A Better Method for Preventing Hydrate Plugs in Deep Sea Oil and Gas Pipelines

1988-1993

Challenge/Motivation

As much as one-third of the world’s oil and gas comes from offshore sources. Because these pipelines are underwater and inaccessible, ensuring that oil and gas can flow through them is vital. Yet the high pressures and low temperatures within these pipelines can lead to the development of solid hydrate plugs that clog the flowline. In deepwater oil and gas production, hydrate plugs are the largest single problem in flow assurance. These plugs are costly, as drilling operations need to be shut down and depressurized for up to a year to remove the plug. Traditional plug prevention methods, including alcohol or glycol injection, are expensive, and displacement of the flowline fluids by “dead” oil as a last resort causes long shutdowns.

Solution

In 1988, Dendy Sloan and Raj Bishnoi (U. Calgary) were driving to Banff and talking about new ways to prevent the hydrate plugs from forming. They realized that they should look beyond the mechanism used by standard methanol and glycol plug inhibitors, which disrupt water solid formation by hydrogen bonding, and investigate other factors.

In 1990, Mines asked for the oil industries’ support in two methods of investigation: computer simulations and a trial and error approach to test a wide variety of chemicals from different chemical families. The computer simulation was too slow to make progress, but using the second method, the group at Mines developed a screening technique for over 2,000 chemicals. They discovered the first new hydrate plug inhibitor in 1993 and classified sister chemicals the next year. This new class of inhibitor worked by adsorbing the polymer onto the hydrate crystal surface, preventing the growth of plugs.

Real World Impact

By 2003, the new Mines’ inhibitors were being used in many hydrate plug-prone oil and gas pipelines, including by Exxon in the world’s largest gas line. This simple and effective solution has saved the oil and gas industry millions of dollars by preventing the shutdown of deepwater oil and gas lines, and continues to be used today all over the world.

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