New Field-Applied Anti-Corrosion System for Pipelines with Moist Surfaces“

Dr. Thomas Löffler, Michael Schad
DENSO GmbH, Leverkusen, Germany
e-mail: loeffler@denso.de, schad@denso.de

ABSTRACT

One of the biggest challenges for field applied coating systems are pipelines which show a condensate film on the surface. Such moist surfaces can be found on gas pipelines or coolant lines that are under load or when there is a high humidity in the environment (e.g. tropical climate etc.).
We will present a new corrosion prevention system, which is best suited for damp and wet surfaces and needs only little pre-surface treatment. It can be executed under nearly all conditions on site. A water displacing and repellent petrolatum system in combination with a concerted self-amalgamating 3-ply PE/Butyl-Tape provides an excellent, long lasting corrosion prevention with a superior mechanical protection. Due to the pronounced flexibility the system is perfectly suited to protect also irregular shaped geometries like fittings.
Furthermore, the costs of rehabilitation are reduced to a minimum, since shut downs, pressure reductions of pipelines or the use of complex techniques are no longer mandatory.

INTRODUCTION

One of the biggest challenges for field coating systems are pipelines which show a condensate film or waterdrops on the metal substrate. Such moist surfaces can be found on gas pipelines or coolant lines that are under load or when there is a high humidity in the environment (e.g. tropical climate etc.).

Many operators try to cope with the situation of moist surfaces by regulating the pressure of the pipeline, or air drying of the surface in an acclimatized tent, but often without significant success. Up to now there are, according to our knowledge, no corrosion protection systems for moist surfaces available which could be applied under nearly all conditions on site. If standard anti-corrosion coatings as PE/Butyl tapes, heat shrinkable sleeves or liquid coatings were used on moist surfaces, the results were very often questionable. In the last years a few liquid epoxy systems could be applied on damp or even wet surfaces, however they all need mandatory grit blasting according to SA 2 ½ as surface preparation. Any grid blasting according to SA 2 ½ can not be exceuted on pipelines which are under load.

A new approach starts first of all by accepting these circumstances: In many cases it is simply not possible to remove the moisture from the surface. Therefore, it seems almost impossible to reduce the costs of potential shut downs or pressure reductions.

A NEW 3-COMPONENT CORROSION PREVENTION SYSTEM

In this paper we will introduce a new corrosion prevention system (cf. figure 1), which is best suited for damp and wet surfaces and needs only little pre-surface treatment. It can be executed under nearly all conditions on site. The combination of a water repellent petrolatum system and a concerted self-amalgamating 3-ply PE/Butyl-Tape provides a long lasting and excellent corrosion prevention and mechanical protection.

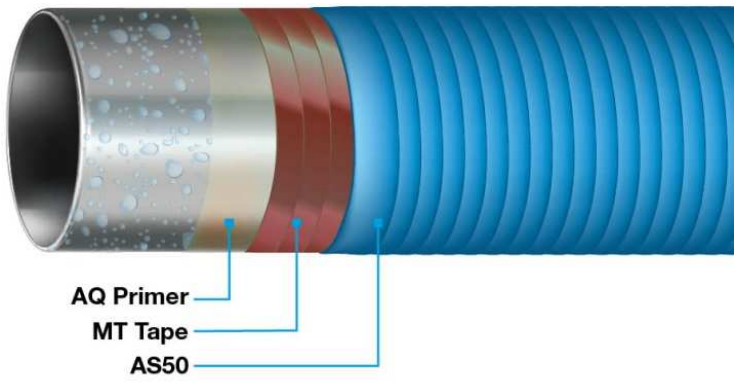

Figure 1: scheme of the new corrosion prevention system .

The coating system for wet or damp surfaces comprises of three components:
First, a special water displacing primer,
second, a corrosion prevention tape and
third, a hybrid system for corrosion and mechanical protection based on a concerted self-amalgamating PE/Butyl-Tape.

