

The Effect of Sulphur on the Catalytic Performance of Cobalt-based Fischer-Tropsch Catalysts

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1. INTRODUCTION

Biomass and natural gas can play a role in the reduction of the oil share and, at the same time, minimize the anthropogenic greenhouse gas emissions, mainly, CO₂ [1]. These two issues make the catalytic conversion of synthesis gas into hydrocarbons via Fischer-Tropsch synthesis (FTS) an interesting process. Sulphur compounds contained in biomass or natural gas are known to be severe poisons for FT catalysts [2-4]. Studies on cobalt-based FT catalysts can be found in literature [2, 5, 6]. However, there is no full agreement on the effect of this poison on the FT product selectivity [5,6]. In this study, cobalt catalyst samples were loaded with different amounts of sulphur and tested under realistic conditions to analyze the effect of sulphur on their catalytic performance.

2. EXPERIMENTAL

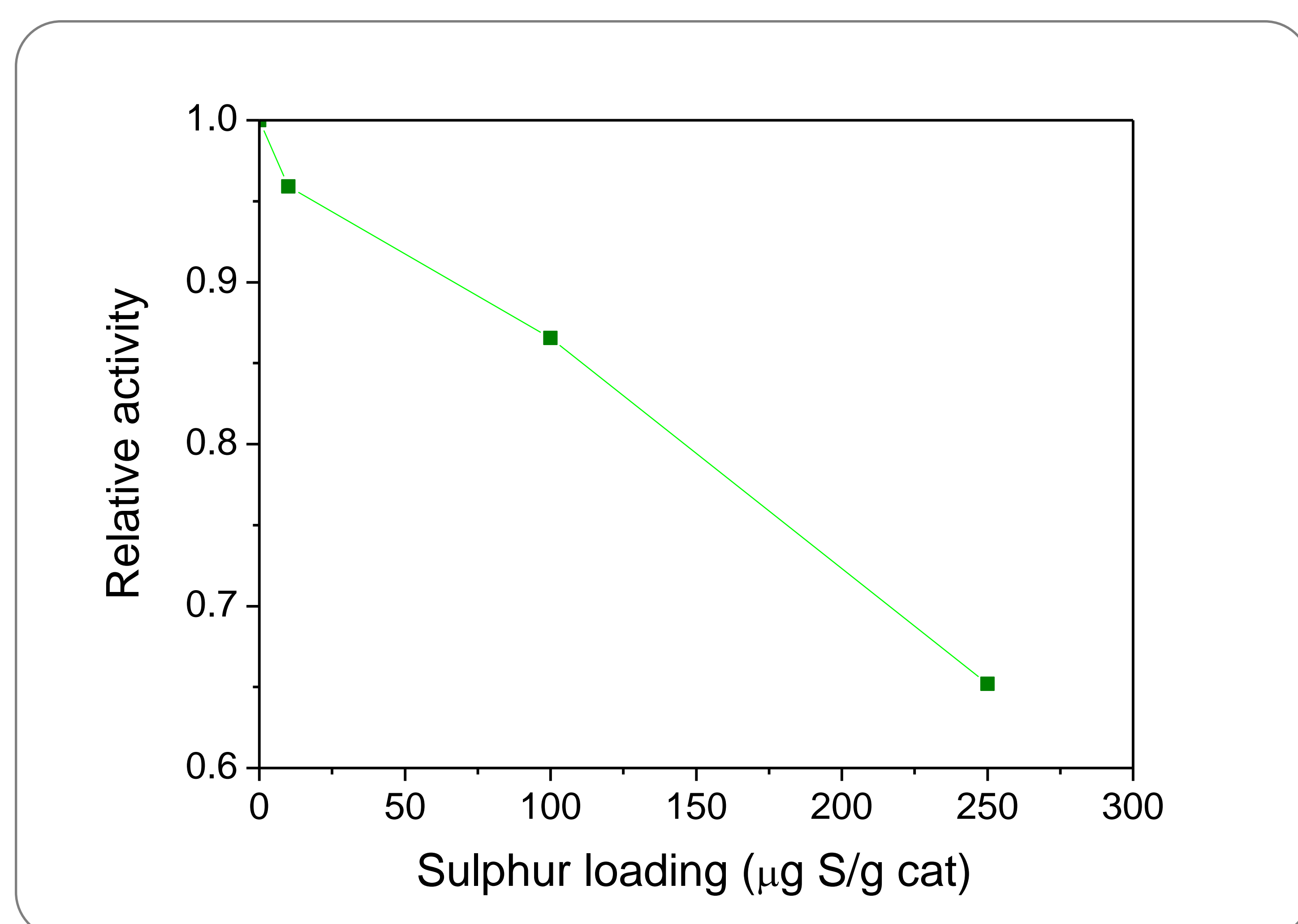
The cobalt-based catalyst, consisting of 12 %wt. Co and 0.5 %wt. Pt was prepared by incipient wetness impregnation of a γ -Al₂O₃ support with cobalt and platinum nitrate aqueous solutions. Prior to sulphur addition, the catalyst was reduced at 623 K during 16 h in H₂. Sulphur addition was performed by incipient wetness impregnation using ammonium sulphide aqueous solutions in an inert atmosphere in order to better simulate the interaction of S with reduced Co. By using this method, catalyst samples loaded with 10, 100 and 250 ppm of S were prepared. The catalysts were reduced in situ, once more, at the same conditions. The catalysts were tested at 20 bars and 483 K using a synthesis gas with a H₂/CO ratio of 2.1.



