
Chapter 3: Objective of investigation

3.1. Introduction

The extensive literature survey presented in the previous section provides evidence that the subject of catalytic gasification has previously received considerable attention. Various aspects of catalytic gasification, including type of catalysts, impregnation methods, reaction mechanisms and kinetic models, have been studied in order to develop and improve the fundamental approach towards catalytic gasification.

It was found that potassium carbonate is the most effective catalyst, and that the impregnation method should be selected based on the particle size used and the degree of dispersion obtainable. The ESI method was therefore selected to impregnate the large coal particles, in order to obtain sufficient contact between the catalyst solution and coal. The complex mechanism of catalytic steam gasification has been studied by various researchers and a consensus exists that the mechanism does follow a redox cycle. Up until now, research conducted in the field of gasification has only focused on coal particles as large as 3 mm.

The conclusions drawn from the literature review, as mentioned above, were used to formulate the aim, objectives and scope of this investigation.

3.2. Aim

The main aim of this investigation was to identify a suitable impregnation method to impregnate large coal particles, and to study the influence of catalyst addition in terms of reactivity.

3.3. Objectives of this investigation

- To impregnate the coal particles using K_2CO_3 as catalyst, and the excess solution impregnation method (ESI).

- To study the effect of impregnation on large coal particles in terms of catalyst loading, catalyst distribution and structural changes.
- To investigate the influence of catalyst addition to large coal particles in terms of reactivity, by conducting steam gasification experiments.

3.4. Scope of this investigation

A relatively low ash coal will be selected for this study, and a general characterisation will be conducted on a representative sample of the bulk coal sample. For experimentation purposes, coal particle sizes of 5 mm, 10 mm, 20 mm and 30 mm will be used. Potassium carbonate (K_2CO_3) will be used as catalyst, and the coal particles will be impregnated using the ESI method. Catalyst loading will be determined using two methods, namely: XRF, where the wt.% of K in the ash will be measured, and ISE (ion-specific electrode), where the difference in $[K^+]$ of the impregnation solution will be determined. Isothermal steam gasification experiments will be conducted in a large particle TGA, at 800 °C, 825 °C, 850 °C and 875 °C, with 80 mol% steam. Raw and impregnated coal particles will be used for the reactivity experiments in order to study the catalytic effect.