First component to apply is an innovative corrosion protection petrolatum primer. By applying the primer-mastic, the moisture or moist substrate will be displaced from the surface. At the same time the surface will be sealed against corrosive media of all kinds. The non hazardous primer is applied manually to the surface.
It can be used for permanent operating temperatures of up to + 80℃ (+176℉).
Prior to application, the surface to be coated has to be free from dust, dirt, grease, oil and other contamination. The cleaning process shall include at least 100 mm of the adjacent factory coating. The edges of the plant coating shall be bevelled and the plant coating shall be roughened for the minimum length according to the overlap on the plant coating. The steel surface being coated shall be cleaned according to ISO 8501-1 with a minimum grade St 2 and, if applicable, according to ISO 8501-2 with a minimum grad P St 2.

The second element of the system is a new developed petrolatum tape which consists of a robust polypropylene nonwoven and a corrosion prevention petrolatum based coating. It shows a high dripping point and very good adhesive resistances at high temperatures. Therefore, this tape is especially well qualified for high mechanical and thermal loads. Both, the petrolatum primer-mastic and the petrolatum tape provide an excellent corrosion prevention.

An additional high mechanical resistance to impact and indentation loadings is achieved with the third element, an approx. 1,1mm thick, self-amalgamating PE/Butyl-Tape (cf. figure 2a). From a physical point of view, butyl-rubber is more fluid than a solid substance. In the overlap areas of the PE/Butyl-Tape, the molecules migrate from one butyl-rubber layer to the other. Due to this amalgamation of the butyl rubber layers, this is not only a mechanical protection, but also creates a hose-like coating or a second barrier of corrosion prevention as there will be no chance for oxygen or vapour to get into the system.
Furthermore, the mechanical protection tape based on cold applied 3-ply PE/Butyl tape technology will show a good adhesion to the modified petrolatum tape thus providing an impermeable structure of the entire tape coating and therefore forming a third barrier of corrosion protection. The good adhesion can be shown by the cohesive rupture between the AS50- and the MT-tape (cf. figure 2b).

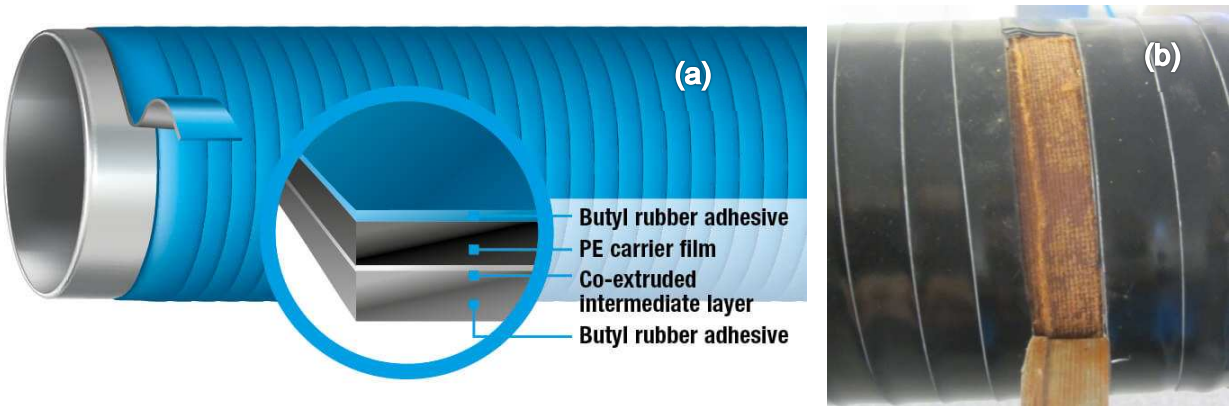

Figure 2: (a) scheme of the cold apllied 3-ply PE/Butyl tapeAS50 as mechaniocal protection
(b) cohesive rupture between the AS50- and the M-tape proving the good adhesion

For the application of the system there is no need for sophisticated or voluminous tools. Extensive and error-prone lamination as needed for many Glass fibres reinforced systems, is not required.
In addition, the used materials are non hazardous. Therefore, the requirements with respect to the occupational health and safety guidelines are negligible compared to the widely used systems based on quick curing resins which are impregnated into a fiberglass fabric. These resins usually contain Methylendiphenylisocyanate (4,4′-MDI), that is classified as carcinogenic according to EC Category 2, i.e. Substances which should be regarded as if they are carcinogenic to humans.

