THE WORLD OF FIELD-APPLIED PIPELINE COATINGS

Robert Buchanan, Canusa-CPS, Canada, provides details on the array of pipeline coatings available for use in the field.

The world of pipeline coatings is quite broad, with increased focus on field-applied systems for new construction and rehabilitation. Pipeline coatings conferences seem to be more prevalent, ISO norms are developing, and the various manufacturers of coatings are eager to be involved, sponsor and speak about their unique product or technology at global forums. In the world of field-applied coatings, the choices are many and it is a challenge for specifiers to know which to choose. Choice generally comes down to a technical evaluation of various technologies, but sometimes it is which sales person gave the best pitch, is fresh in the specifier's mind or offers the contractor a better price.

Figure 1. Canusa's induction heating equipment.

Canusa-CPS is well versed in field-applied coatings since the company's roots go back to the 1950s when Canusa's parent company founder, Leslie Shaw, developed the first plant-applied extruded polyethylene-based coatings, thus displacing the over-the-ditch coating of pipelines during construction. He recognised that the girth weld joints needed to be coated in the field with something that was close in performance to the mainline coating. With that in mind, the company developed heat-shrink technology as a means of getting a polyethylene coating applied in the field. Many things have changed since the days of small diameter, low operating temperature pipelines and, today, pipelines are very large in diameter and can operate up to 150 ˚C, thus creating incredible challenges.

As we all are aware, pipeline coatings are critical to the long-term performance of a pipeline so the selection of product should not be taken lightly. In the early years of pipeline construction, bitumen and coal tar applied over the ditch were the original 'field-applied' coatings for the entire pipeline, not just the field joints. These were excellent coatings to meet the requirements of the time but two things have happened since then. Firstly, for new construction, coatings must now meet the demands of increasingly severe pipeline construction and operating conditions due to the depth of the reservoirs and remoteness of the fields. Technologies are available and they can be well applied in factory settings, but how do they translate to field application? Secondly, the pipelines that were coated with bitumen and coal tar decades ago are now getting old and the coatings are becoming due for replacement. These are two unique markets for field-applied coatings.

For pipeline rehabilitation, there are a number of coating types available, but the most common is 2-component liquid epoxy. Liquid epoxies provide excellent long-term performance but require very good surface preparation and installation techniques in order to work at their ultimate level. Cold applied tapes, be they traditional polyethylene backed products with butyl adhesives or the more recent 'visco-elastic' products, are a little more forgiving on field application technique but less resistant to soil stress. It is up to the specifier to determine which technology provides the most fit-for-service system, but each of these systems relies on the contractor to do his job well.

The most prevalent new construction coatings used around the world are 3-layer polyethylene (3LPE) and 3-layer polypropylene (3LPP). These consist of a fusion bonded epoxy (FBE) primer, a polyethylene-based or polypropylene adhesive and a high-density polyethylene or polypropylene topcoat. The choice often depends on operating temperature, expected level of abrasion or field friendliness. Both technologies have pros and cons; polypropylene is more resistant to high temperatures and tougher but polyethylene is a bit more field-friendly, especially as it pertains to the field joint choices.

Commonly available options for new construction field joint systems that are compatible with 3LPE and 3LPP plant-applied coatings have traditionally provided a performance level that is somewhat lower than that of the mainline coating. This is mirrored in documents like ISO 21809-3, which focuses on field joint coatings. The performance

