

Increasing Gas Purging Efficiency at the Pearl GTL Plant

When completed, the Pearl gas-to-liquids (GTL) project will be the largest GTL complex in the world — Fig. 1. A joint project of Qatar Petroleum and Royal Dutch Shell plc in Ras Laffan, Qatar, it involves the development of offshore natural gas resources in the Qatar North Field and is comprised of offshore upstream gas production facilities and an onshore GTL plant that will produce thousands of barrels per day of GTL products and equivalent amounts of natural gas liquids (Ref. 1). The plant will produce a range of clean liquid products and fuels, which will include naphtha, GTL fuel, normal paraffins, kerosene, and lubricant base oils (Ref. 2). With lower emissions at point of use, it can play a role in reducing local air pollution in cities and provide a strategic diversification of liquid transport fuel for importing countries (Ref. 2).



Fig. 1 — When completed, the Pearl gas-to-liquids complex will produce a wide range of liquid products and fuels.

circumstances surrounding its use. There are also criteria related to quality assurance; health, safety, and the environment; evaluation of the technical and commercial aspects of the product; and any previous experience CCC might have had with the product.

All of these criteria were considered when it came time to select a gas purging method.

The Need for Gas Purging

The Pearl GTL piping is many miles long and requires many technical operations including fabricating, assembling, welding, purging, and hydro-testing of the pipes. These operations are time consuming, labor intensive, and use inordinate amounts of materials including welding wire, rod, tungsten electrodes, shielding gas, and purging equipment. With a variety of stainless steel pipe diameters ranging from 2 to 72 in. (51 to 1829 mm) to be welded and stringent procedures in place, maintaining quality has always been a critical issue. Failure to eliminate oxygen can result in porosity, corrosion, and premature failure of the joint due to cracking. To obtain a quality weld, complete evacuation of oxygen is necessary.

Inert gases such as argon or a noble gas mix (argon and helium) are used to shield the molten weld pool from atmospheric contamination and oxidation. The inert gas is pumped into the dammed area through a tube inserted into the weld joint. Since argon has a greater density, it will naturally displace the oxygen, requiring it to evacuate through the root opening or other exit point. Two processes that commonly use inert gases are gas tungsten arc welding (GTAW) and gas metal arc welding (GMAW).

The objective of pipe purging is to shield the back of the joint from atmospheric contamination. It is a two-stage operation, involving a pre-purge, then purging during welding. The pre-purge displaces air inside a pipe with an inert gas; the purge during welding maintains the oxygen-free backing gas achieved by the pre-purge and prevents air ingress into the system.

As any accountant will tell you, true cost is a function of many variables. In welding, shielding gas is often overlooked as a potential area of savings. Shielding gas can be costly and, at times, short in supply. As the area to be purged increases, so does the cost. In addition, construction managers often overlook crew waiting time for filling the line with gas. A cost is also attached to idle welding crews; therefore, it is important to select a purging system that minimizes shielding gas usage and crew waiting time as well as help keep the project on schedule.

For CCC's work on the Pearl GTL Project, purging was localized. Total purging of the pipe would be impractical or extremely costly. Therefore, it was necessary to select from an array of purge systems that could isolate the weld area and minimize the amount of gas used. The time to pre-purge the line and ease of product setup and removal were additional factors considered for selection of a purging system.

Cost and Time Associated with Purging

The CCC engineers compared all the existing systems and took note of the far placement associated with conventional purging methods such as inflatable rubber bladders, rubber gaskets, and cardboard discs.

Purge bladders consist of "balloon" devices connected by a tube that carries gas to inflate them. The bladders are positioned on each side of the weld area and, once inflated, form a seal. Once the bladders are inflated, a release valve opens to flood the weld area between the two bladders with shielding gas. Once the weld is complete, the bladders can be deflated and extracted. Purge bladders can only be used on one joint at a time, then must be removed.

To avoid thermal damage, purge bladders require placement far from the weld

The Methodology behind Using New Technology

Consolidated Contractors International Company (CCC), based in Athens, Greece, was one of 11 contractors awarded work on the project, which employs more than 50,000 workers. Construction is expected to be complete by the end of this year, with production ramp-up in 2011.

A key to CCC's being awarded this project was agreeing to adhere to Shell's Flawless Startup Initiative, a process the company has developed over the last 15 years to ensure successful commissioning, startup, and first cycle operation of the facility.

With CCC's corporate initiative to "care for the protection of the environment and the welfare of our planet," the company considered it more important than ever to select construction consumables that reduce waste. Utilizing new, more efficient technology that is also "green" certainly was an important and significant consideration when selecting products.

"CCC has a green initiative organization in place and has conducted many studies without external financing, to reduce its CO₂ emissions," said Dimitri Mavrikios, group technical manager. He added that other variables are also factored into decisions on adopting new technology such as the nature of the product, where the product will be used, and the



Fig. 2 — An example of the 72-in.-diameter water-soluble purge dam created for the Pearl GTL Project.

zone, anywhere from 10 to 40 ft (3–12 m). Remote placement of the purge bladders would require large amounts of noble gas to displace the oxygen in the weld zone for the many miles of construction. In addition, positioning and removing purge bladders can prolong setup and teardown.

The company eventually decided to use the EZ Purge® system from Aquasol Corp., North Tonawanda, N.Y.