The combination of these three elements provides not only a proven corrosion and mechanical protection for lines with a condensate film on the substrate, but also an easy and safe application and secures a long lasting protection for irregular shaped geometries such as tees, flanges and valves. It is essential for field coating materials to be easily applied under a wide variety of ambient conditions. This ease of application reduces the risk of human mistakes. An excellent quality corrosion prevention is the result which provides an economical and safe operation of the pipeline.
This system, withstands high mechanical loads (e.g. indentation resistance cf. figure 3) and impacts as it is required for the highest mechanical stress class “C” of the worldwide leading standard EN 12068.
The system offers a very good resistance to salt-containing atmospheres and soils. Neither of the system components contains solvent and needs no time for curing or drying, thus enabling a fast working progress if a self-amalgamating PE/Butyl-Tape will be used.
The new coat system is a successful solution for wet steel pipes and fittings.

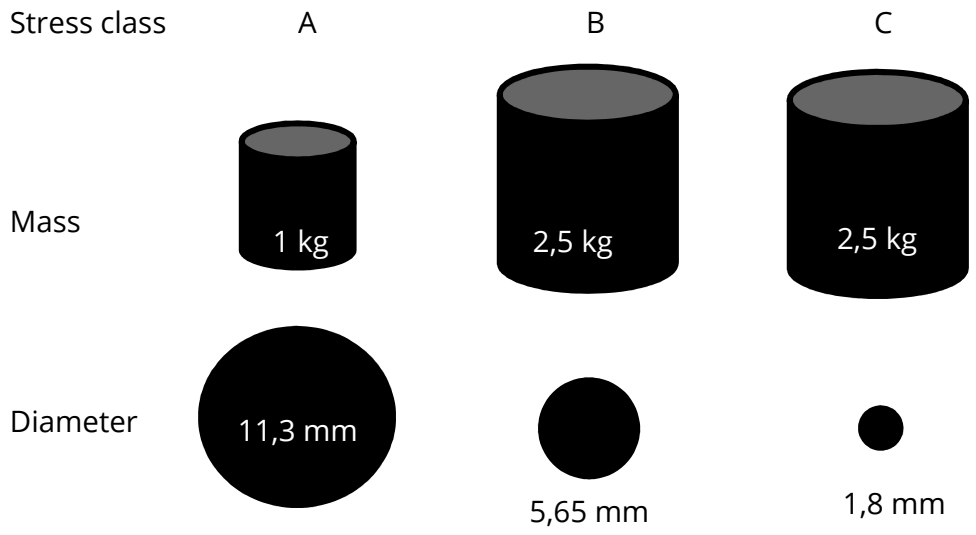

Figure 3: indentation resistance according to EN 12068

FIELD CASES

ONTRAS Gastransport GmbH in 2015

From July 6th to 10th, 2015 the corrosion protection coating of the gas pipeline of the German operator ONTRAS Gastransport GmbH near Espenhain, Eastern Germany had to be rehabilitated (cf. figure 4 and 5).
The pipeline was constructed in 1994. It has a nominal diameter of 900 mm (36”) and transports about 400,000 to 600,000 m^3 of gas per hour. The pressure of the gas is about 55 bar. Special circumstances were given: The surface of the pipeline was wet due to the cold gas flow through the pipe in combination with relatively high ambient temperatures and humidity. Hence, a corrosion prevention system had to be chosen for wet surfaces. And even more, the pipeline had to stay in operation.
The construction company VORWERK from Halle, Germany chose the tape system of petrolatum with internal resistant polypropylene nonwoven with the self-amalgamating PE/Butyl-Tape as the outer mechanical protection layer.