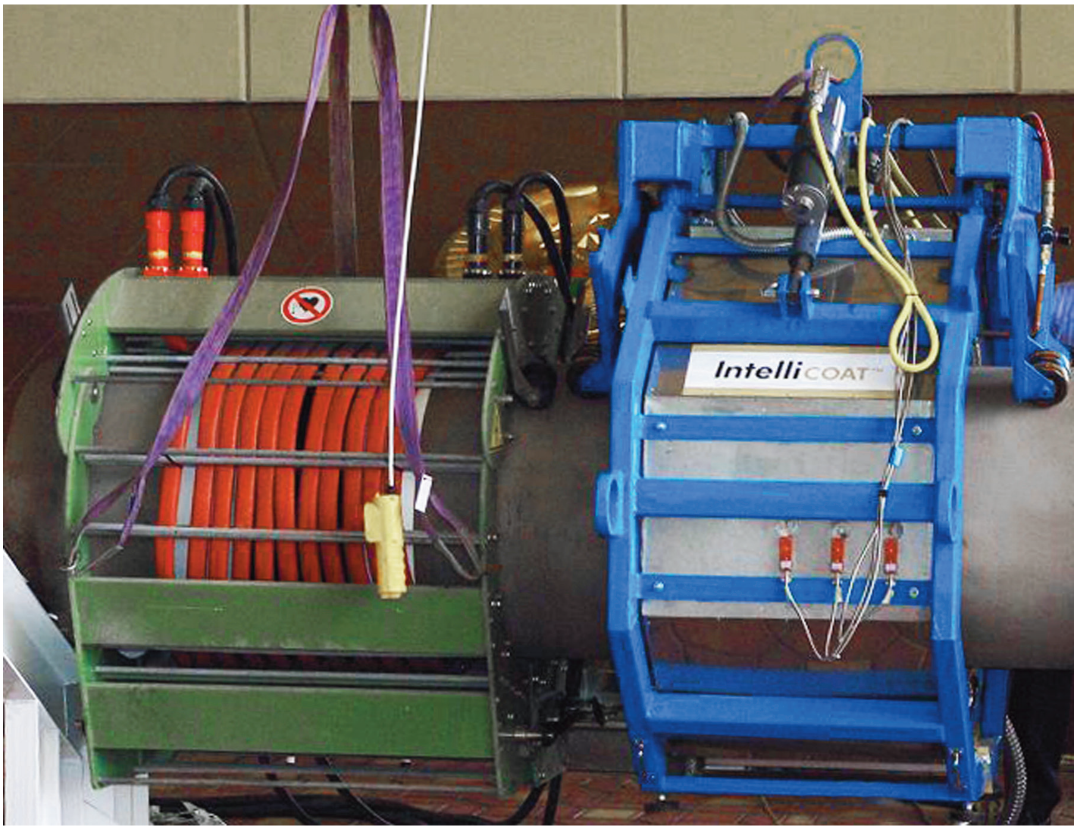

Figure 2. Canusa's IntelliCOAT™ equipment.

requirements in the document are lower than the performance expectations of the mainline coating, simply because field applied coatings need to balance properties of performance with installability. This is possibly why some people believe that the weak link in a pipeline is the field joint. It does not have to be that way.

In 2002, Canusa-CPS developed and commercialised GTS-PP, the first truly polypropylene based heat-shrinkable sleeve that met the same coating standard requirements as the 3LPP mainline coating and not something lower. This improved the acceptance of polypropylene mainline coatings because, aside from performance, the field joint coating could be applied by the pipeline contractors, rather than requiring them to hire subcontract applicators for systems like flame spray or fused tapes.

More recently, Canusa developed a similar product for 3-layer polyethylene coatings and branded it as GTS-PE. It is a heat-shrinkable product that, like GTS-PP for polypropylene, provides a field joint system that has the same level of performance as the 3LPE mainline coating.

Not only do Canusa's GTS-PP and GTS-PE products deliver the same level of performance as the mainline coating in a field-applied system, Canusa also developed a way of bringing factory quality installation to the field. With the development and recent launch of the IntelliCOAT™ system of installing heat-shrinkable sleeves, Canusa was able to virtually eliminate field application variability.

Without the use of a flame, Canusa's IntelliCOAT™ automates the application of heat-shrinkable sleeves onto pipeline girth weld areas. After positioning the IntelliCOAT™ unit over a loosely wrapped sleeve, a technician simply presses the 'start' button and the IntelliCOAT™ system completes the installation. Aside from the method of delivering heat, the breakthrough technology was IntelliCOAT's™ algorithm for controlling heating intensity and timing over several zones. This technology comes after several years of development, trying a number of methods to provide heat and control the process.

When combined with Canusa's state-of-the-art GTS-PP and GTS-PE products, the outcome is consistent application and full repeatability with improved safety, delivering a coated field joint that mirrors a factory-applied coating in performance.

As mentioned at the start, the world of field-applied pipeline coatings is quite broad with many choices of, not only competitors with similar technologies, but companies with competing technologies, each with their own advantages and disadvantages. As a final word, the choice rests with the specifier, but prudence often dictates that one should look at what 90% of the pipeline is coated with then strive to coat the 10%, the field joint, with something that is pretty close. WP

Table 1. 3LPP factory versus field

Test/property	3LPP factory coating NFA 49-711	3LPP factory coating DIN 30678	Canusa GTS-PP Global specs	PP field joints ISO 21809-3
Coating type	3LPP	3LPP	3LPP	3LPP
Ambient adhesion	≥ 250N/cm	≥ 100 N/cm @ 50 °C	> 250N/cm	≥40 N/cm
Adhesion @ OT	≥ 80 N/cm @ 110 °C	≥ 80 N/cm @ 90 °C	> 80 N/cm @ 110 °C	≥ 20 N/cm @ OT
Adhesion to 3LPP	N/A	N/A	Fused	≥ 20 N/cm
Impact resistance	≥ 10 J/mm (pass holiday test)	≥ 5 J/mm, 30 impacts (pass holiday test)	> 10 J/mm (pass holiday test)	≥ 8 J/mm (pass holiday test)
Indentation resistance	≤ 0.1 mm @ 23 °C ≤ 0.4 mm @ 110 °C	≤ 0.3 mm @ 90 °C	< 0.1 mm @ 23 °C < 0.4 mm @ 110 °C	≤ 1.9 mm[1] (≥ 0.6 mm remaining)

1: ≥ 0.6 mm remaining result shown assumes 2.5 mm thick system

Table 2. 3LPE factory versus field

Test/property	3LPE factory coating DIN 30670	Canusa GTS-PE Global specs	PE field joints ISO 21809-3
Coating type	3LPE	3LPE	3LPE
Ambient adhesion	≥ 35 N/cm	> 140 N/cm	≥ 25 N/cm
Adhesion @ 80 °C	≥ 15 N/cm	> 20 N/cm	≥ 15 N/cm
Impact resistance	≥ 5 J/mm (pass holiday test)	> 10 J/mm (pass holiday test)	≥ 5 J/mm (pass holiday test)
Indentation resistance @ 80 °C	≤ 0.3 mm at 70 °C	< 0.2 mm at 70 °C	≤ 1.9 mm[1] (≥ 0.6 mm remaining)
Thermal ageing	≥ 65% of un-aged elongation	95% of un-aged elongation	≥ 75% of un-aged elongation

1: ≥ 0.6 mm remaining result shown assumes 2.5 mm thick system