ENERGY & POWER

BHR Group
EXPERTS IN FLUID ENGINEERING

Ensuring performance of wet thermal insulation solutions: OUR EXPERT OPINION

Inadequate thermal insulation can ultimately result in prohibitive penalties or in costly production restarts (after shutdown in case of a hydrate plug, for example). Clearly the best way to avoid this is to take a thorough approach, by ensuring any new products you design or that are provided by your supply chain, have been tested to agreed industry standards, but what's the most cost-effective way to do that?

Benoit Post, Head of Energy & Power shares our current thoughts.

The solution – using industry standard tests?

Thermal qualification testing of wet insulation materials for subsea deployment (pipeline, flow lines, equipment and subsea structures) is described in the ISO Standard 12736:2014 Petroleum and Natural Gas Industries.

So, all we have to do is meet those standards to make sure we don't have any unforeseen problems? This seems reasonable enough, but what are the costs and timeframe associated with testing to this standard?

ISO requires full scale Simulated Service Testing (SST) for new wet thermal insulation coatings meant for pipeline systems at subsea field operating conditions, i.e temperature and pressure:

- Section 8.2.7 SST factory applied coating
- Section 8.2.8 SST field joint
- Section 8.2.9 SST subsea equipment (optional)

In order to undertake this investigation, the standard requires full scale insulated pipelines to be tested (for example around 6m to 12m for an SST field joint). This in turn, requires very large Hyperbaric Vessels to be used to determine the thermal and mechanical performance on new insulation materials.

Typically, SST costs money and can cause bottlenecks/delays (depending on availability of such hyperbaric vessels). In the current economic climate, with wider cost pressure faced by the industry combined with project commissioning and installation deadlines, SST costs and timeframes can be arguably prohibitive.

So is there a more affordable, faster option that doesn't compromise safety and standards?

From a purely thermal performance perspective, our clients' experience is that the cost/benefit analysis of doing hyperbaric tests at large scale is questionable.

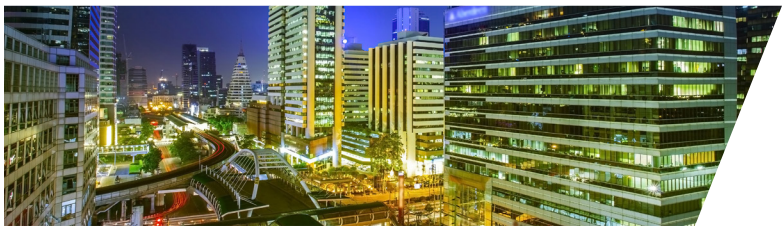
We believe any thermal performance differences between hyperbaric tests (SST) and shallow water tests (water basin) for wet insulated subsea pipeline systems are likely to be minor. For example, U value and cool down time is determined over a few days at full scale. That is, of course, unless there is mechanical failure due to hydrostatic pressure conditions.

Additionally, thermal performance (U value and cool down time) of wet insulated subsea modules (XT, manifold, subsea processing module), valves connectors and well jumpers are currently qualified by the industry through shallow water testing and not through hyperbaric vessels.

This prompts us to ask, why is a different approach used for subsea pipeline systems?

Our understanding is that SST requirements for subsea pipeline systems are driven by mechanical performance (water absorption effects, pressure effects, bonding, field joint, thermo-mechanical properties degradation due to water ageing), rather than thermal performance.

Therefore, surely we can find a better way to confirm mechanical performance for subsea pipeline systems?



Considering the whole supply-chain picture on mechanical and thermal performance

The ISO Standard 12736:2014 (Section 7.2.2 and Section 7.2.3), rightly advocates using small scale ageing tests for assessing the thermal, chemical and mechanical stability of the insulation material and predicting end of life properties. Sample sizes are typically 50 x 50 x 4 mm and 50 x 50 x 8 mm. This approach allows a range of materials to be easily tested at different temperatures and under hydrostatic field operating pressure conditions over a 1-year period.

Our view, is that these small-scale aging tests are best performed with independent material testing in small hyperbaric vessels. **We suggest that specialist chemical manufacturers should ensure these tests are undertaken**.

The ISO Standard 12736:2014 does not advocate compulsory medium scale ageing tests (Section 7.2.4 is optional) on a representative full insulated pipe of 1m long and 25mm diameter. We believe these medium scale ageing tests can give confidence on the mechanical performance, such as water absorption effects, pressure effects, material pipe bonding, field joint and material interfaces.

A range of medium scale fully insulated pipes can be easily tested with different material interfaces and field joints. They are best undertaken through independent testing in medium scale hyperbaric vessels over 6+ months. Therefore we advocate that these should become recommended not optional tests. **We suggest that specialist coating applicator organisations should ensure these tests are undertaken.**

OUR RECOMMENDATIONS

Our view on the ISO Standard 12736:2014:

- ***Small-scale ageing tests recommended under the standard:*** specialist chemical manufacturers should ensure these tests are undertaken and that they are best performed with independent material testing in small hyperbaric vessels.
- ***Medium-scale ageing tests optional under the standard:*** specialist coating applicator organisations should ensure these tests are undertaken through independent testing in medium scale hyperbaric vessels over 6+ months.
- ***Full Scale Thermal Performance:*** Subsea Contractors should undertake independent thermal testing in shallow water on full scale insulated pipeline systems.
- ***Full Scale Mechanical Performance:*** Subsea Contractors can reduce full-scale SST to the bare minimum, if there is good traceability and transparency of mechanical performance results from both the small and medium scale ageing tests already conducted.

The ISO Standard 12736:2014 advocates using full scale SST (Section 8.2.7, 8.2.8 and 8.2.9) for assessing both in-service thermal and mechanical performance over 1-3 months.

Full Scale Thermal Performance – our experience shows that full scale thermal testing in shallow water (not in hyperbaric vessels) over few days should be good enough for assessing the thermal performance of the wet thermal insulation coatings for pipelines. **We suggest that Subsea Contractors should undertake independent thermal testing in shallow water on full scale insulated pipeline systems.**

Full Scale Mechanical Performance – in our opinion, both the number and the duration of full scale SST performed for Subsea Contractors could be reduced to the bare minimum, if there is good traceability and transparency of mechanical performance results from:

- Small scale material ageing tests performed for specialist chemicals manufacturers
- Medium scale ageing tests performed for coating applicators

Working together to improve innovation and share efficiencies

We are confident that this collaborative approach across the supply chain from Specialist Chemical Manufacturers, Coating Applicators and Subsea Contractors, will maximise testing results and increase efficiencies.

This transparency, with the added benefits of faster commissioning and cost reductions on new field development, will give Operators the confidence to adopt new innovative wet thermal insulation coatings. This brings improvements across the market in a cost effective and collaborative manner.

Next steps

Not sure? Give me a call on +44 (0)330 1192096 and I'd be delighted to share our experience and findings with you.