Figure 4: Application of Petrolatum Mastic

Figure 5: Application of Petrolatum Tape MT

After the fast and easy installation both, ONTRAS and VORWERK were very satisfied with the application and technical performance of the used coating system.
The evaluation results are as follows:

- Minimizing danger of application faults.
- Excellent application of all system components.
- Only little surface preparation necessary.
- Ambient conditions are not relevant to the quality of the coating

As a result the whole three component system obtained the approval from the ONTRAS for a number of application fields

- Armatures in different dimensions.
- Air-to-ground-zones.
- In special construction plants or difficult located areas.
- In areas of changing temperatures

Hospital Inselspital in Bern, Switzerland

An additional proven solution in rehabilitating the coating of cooling pipes is the recent project of “Inselspital”, a hospital in Bern, Switzerland.
Due to condensation of humidity on the cold pipe surface, corrosion was detected on the pipes (cfr. Figure 6a). With the use of the coating system for wet or damp surfaces, the pipeline could be kept in power and the hospital services run without restrictions during the rehabilitation works (cf. figure 6b). This project demonstrates the advantages of the new coat system for an application at narrow spaces as well as at flanges and other pipeline parts without the need of heavy or expensive equipment. Further, a functional thermal insulation was applied above the corrosion prevention coating to minimize energetic losses.

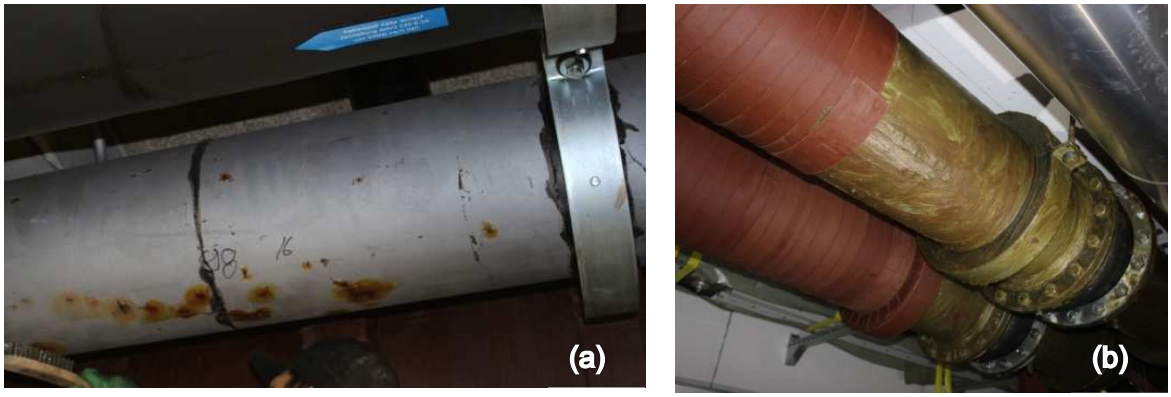

Figure 6 (a) Cooling pipeline showing corrosion due to condensation of water on the cool surface.
(b) The same line during rehabilitation works

CONCLUSION

The evaluation of an appropriate rehabilitation system for corrosion prevention on pipes and pipelines with moist surfaces depends on many specific circumstances and has to be chosen in coordination with the material and onsite requirements. Furthermore, it has to be suited for the relevant and unique project conditions, especially taking into account an easy, economical and safe way of applying the system.

The newly developed system for wet or damp surfaces is designed to combine the ease of application, excellent mechanical resistance and outstanding corrosion prevention for small and large scale rehabilitation projects. It is developed especially for an application on wet surfaces and on lines which remain in service.
Due to the pronounced flexibility the system is perfectly suited to protect also irregular shaped geometries like fittings.
With this system the costs of rehabilitation are reduced to a minimum, since shut downs or pressure reductions of pipelines are no longer mandatory Reasoned by the nature of the used substances, the requirements with respect of the occupational health and safety guidelines as well as potential environmental impacts are negligible compared to widely used systems based on quick curing resins impregnated into a fiberglass fabric.