SCALING -UP FROM A FIXED BED REACTOR TO A MULTI-TUBULAR REACTOR FOR A HIGHLY EXOTHERMIC HYDROSILYLATION REACTION

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Abstract

The design and operation of heterogeneous reactors highly exothermic reactions require special attention to heat transfer requirements. This presentation will provide an example for the scale-up of such a reaction from a conventional fixed bed reactor to a multi-tubular fixed bed reactor, based on heat transfer requirements. Included in this example will be some process design considerations for inherently safe operation as well some start-up considerations.

Keywords

Hydrosilylation, Heterogeneous Catalyst, Fixed Bed Reactor, Multi-tubular Reactor, Heat Transfer, Safety

Introduction

Hydrosilylation is a key technology for the production of organofunctional silanes and silicones. The subject of this presentation will focus on the hydrosilylation an alkene with trichlorosilane, $HSiCl_3$, as shown below:

The reaction is commonly carried out using a catalyst. The most common catalysts are based on Pt group metals. Commercially used catalysts include both homogeneous metal complexes and heterogeneous supported metal catalysts.

Discussion

The hydrosilylation reaction of olefins is very exothermic with heat of reaction typically in the range of 25-40 kcal/mol. Design, start-up, and operation of a commercial scale hydrosilylation process requires careful attention to manage the exothermic nature of this reaction. Further complications often arise due to issues involving catalyst activation as well as catalyst deactivation and poisoning.

This presentation will provide an example of scaling up from a conventional fixed bed reactor to a multi-tubular fixed bed reactor to provide improved heat transfer and temperature control. The example will include process design considerations (designing for inherently safe operation) as well as start-up considerations.

Conclusion

The design and operation of fixed bed reactors for highly exothermic reactions is dominated by heat transfer considerations. Understanding of reaction kinetics and mass transfer are critical for accurately being able to predict temperature profiles within the reactor and heat transfer required for safe operation.

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