



Cansolv DC-201 Testing at TCM: Impact of degradation inhibitor on degradation rate and emissions

Matthew Campbell

Shell Cansolv, 400, de Maisonneuve West, Suite 200 Montreal, QC, H3A 1L4, Canada

Abstract

Shell Cansolv and Technology Center Mongstad (TCM) have performed two testing campaigns in 2015 and 2016. For both testing campaigns the evaluated solvent was Cansolv DC-201, which is the latest generation solvent for CO₂ capture which has been developed and deployed by Shell Cansolv. The first TCM demonstration test occurred from November 2014 to May 2015. The objective of this campaign was to confirm scale-up of process performance (CO₂ removal, temperature profiles and energy consumption) from (1 – 8 tons CO₂/day) to (50 – 100 tons CO₂/day). This has been achieved and good model validation results have been presented at GHGT-12.

Also, during the first demonstration campaign a focus was made to clearly understand the Cansolv DC-201 degradation rate and the amount of emissions (amine and degradation products) that enter the atmosphere. The test in 2015 was a benchmark or baseline test where no inhibitors of degradation have been added to the process. The emission results in the absence of degradation inhibitors were still below the acceptable emission levels according to the TCM emission permit regulated by Norwegian authorities. Accurate measurements and calculations for degradation and emissions were only possible due to the good instrument and analytical capabilities of TCM and Shell Cansolv. All necessary instrument and lab quality assurance were confirmed prior to the start of the testing campaigns. The most important quality assurance checks performed were:

- CO₂ gas analyzers (absorber inlet, absorber outlet and CO₂ product)
- Tank levels and solvent inventory throughout the plant
- Steam flowrate
- Liquid Chromatography Mass Spectrometry (LCMS) – used for monitoring amine and amine degradation product concentration in the solvent
- Proton Transfer Reaction Mass Spectrometry (PTR-MS) – used for monitoring amine and amine degradation product concentration in solution
- Fourier Transform Infrared Spectroscopy (FTIR) – used for online emission monitoring (amine and amine degradation product components)
- Proton Transfer Reactor Time-of-Flight Mass Spectrometry (PTR-TOF-MS) – used for online emission monitoring (amine and amine degradation product components)
- Extractive impinger gas sampling – used for emission monitoring (amine and amine degradation product components)

In 2016 an additional demonstration campaign was planned and performed at TCM with a very effective degradation inhibitor for Cansolv DC-201. This inhibitor was identified by Shell Cansolv after performing carefully controlled laboratory experiments which mimicked real plant operation. Many inhibitors have been screened during these laboratory tests and Cansolv Inhibitor DC-A was identified as the best candidate for technology development at the larger scale. This inhibitor was not only screened for performance (i.e. the reduction of degradation rate) but also cost, availability, health and safety and the by-products which are formed. This presentation will demonstrate the difference of degradation and emission levels when the Cansolv Inhibitor DC-A was added to the Cansolv DC-201 solvent at TCM. The operation conditions of testing with and without inhibitor were closely mimicked to ensure a relevant head to head comparison was possible.