Chapter 1

Introduction

1.1 Background

During the last couple of years , there has been a renewed interest in the use of Fischer-Tropsch technology for the conversion of natural gas to hydrocarbon liquids (GTL process). Some of the factors that contributed to this are (Vosloo, 2001):

1. An increase in the known reserves of natural gas.
2. The need to monetise remote or stranded natural gas.
3. Environmental pressure to minimise the flaring of associated gas.
4. Improvements in the cost-effectiveness of Fischer-Tropsch technology resulting from the development of more active catalysts and improved reactor designs.

The process to convert natural gas to hydrocarbon liquids can be divided into three process steps:

1. Syngas generation
2. Syngas conversion
3. Hydroprocessing

Although all three of the technologies for converting natural gas to hydrocarbon liquids are well established, individually optimised and commercially proven, the combined use is not widely applied (Vosloo, 2001). The optimal layout of the plant is determined by both economic and environmental aspects. Thus a balance have to be found between minimising expensive unit processes (economic aspects) and negating environmental impacts. The Gas–to–Liquids (GTL) process would only be viable if capital cost could be reduced through integration (Hill, 1998). The integration of the three technologies for converting natural gas to liquids poses an interesting challenge to the designer. In order to make the GTL technology more competitive, the challenge goes beyond the optimization that deals only with the known aspects of these technologies. It also includes those aspects that are not commercialised yet and that may still be in the very early stages of development.

In this work an integrated GTL process design will thus be developed with specific focus on:

- optimization of product yield (i.e. maximum carbon efficiency) and
- minimum energy requirements.

A combination of process synthesis and exergy analysis will be used to reach these specific goals. The process synthesis will give the initial direction and identify the governing variables in the process. An exergy analysis will provide a sufficient approximation to the minimum energy requirements. In contrast to a mere energy study the exergy analysis also takes the thermodynamic quality of heat compared with other resources into consideration (Futterer *et al.*, 1996). In order to illustrate the applicability of the exergy concept and a way of presenting results of exergy analyses, computer-aided exergy analyses will be carried out for several process routes to find the optimum integrated GTL process. This work will only focus on the interaction between the syngas generation and syngas conversion process steps and will be referred to as the GTL process. The hydroprocessing units were not modelled and will thus not be included in this study.