Impact of Subcooling on Gas Condensate Systems: Insights into Hydrate Plugging with Methanol and Kinetic Hydrate Inhibitor (KHI)

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The influence of methanol (MeOH) and kinetic hydrate inhibitors (KHIs) on hydrate nucleation and agglomeration is investigated in a gas condensate system. In under-inhibited MeOH systems, the hydrate volume percent (HVP) was higher than the base system (without any inhibitor), indicating a higher rate of hydrate formation. The addition of MeOH, combined with ball movement in rocking cells, produced an emulsion with smaller droplets relative to the base system, contributing to a higher rate of hydrate formation. The impact of subcooling with various MeOH concentrations was analyzed and defined under three transition zones: non-flowable, flowable slurry (sweet inhibition), and full inhibition. Sweet-inhibition, is defined as the THI concentration or subcooling that enables a flowable hydrate slurry, reducing the risk of hydrate blockage. Five commercial KHIs were tested across different subcoolings, revealing sticky hydrate plugs deposited on top of the sapphire tube in all KHI systems. Visual observations indicated differences in hydrate plug morphology, with the base system displaying solid plugs (hard), the MeOH system exhibiting permeable plugs (porous), and adhesive plugs (sticky) in KHI systems. Both MeOH and KHI systems showed that lower subcooling temperatures might mitigate hydrate plugging tendencies and delay nucleation. The KHI systems showed delayed nucleation with decreasing subcooling.