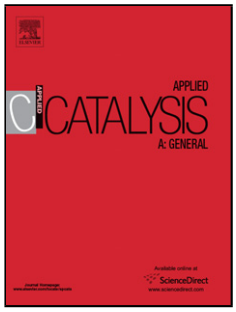

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Title **Deactivation of alumina supported cobalt FT catalysts during testing in a Continuous-stirred tank reactor (CSTR)**

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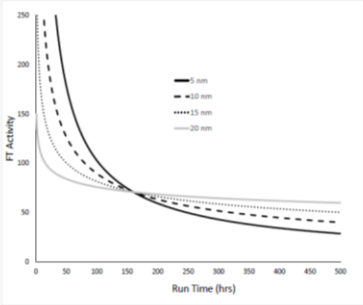
Graphical abstract;



Highlights:

- Cobalt FT catalysts synthesised with a range of metal particle sizes
- CSTR testing demonstrates that small cobalt particles deactivate rapidly
- Deactivation is consistent with an Ostwald ripening sintering process
- Stable FT operation requires cobalt particles > 20 nm

Abstract

A set of alumina supported cobalt catalysts was prepared, varying the synthesis method and formulation to produce a range of cobalt particle sizes. A combination of degree of reduction (DOR) measurements and H_2 chemisorption was used to calculate the cobalt particle sizes on the fresh catalyst samples (5-19 nm). The catalysts were pre-reduced and encapsulated in wax prior to testing for Fischer-Tropsch (FT) activity in a continuous-stirred tank reactor (CSTR) system for between 500 and 6000 hrs on-line. The catalysts all demonstrated rapid deactivation over the first 200 hrs of FT testing, with the catalysts with the highest initial activity deactivating most rapidly. Characterisation of the discharged catalysts samples using XRD, TEM and H_2 chemisorption indicated that the cobalt particles had undergone a sintering process consistent with an Ostwald ripening mechanism. Catalyst stability in CSTR testing can be enhanced by the presence of large cobalt particles (> 20 nm).

Key words Fischer-Tropsch, Cobalt catalyst, Deactivation, Sintering, CSTR testing