

The Duplex Dragon

Deep within the Tarim Basin of Xinjiang, China, pipelines transport natural gas as it is extracted and refined for distribution throughout the country. However, gas leakage has been a recurrent issue as a result of pipeline corrosion. Enter the ‘Pipeline Dragon’: constructed entirely of molybdenum-containing 2205 duplex stainless steel, a new pipeline promises to reduce gas leakage, preventing environmental disaster while conserving resources. At 4,500 tonnes, it is the largest single order of duplex stainless steel in China to date.

Some of the earliest uses of natural gas date back 500 BC, when the Chinese used hollow bamboo stalks to transport gas into stoves that boiled seawater for salt. Today, China’s natural gas industry continues to grow as the country seeks to reduce its carbon footprint and move away from its dependence on coal. One of the largest domestic deposits of raw gas that supplies this industry is found in the Tarim Basin, which is estimated to contain over 200 trillion cubic feet of natural gas in underground reserves.



The new pipeline is located in the Tarim Basin of China’s Xinjiang Province, highlighted in orange.

Gas production in the middle of nowhere

The Tarim Basin sits in a sparsely populated area of China’s westernmost

province. The production and transport of natural gas in this desert region is no small feat. The challenging, wind-swept

terrain and the lack of access roads make the drilling of wells and especially the building of pipelines extremely difficult, time-consuming, and expensive.

From the wells, raw gas is transported through pipelines to nearby refineries for processing. Balancing gas input with refinery capacity is vital to maximize productivity. Therefore, a new pipeline, the Pipeline Dragon, connecting two refineries, has been started. When it is finished, the refineries will be able to route the flow of gas to optimize capacity utilization.

Eventually, the refined gas from the Tarim Basin feeds into the massive West-East Gas Pipeline for use across China. ➤



Duplex stainless steel pipes awaiting installation in the field. © Wang Qinghai

Preventing gas leaks

The environmental conditions in the Tarim Basin pose several challenges to pipeline operation. The vast, Taklamakan desert is extremely dry. Summers are hot and winters are cold, and strong winds often form massive dust storms, making for extremely difficult working conditions. The soil in the area is classified as highly corrosive. It can contain significant concentrations of soluble salts, left behind by evaporating water over the millennia. Furthermore, the raw gas is high in carbon dioxide and contains up to 10% chlorides, increasing its corrosiveness. In this environment, only a highly corrosion resistant material can provide a permanent solution.

Pipelines carrying corrosive raw gas here have typically been built from clad pipe, a carbon steel pipe that is internally lined with a thin layer of Type 316 stainless steel. Such a pipe can resist corrosion by the aggressive gas and is initially less expensive than a solid stainless steel pipe. However, welding clad pipe in the field is far more difficult than welding it in the controlled environment of a factory. The internal stainless steel weld bead can become diluted with carbon steel, lowering its corrosion resistance. Weld corrosion of clad pipe has been found to be a cause of frequent leaking in the Tarim Basin.

The ensuing environmental damage, loss of revenue and, in the worst case, explosions, mean that leaks must be fixed as quickly as possible. However, finding and repairing leaks is challenging, time-consuming and even dangerous in the desert sands of this difficult to access area. The gas company, therefore, sought a more robust pipe material for the new pipeline to prevent leaks from occurring in the first place.

Scales reinforced with molybdenum

The new pipeline connecting the two refineries is 3.3 kilometers long and has diameters of 325 and 406 millimeters, with wall thicknesses between seven and



The Pipeline Dragon is located in a remote desert area in western China. © Cheng Xingbao

17 millimeters. To completely avoid corrosion, the engineers chose a solid stainless steel solution rather than coated or clad carbon steel pipe. A literature study and testing concluded that 2205

duplex stainless steel would be able to resist the corrosive raw gas. With 3% molybdenum, this stainless steel grade has superior pitting and crevice corrosion resistance to Type 316 stainless steel. ➤

To test whether 2205 duplex stainless steel would also be resistant enough to the salt-laden desert sand, a three-year corrosion study was conducted. Test samples, buried in the sand, were examined at yearly intervals with satisfactory results.

In addition to its corrosion resistance, duplex stainless steel provides other advantages to such projects: its superior strength enables thinner wall thicknesses and reduced weight of the finished pipe, facilitating transport, handling and installation, important considerations in the extreme weather of the Tarim Basin. The thinner wall thickness also reduces welding time and cost, without the complications associated with clad pipe.

These advantages translate to a long and maintenance-free service life, contributing to the protection of the

environment and the safety of the workforce. And despite a slightly higher initial cost compared to clad pipe, the duplex solution has a significant impact on lowering the overall cost of gas production.

An enduring solution

Life Cycle Costing (LLC), where material selection is based not just on initial installation costs, but also on cumulative costs of future maintenance and operations, is becoming more prevalent. Over time, a duplex stainless steel pipeline can pay for itself in avoiding gas loss and eliminating repair and replacement cost.

Xinjiang's 'Pipeline Dragon' not only optimizes natural gas production in western China but also spearheads the country's commitment to a more sustainable future in energy. The robust



Workers inspecting the new pipeline.
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investment in a duplex stainless steel pipeline signifies a move away from less expensive construction to sustainable, long-lasting solutions. (Rikki Li)

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