Abstract

Natural gas is generally defined as a naturally occurring mixture of gases containing both hydrocarbon and nonhydrocarbon gases. The hydrocarbon components are methane and a small amount of higher hydrocarbons. The nonhydrocarbon components are mainly the acid gases hydrogen sulfide (H$_2$S) and carbon dioxide (CO$_2$) along with other sulfur species such as mercaptans (RSH), organic sulfides (RSR), and carbonyl sulfide (COS). Nitrogen (N$_2$) and helium (He) can also be found in some natural gas fields. Natural gas must be purified before it is liquefied, sold, or transported to commercial gas pipelines due to toxicity and corrosion-forming components. H$_2$S is highly toxic in nature. The acid gases H$_2$S and CO$_2$ both form weak corrosive acids in the presence of small amounts of water that can lead to first corrosion and later rupture and fire in pipelines. CO$_2$ is usually a burden during transportation of natural gas over long distances. CO$_2$ removal from natural gas increases the heating value of the natural gas as well as reduces its greenhouse gas content. Separation of methane from other major components contributes to significant savings in the transport of raw materials over long distances, as well as savings from technical difficulties such as corrosion and potential pipeline rupture.

Natural gas processing projects are facing challenges due to stringent sales gas specifications and increasingly impure natural gas. CO$_2$, H$_2$S, N$_2$, He, COS, water, mercaptans, and organic sulfides need to be removed from natural gas prior to its liquefaction or sales. This report addresses the technology review and process economics of removing acid gases H$_2$S and CO$_2$ from raw natural gas and the subsequent conversion of H$_2$S to sulfur for sale. This report also gives an overview of conventional treating technologies, gas sweetening solvents, and the latest treating technologies for CO$_2$ removal, mainly using absorption processes.

This report presents the comparative technoeconomic evaluation for different feedstock with varying CO$_2$ and H$_2$S composition in the feed natural gas, by using two different type of solvents as mentioned below.

To illustrate the process economics of acid gas removal and sulfur recovery, we selected the following two modules. For Module-1, nine cases have been evaluated and compared, and for Module-2, three cases have been evaluated and compared. These cases have different sour gas feedstock natural gas composition by varying CO$_2$ and H$_2$S concentration. Following are the two type of modules that have been evaluated:

- **Module-1:** Acid gas removal from natural gas using MDEA and piperazine amine solvents, Claus sulfur recovery, and tail gas treatment using MDEA amine sweetening solvent

- **Module-2:** Acid gas removal from natural gas using Shell’s Sulfinol*-X solvents, Claus sulfur recovery, and tail gas treatment using MDEA amine sweetening solvent

In these modules, each case has different H$_2$S and CO$_2$ concentrations in the feedstock raw natural gas. For different cases, CO$_2$ molar concentration is varies between 5%, 12%, and 20%, and H$_2$S molar concentration varies between 2%, 6%, and 10% in raw natural gas feedstock. For Module-1, nine cases, and for Module-2, three cases have been technoeconomically evaluated and compared for different combinations of H$_2$S, CO$_2$ concentration in the feedstock. For these different feedstock raw natural gas compositions, CAPEX and net production cost graphs has been prepared and results discussed for removal of acid gases from raw natural gas feed.
# Contents

<table>
<thead>
<tr>
<th></th>
<th>Introduction</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Summary</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Module-1—Acid gas removal from natural gas using MDEA and piperazine amine solvents, Claus sulfur recovery, and tail gas treatment using MDEA amine sweetening solvent</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>Module-2—Acid gas removal from natural gas using Shell's Sulfinol-X solvents, Claus sulfur recovery, and tail gas treatment using MDEA amine sweetening solvent</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Economic aspects</td>
<td>16</td>
</tr>
<tr>
<td>2</td>
<td>Commercial status</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>Natural gas market</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>Overall global energy perspective—Current and historical</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>World major natural gas reserves</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>Natural gas world production and consumption</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td>Natural gas as a major energy source for the United States</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>Raw natural gas composition</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td>Natural gas product specifications</td>
<td>33</td>
</tr>
<tr>
<td>3</td>
<td>Technical review</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td>Acid gas removal</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td>Conventional acid gas removal processes and criteria for selection</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td>Basics of gas sweetening process</td>
<td>39</td>
</tr>
<tr>
<td></td>
<td>Absorber column</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>Regenerator column</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>Rich amine flash drum</td>
<td>41</td>
</tr>
<tr>
<td></td>
<td>Lean/rich exchanger</td>
<td>41</td>
</tr>
<tr>
<td></td>
<td>Solvent make-up</td>
<td>41</td>
</tr>
<tr>
<td></td>
<td>Circulation pump</td>
<td>41</td>
</tr>
<tr>
<td></td>
<td>Air cooler</td>
<td>41</td>
</tr>
<tr>
<td></td>
<td>Chemical solvents</td>
<td>41</td>
</tr>
<tr>
<td></td>
<td>Chemistry of alkanolamines solutions</td>
<td>42</td>
</tr>
<tr>
<td></td>
<td>Acid gas loading</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>Gas sweetening chemical solvent</td>
<td>44</td>
</tr>
<tr>
<td></td>
<td>Monoethanol amine (MEA)</td>
<td>44</td>
</tr>
<tr>
<td></td>
<td>Diglycolamine (DGA)</td>
<td>44</td>
</tr>
<tr>
<td></td>
<td>Diethanolamine (DEA)</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>Disopropylamine (DIPA)</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>Methyldiethanolamine (MDEA)</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td>Properties of chemical alkanolamine solvents</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td>Chemical solvent blending</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td>Mixed amines</td>
<td>47</td>
</tr>
<tr>
<td></td>
<td>Additives</td>
<td>47</td>
</tr>
<tr>
<td></td>
<td>Sulfur recovery unit (SRU)</td>
<td>49</td>
</tr>
<tr>
<td></td>
<td>Conventional Claus process</td>
<td>49</td>
</tr>
<tr>
<td></td>
<td>Claus straight through process</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>Burner and waste heat boiler (WHB)</td>
<td>50</td>
</tr>
</tbody>
</table>
Claus beds 51
Sulfur condensers 52
Preheater 52
Different configuration of sulfur recovery unit 52
Acid gas bypass configuration 52
Preheating configuration 53
Tail gas treating unit 53