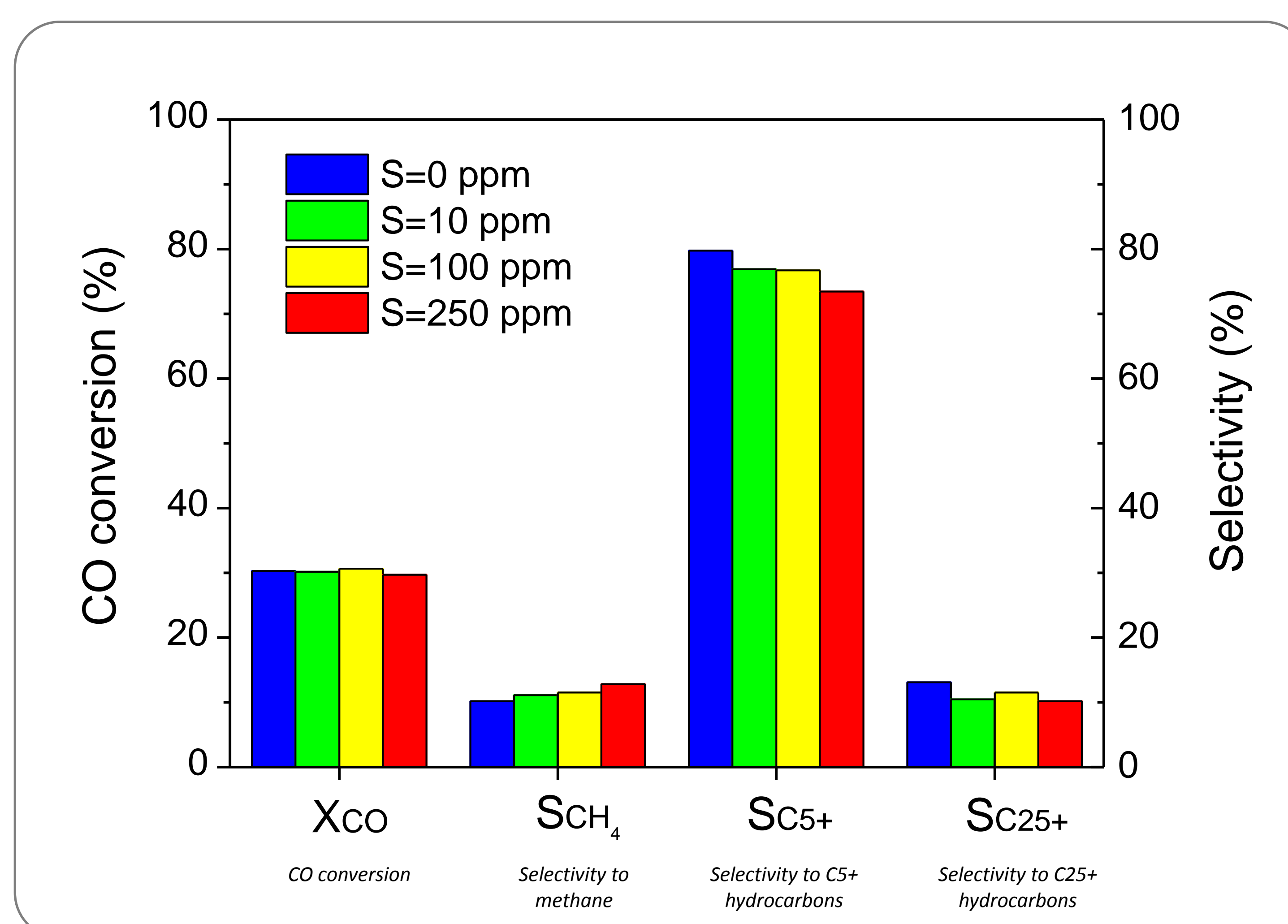
Chamber used for sulphur addition in inert atmosphere

3. RESULTS AND DISCUSSION

1) Effect of sulphur on activity



2) Effect of sulphur on selectivity



IMPORTANT NOTE: different GHSV were used in order to evaluate the differences in selectivity at the same CO conversion level.

4. CONCLUSIONS

- Sulphur has a negative effect on the activity of cobalt-based catalysts even at low sulphur coverages.
- The presence of sulphur on the cobalt surface decreases the selectivity to long chain hydrocarbons, specially, at high sulphur coverages.

References:

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