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## Understanding Kinetic Hydrate Inhibitor and Corrosion Inhibitor Interactions

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### Abstract

Kinetic Hydrate Inhibitors (KHI) are increasingly becoming more prevalent in the oil and gas industry, thus the knowledge of how they impact other oilfield chemicals becomes important. This paper will attempt to explain how these products impact both the KHIs and corrosion inhibitors (CI) performance in the presence of each other. Application: This paper will address fundamental properties of both chemistries and how their interaction can be understood at the molecular level. Ultimately, this fundamental understanding allows for a more informed selection of KHI and CI for sub-sea applications. Results, Observations, and Conclusions: A more in-depth understanding of how KHI and CI interact with each other will allow for better selection of these products and will help develop the next generation of these chemistries. By understanding at the molecular level more favorable selection can be made and problems of negative interaction can be avoided. This work will explore the possibility of two separate mechanisms that can cause KHIs and CIs to negatively impact each other. The two mechanisms will be explored by using LC/MS (Liquid Chromatography Mass Spectrum) and SFT (Surface Tension measurement) with the results from these exploratory techniques correlated to performance testing for both KHIs and CIs we hope to gain a better grasp of the underlying issue. Significance of Subject Matter: The compatibility of the KHI with the CI is not a well-understood phenomenon and this paper will address this compatibility from a chemistry point of view. Therefore, this provides a more fundamental insight into the interactions of KHI'S and CIs.

### Introduction

The oil and gas industry is relying on more and more on chemical solutions for flow assurance and corrosion inhibition, however these chemicals not only interact with the environment they can interact with each other. Several papers (Frostman, L.M et al, Fu, B, Graham, G.M et al, Swanson, T.A et al and McDonald, A.W.R et al) have addressed this interaction highlighting, negative, positive or neutral impact from a performance standpoint. A literature review reveals that none have delved into the chemistry of Kinetic Hydrate Inhibitors (KHI) and Corrosion Inhibitors (CI) to explore the interaction from a more fundamental viewpoint. Klomp et al (Klomp, U et al) reports that the origins of these incompatibles are still unknown. This stems from the fact that chemical vendors are hesitant to divulge chemical compositions to the industry. This paper will discuss the interaction of the KHIs and CIs at a fundamental level with the hope that a deeper understanding of why these incompatibilities exist will then enable a better-informed decision of a particular KHI and CI for an individual asset.

Hydrate inhibition has traditionally used mechanical methods to avoid hydrate formation by preventing their formation this was accomplished utilizing heated/insulated pipes or by gas dehydration. Another conventional means of preventing hydrates is utilization of Thermodynamic Hydrate Inhibitors (THIs) such as methanol and monoethyleglycol. More recently hydrate control has been achieved through the use of Low Dosage Hydrate Inhibitors (LDHI). LDHI use has allowed for lower volumes of chemical to be employed. The two types of LDHI are anti-agglomerates (AAs) and kinetic hydrate inhibitors (KHIs). AAs allow the hydrate crystals to form but manage the size of the crystals so that they can be dispersed in the hydrocarbon fluid. The surfactant molecules are able to surround the hydrate crystal and prevent crystal growth. AAs are typically used for severe hydrate conditions and long shut-in periods. On the other hand KHI's interfere with the crystal nucleation process, thus delaying the onset of hydration for a significantly longer period of time. KHI's are typically used at more moderate sub-cooling and can be used at a wide variety of water cuts. LDHI's are typically of polymer type chemistry and commonly versions of polyvinylpyrrolidone (PVP) and/or polyvinylcaprolactam as either homopolymers or co-polymers.