5 Module-1—Acid gas removal from natural gas using MDEA and piperazine amine solvents, Claus sulfur recovery, and tail gas treatment using MDEA amine sweetening solvent 55

Review of processes 56
Activated MDEA solution 56
Solution concentration 56
Chemistry 57
Process economics 58
Capital cost 58
Production cost 58
Process economics by case 59
Module-1, Case-1 60
Process description 60
Acid gas removal unit (AGRU) 60
Sulfur recovery unit (SRU) 61
Tail gas treating unit (TGTU) 61
Cost estimates 71
Capital cost 71
Production cost 73
Module-1, Case-2 77
Module-1, Case-3 89
Module-1, Case-4 101
Module-1, Case-5 113
Module-1, Case-6 125
Module-1, Case-7 137
Module-1, Case-8 149
Module-1, Case-9 161
Process discussion 173
Economic discussion 175

6 Module-2—Acid gas removal from natural gas using Shell’s Sulfinol®-X solvents, Claus sulfur recovery, and tail gas treatment using MDEA amine sweetening solvent 181

Review of processes 182
Solution concentration 182
Process advantage 183
Process economics 185
Capital cost 185
Production cost 185
Process economics by case 186
Module-2, Case-10 187
Module-2, Case-11 199
Module-2, Case-12 211
Process discussion 223
Economic discussion 224

Appendix A—Patent summary tables 227
Appendix B—Cited references 231
Appendix C—Properties of technical grade absorption solvents 234
Appendix D—Process flow diagrams 236
## Tables

Table 1.1 List of cases considered in Module-1 (varying CO₂ and H₂S composition in feed raw natural gas) 12
Table 1.2 List of cases considered in Module-2 (varying CO₂ and H₂S composition in feed raw natural gas) 13
Table 2.1 List of cases considered in Module-1 by (varying CO₂ and H₂S composition in feed raw natural gas), feed flow, treated natural gas mass and volumetric flow 15
Table 2.2 List of cases considered in Module-2 by (varying CO₂ and H₂S composition in feed raw natural gas), feed flow, treated natural gas mass and volumetric flow 16
Table 2.3 Summary of economics for acid gas removal and sulfur recovery for nine cases of Module-1 17
Table 2.4 Net sweetening cost based on unit volume of sour gas feed of Module-1 cases 20
Table 2.5 Summary of economics for acid gas removal and sulfur recovery for three cases of Module-2 21
Table 2.6 Net sweetening cost based on unit volume of sour gas feed of Module-2 cases 23
Table 3.1 Global natural gas production by country and region, 2010–40 26
Table 3.2 Top five proved reserves of natural gas by country—2012 27
Table 3.3 Top twenty proved reserves of natural gas by country—2012 28
Table 3.4 Proved reserves of natural gas for different world regions—2012 28
Table 3.5 World natural gas production and consumption by region—2012 30
Table 3.6 US natural gas supply and demand—2012 31
Table 3.7 Historical US consumption of natural gas in chemicals 31
Table 3.8 Historical Western Europe consumption of natural gas in chemicals 32
Table 3.9 Typical shale gas composition 32
Table 3.10 Representative Marcellus shale gas compositions 33
Table 3.11 Pipeline natural gas specification 33
Table 4.1 Operating parameters of alkanolamine solvents 46
Table 4.2 CO₂ absorption technologies (includes H₂S absorption also) 48
Table 4.3 Recommended configuration of sulfur recovery unit 52
Table 5.1 List of cases considered in Module-1 by (varying CO₂ and H₂S composition in feed raw natural gas) 55
Table 5.2 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-1 Design bases and assumptions 63
Table 5.3 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-1 Main stream flows 65
Table 5.4 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-1 Major equipment 69
Table 5.5 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-1 Utilities summary 71
Table 5.6 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-1 Capital investment by section 72
Table 5.7 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-1 Total capital investment 73
Table 5.8 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-1 Production costs 74
Table 5.9 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-2 Design bases and assumptions 77
Table 5.10 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-2 Main stream flows 79
Table 5.11 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-2 Major equipment 83
Table 5.12 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-2 Utilities summary 85
Table 5.13 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-2
Capital investment by section