EZ Purge® is a preformed, patented, water-soluble and self-adhesive purge dam. Made of sodium carboxy methyl cellulose and wood pulp, the purge dam dissolves instantly and completely in most liquids and is 100% biodegradable. Its zero air permeable (ZAP™) technology prevents air from permeating the dammed area, creating an airtight enclosure.

“Our construction manager on the Pearl GTL project, Salem Mahrouse, was the construction manager at our Bahrain project. He was satisfied with EZ Purge, advised us, and convinced us to use it again on this project,” explained Abdallah G. Akkad, deputy project director/project manager, Process Area Pearl GTL Project.

He added, “One of the good features, other than saving time and cost, is that we don’t have to worry about forgetting the plug inside the line, which will create later problems and waste of time. This also satisfies Shell Flawless Startup requirements.” Shell’s Flawless Startup is a system that attempts to identify and mitigate potential flaws in plant and equipment startups.

CCC’s Bahrain office first commissioned use of the water-soluble purge dam in 2006 shortly after the product was launched. At that time, standard pipe diameter sizes of up to 24 in. (605.5 mm) were being offered in the marketplace. Then in 2008, CCC challenged Aquasol to engineer the product up to 72 in. in diameter.

This challenge presented a multitude of design issues because the proposed size was enormous. What would need changing in the manufacturing process? How could the purge dam be designed to allow retention of gas flow pressure and be 100% impermeable to air? Faced with a tremendous undertaking, the engineering design team tackled each issue one by one.



Fig. 3 — The 72-in. version of EZ Purge utilizes the same water-soluble tape as is shown here in a 24-in.-diameter version.

In a matter of months, an enhanced patented design was birthed and the new sizes were made available. The company unveiled the largest water-soluble purge dam in the world, possessing a diameter and height of 72 in. (1829 mm), the height of a tall man — Fig. 2.

Similar to a mechanical purge device, the shape of the larger-size purge dam would remain flat to allow equal distribution of gases across the body of the dam and to prevent blowouts. The larger sizes were designed to contain the company’s water-soluble paper combined with other water-soluble polymeric composites to provide a uniform, substantive body designed to maximize gas retention. Water-soluble tape was built into the purge dam sidewall so the customer did not need to purchase separate inventories of the adhesive and the purge dams. The portion of water-soluble tape along the tapered sidewall was proportionate to the size of the dam and preinstalled in sections, a design that allows for easy alignment and tacking of the dam — Fig. 3. To enable the welder to maneuver the large-sized dams and place them in position, the manufacturer’s engineering team specifically designed an installation disk.

Aquasol President Mike Hacikyan commented, “I consider our products to be ‘Greenventions,’ the marriage of bio-sustainability with invention. There is no reason the two cannot exist simultaneously creating a more eco-friendly manner of doing business yet still offer improved efficiencies.” It took more than two years to develop EZ Purge because of the design challenges, Hacikyan said.

Water-Soluble Alternatives

Water-soluble paper in sheet and roll format has been available for many years. And, in certain situations, may still be the best alternative. For instance, for pipes with diameters less than 2 in., the welder

need only crumple half a sheet of the 8½ × 11-in. water-soluble paper into each end of the pipe to be joined.

Water-soluble film works similarly. The film must be measured, cut, and constructed to fit the pipe. A liquid adhesive, which requires 15 to 30 min to dry, is often used to attach the film to the pipe. Drawbacks to the film are that it is transparent, fragile, awkward to work with, and unsuitable for large pipe diameters.

Welders sometimes make their own purge dams out of water-soluble paper,

but for larger pipes this can be time consuming, requiring the skilled welder to precisely measure, cut, and construct them by hand. As the diameter of the pipe increases, the time required to build the dam increases and the operation becomes more complex. Since standard paper widths are limited, the welder may be required to splice together two or more sheets of paper with water-soluble tape in order to create the required size. Large handmade dams can also be delicate and difficult to maneuver.

As the diameter of EZ Purge increases, the paper increases in thickness and the exposed water-soluble skirt available for adhesion to the pipe increases in area. This is the primary and most important difference between handmade and preformed purge dams. For instance, the largest size EZ Purge (72 in.) is 0.045 in. (1.15 mm) thick and contains a 20-in. (508 mm) water-soluble skirt. With a handmade dam, the maximum thickness would be 0.008 in. (0.2 mm) and the water-soluble tape (skirt) 2 in. (50 cm).

With thousands of joints to be welded, it made little sense for CCC's skilled welders to painstakingly expend numerous hours creating handmade dams when that time could be saved and improve the timeline of the project. CCC was provided with two tools that helped to convince the company to use the new technology.

Calculation spreadsheets were designed to convince project engineers and salespeople of the advantages of using the product. The Labor and Cost Savings spreadsheet calculates labor and time savings for using the manufactured purge dam. The user simply enters the pipe size, number of welds, and labor rate into the spreadsheet, and the savings are automatically calculated. The Argon Cost Saver Spreadsheet works in a similar fashion and compares EZ Purge to other purging devices. Here, the user enters the price of argon, and the spreadsheet calculates savings based on cubic feet of gas. Both spreadsheets can be accessed at www.aquasolcorporation.com.

"It is standard CCC procedure to justify any expenditure, therefore these savings were evaluated in detail," Mavrikois said.

The advantages of the new technology as a solution to backpurging of weld roots in stainless steel piping, according to Mavrikois, "are simplicity of installation and considerable time and cost savings." ♦

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CHERYL GONDEK (cgondek@aquasolcorporation.com) is vice president, marketing, Aquasol Corp., North Tonawanda, N.Y.

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