Application of Uncertainty Analysis in the Design of Subsea Natural Gas Dehydration Units

Advances in subsea processing present the opportunity for high pressure natural gas dehydration and product export directly from the seabed. In this work we evaluate dehydration using monoethylene glycol (MEG) as an absorbent. A combination of parameter uncertainty and process input sensitivity analysis is used to evaluate the feasibility of 18 different scenarios. For a representative light and heavy natural gas, a 3x3 experimental matrix for processing pressure (60, 90 and 120 bar) and lean MEG quality (90, 95 and 98 wt%) was used. 5000 Monte Carlo simulations were performed for each case with the output mean and confidence intervals being calculated.

In terms of dehydration performance, the feed gas composition has only a minor effect in the order of 2.5%. The process is shown to be infeasible when using lean MEG with a quality of 90 wt%, while the lean MEG flow rate can be adjusted to meet product specification of 32 ppm H2O if higher quality lean MEG is used. The required flow rates ranged between 16 and 254 m3/h. The minimum required lean MEG quality is estimated as 95, 93 and 92 wt% at 60, 90 and 120 bar processing pressure respectively. From the upper bound of the 99% confidence interval, it is estimated that the minimum safety factor of 5-9 ppm is required (depending on the quality of lean MEG used).

Secondary performance measures were also evaluated. MEG content in the product gas varied most strongly with gas composition (especially at high pressure), where differences of up 150% are seen for the light and heavy gas. Product recovery was between 97.5 and 99% for the feasible cases with the best recover found at high pressure and lean MEG quality, while recovery of light gas was slightly improved compared to heavy gas.