PRESS INFORMATION

Complete Refurbishment of LNG Tanks using Cold Bonding

Hot work required for welding, grinding and cutting operations presents potential hazards when conducted in potentially explosive and flammable environments. According to the Health and Safety Executive guidance 2013, “Flammable liquids and vapours such as petrol, diesel, fuel oil, paints, solvents, glue, lacquer and cleaning agents are found in many places of work. If a welding torch or powered cutter is used on a tank or drum containing flammable material (solid, liquid or vapour), the tank or drum can explode violently”.

In order to minimise the risk, cold bonding solutions involving materials that are applied and cured at ambient temperatures can offer an alternative solution for repair and newbuild applications on metallic surfaces.

Picture 1: Cold bonding application

1. Refurbishment of 3 LNG Tanks in Algeria

In 1990, three LNG tanks of 100 000 M^3 capacity designed, constructed to API Standard 620 and commissioned in 1977 were severely corroded after 13 years of continuous service in a coastal environment in Algeria. The inspection carried out in 1993 during the LNG plant renovation project revealed that roofs and shells were extensively pitted due to on-going exposure to salt water and salty air moisture, resulting in severe gas leaks predominantly on the roofs.

The client was looking for a reliable and long term solution to repair the LNG tanks taking into account all the safety considerations and without disturbing any parts of the inner tanks and their supports. Initially, the plan was to carry out the repairs during the complex shut down of the plant in 1995 when the isolating valves were due to be changed out but in order to avoid many important activities occurring at the same time, only the changing of the valves has been conducted at this period.

2. Repair options

Several solutions were considered for the repair including welding of new plates to the existing live tanks, welding new plates after purging the inner tanks and the insulation

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spaces, or fixing new patch plates over the roofs on site using cold repairs with epoxy adhesives.

For safety reasons, the Government Certifying Authority first preferred to drain, clean and purge the LNG tanks as described in the Defence Works Functional Standard Specification 031 for Internal Cleaning of Fuel. Due to their explosive and flammable atmosphere based on the risk of ignition of methane gas leaking, the option of welding new plates on the existing live LNG tanks was definitely excluded. The decided option was to empty each tank and to conduct the repairs, but this caused other more serious problems of thermal expansion and movement as this method would risk damage to the inside of tanks if they were allowed to warm up from their normal operating temperature of around minus 163 ^{0}C. Natural gas trapped within inaccessible parts of the perlite insulation system would remain an unquantifiable potential hazard if the presence of natural gas within the LNG tanks was considered dangerous during certain repair situations.

Upon reviewing all options, it was concluded that the repairs will be conducted on live LNG tanks using the Belzona's cold repairs method. The project was carried out to very stringent standards with salt contamination, blasting profiles, climatic conditions and ultrasonic thickness measurements being constantly monitored.

3. Surface preparation and repairs

The main part of the project was to seal leaks in the outer skin of the tank and to bond doubler plates over the most corroded areas of steelwork. During the blasting process carried out using non-sparking grit to Swedish Standard SA 2, more live gas leaks were found on the surface of the tank and were directly sealed with Belzona 1291 (ES Metal), a rapid curing epoxy paste grade material. The LNG tank roof of about 4100 M^2 surface is consisting of 260 plates of 5.5 mm thickness supported by a compression ring of 32 mm thickness. The roof repairs have been performed essentially by sealing all the leaks of gas, repairing the pits of corrosion and by applying patch plates with Belzona products. Belzona 1121 (Super XL-Metal) with its extended working life, was used for bonding the reinforcing plates. Belzona 1111 (Super Metal) and Belzona 1321 (Ceramic S-Metal) were used in conjunction with Belzona Reinforcement Tape to repair and strengthen the nozzles throughout the tank roof.

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4. Put it to the test

As the project went ahead, the ability to use Belzona materials as a structural adhesive was further investigated. The repair of the trunnion was indeed the most critical concern due to the problem of lifting the 24 inch line. Various tests both independent and at Belzona's facilities were carried out on full size test rigs to confirm the suitability of Belzona to firstly bond the hand rail supports around the tank perimeter and finally the main vent pipe trunnion supporting several tons of pipework. Cleavage adhesion testing was carried out on Belzona 1111 (Super Metal), a paste grade epoxy material usually used for cold bonding applications, in accordance with ASTM D1062 at 20°C, 40°C and 60°C in order to determine the effect of high ambient temperatures on bond strength. When fully cured, the cleavage adhesion of Belzona 1111 was found to be maintained across the 20–60°C test range, i.e. the bond strength was unaffected up to 60°C, and adhesion values were actually found to be slightly higher at higher test temperatures by virtue of the higher cure temperature. Cleavage adhesion values obtained were 1330 pli, 1465 pli and 1450 pli, for 20°C, 40 °C and 60°C testing respectively. Based on the above testing results, new furniture and platforms were installed on the roofs of the three LNG tanks where the different instruments were fixed to their original positions.

The Belzona solution was applied live to keep the site running with minimal disruption without the use of hot work or use of mechanical equipment. No other alternative was deemed to provide a viable solution to the client's requirements due to time scale and the risk of sparks. The application of the API 653 Standard and all the targets have been met with quality of the repairs achieved in excess of the commercial standards. The reliability and the safety of the operation have been provided for the long term service of the plant. This project was completed without any incident. Since the application, it has been regularly inspected and has now been in service for more than ten years demonstrating the high efficiency of the cold bonding solution.

Picture 2: View of the three tanks in 1990
Picture 3-4-5: Application on site.

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Notes to Editor;

About Belzona:

- Established in 1952, Belzona has pioneered innovative polymer technology that has revolutionised industrial repair and maintenance procedures.
- Belzona is a leading company in the design and manufacture of polymer repair composites and industrial protective coatings for the repair, protection and improvement of machinery, equipment, buildings and structures.
- At Harrogate, the full Belzona product range is manufactured to stringent quality and environmental control guidelines complying with the requirements of ISO 9001:2008 and ISO 14001:2004.
- Belzona has over 140 Distributors in more than 120 countries ensuring not only the availability of Belzona materials, but also specification support, project management, application and supervision services. Distributorships and their teams are supported by Belzona Corporate offices in Europe, North America and Asia.

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- Do you have an upcoming topic that we could contribute an editorial on? Please let us know the topic, preferable length and the material submission deadline.

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