the DVGW-leaflet GW7, which was the valid technical specification
for field coatings at that time. When excavated in 2003 all field joint coatings applied in 1976 showed no failure of the coating system and the steel surface presented itself like new. This is by far the best reference for a coating system – more than 27 years in operation without any mechanical or corrosive impact. Although today's corrosion protection standards and stress-classes had been further developed since 1976, this co-extruded self-amalgamating 3-ply tape-system developed in 1976 would even fulfil today's requirements of stress-class C50 – more than 35 years later.

In November 2012 Wingas/Gascade, a subsidiary of Wintershall and Gazprom, excavated two pipe sections at the STEGAL transit pipeline which was laid in a diameter of DN 1200 in the year 1992. After 20 years of operation the joints were still in an excellent shape and exceeded the requested values of the guideline EN 12068 Class C 50 by far.

In 2011 Intergas in Kazakhstan made a rehabilitation test series for the rehabilitation material which should be used for the rehabilitation of their pipeline system.
The application of the 3-ply tapes were made in January 2011 at -30℃. A pipe section of 10 m was wrapped with 3-ply tapes and excavated and tested in August 2012. The whole joint sections proved to be in an excellent stage and showed peeling strength values of more than 70 N measured at 35 ℃ ambient temperature which is a brilliant result.

In 2012 Sasol South Africa decided to use 3-ply tape for the rehabilitation of their major pipelines as its test series revealed that these systems provided the best performance regarding application on site and technical values compared to FBE or other spray coating systems or visco-elastic tapes.

It pays off to specify a high quality coating system and to choose the appropriate system for the unique project requirements on site. It has to be taken into consideration while figuring up the costs for a project , that the percentage for joint coating on a new construction is around 0,03% of the total project costs only, but not choosing the best suited coating system can originate indirect loss and high consequential damages.

Appropriate high quality coating systems will offer a durable and high performing solution in preserving pipeline values for decades to come.

The real co-extruded 3-ply tape technology is easy to apply, has a successful track record for more than 35 years, shows high technical features at an economical interesting pricing with the DENSOLEN AS39P/R20HT-Tape System, which is EN 12068 C50 certified or the DENSOLEN AS 50 /R 20 HT which offers a maximum mechanical protection combined with an outstanding tape flexibility. The systems are compatible with mill coatings based on PE, PP, FBE,PU,CTE and Bitumen.

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