Table 5.14 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-2
Total capital investment

Table 5.15 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-2
Production costs

Table 5.16 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-3
Design bases and assumptions

Table 5.17 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-3
Main stream flows

Table 5.18 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-3
Major equipment

Table 5.19 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-3
Utilities summary

Table 5.20 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-3
Capital investment by section

Table 5.21 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-3
Total capital investment

Table 5.22 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-3
Production costs

Table 5.23 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-4
Design bases and assumptions

Table 5.24 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-4
Main stream flows

Table 5.25 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-4
Major equipment

Table 5.26 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-4
Utilities summary

Table 5.27 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-4
Capital investment by section

Table 5.28 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-4
Total capital investment

Table 5.29 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-4
Production costs

Table 5.30 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-5
Design bases and assumptions

Table 5.31 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-5
Main stream flows

Table 5.32 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-5
Major equipment

Table 5.33 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-5
Utilities summary

Table 5.34 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-5
Capital investment by section

Table 5.35 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-5
Total capital investment

Table 5.36 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-5
Production costs

Table 5.37 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-6
Design bases and assumptions

Table 5.38 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-6
Main stream flows

Table 5.39 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-6
Major equipment
Table 5.40 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-6
Utilities summary 133
Table 5.41 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-6
Capital investment by section 133
Table 5.42 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-6
Total capital investment 134
Table 5.43 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-6
Production costs 135
Table 5.44 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-7
Design bases and assumptions 137
Table 5.45 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-7
Main stream flows 139
Table 5.46 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-7
Major equipment 143
Table 5.47 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-7
Utilities summary 145
Table 5.48 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-7
Capital investment by section 145
Table 5.49 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-7
Total capital investment 146
Table 5.50 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-7
Production costs 147
Table 5.51 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-8
Design bases and assumptions 149
Table 5.52 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-8
Main stream flows 151
Table 5.53 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-8
Major equipment 155
Table 5.54 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-8
Utilities summary 157
Table 5.55 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-8
Capital investment by section 157
Table 5.56 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-8
Total capital investment 158
Table 5.57 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-8
Production costs 159
Table 5.58 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-9
Design bases and assumptions 161
Table 5.59 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-9
Main stream flows 163
Table 5.60 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-9
Major equipment 167
Table 5.61 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-9
Utilities summary 169
Table 5.62 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-9
Capital investment by section 169
Table 5.63 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-9
Total capital investment 170
Table 5.64 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-9
Production costs 171
Table 5.65 Configuration of sulfur recovery unit in the cases of Module-1 173
Table 5.66 Rich loading values for Module-1 cases 174
Table 5.67 H2S concentration in sweet gas, by-product sulfur production and cost, incremental product value of Module-1 cases 177
Table 5.68 Net sweetening cost based on unit volume of sour gas feed of Module-1 cases 180
Table 6.1 List of cases considered in Module-2 by (varying CO₂ and H₂S composition in feed raw natural gas) 181
Table 6.2 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-10 187
Design bases and assumptions
Table 6.3 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-10 189
Main stream flows
Table 6.4 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-10 193
Major equipment
Table 6.5 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-10 195
Utilities summary
Table 6.6 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-10 195
Capital investment by section
Table 6.7 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-10 196
Total capital investment
Table 6.8 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-10 197
Production costs
Table 6.9 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-11 199
Design bases and assumptions
Table 6.10 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-11 201
Main stream flows
Table 6.11 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-11 205
Major equipment
Table 6.12 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-11 207
Utilities summary
Table 6.13 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-11 207
Capital investment by section
Table 6.14 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-11 208
Total capital investment
Table 6.15 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-11 209
Production costs
Table 6.16 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-12 211
Design bases and assumptions
Table 6.17 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-12 213
Main stream flows
Table 6.18 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-12 217
Major equipment
Table 6.19 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-12 219
Utilities summary
Table 6.20 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-12 219
Capital investment by section
Table 6.21 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-12 220
Total capital investment
Table 6.22 Acid gas removal from natural gas by MDEA and piperazine solvent—Case-12 221
Production costs
Table 6.23 Configuration of sulfur recovery unit in the cases of Module-2 223
Table 6.24 Rich loading values for Module-2 cases 224
Table 6.25 H₂S concentration in sweet gas, by-product sulfur production and cost, incremental product value of Module-2 cases 225
Table 6.26 Net sweetening cost based on unit volume of sour gas feed of Module-2 cases 226
Figures

Figure 2.1 CAPEX of natural gas treating plant (AGRU, SRU, and TGTU) with varying H2S and CO2 molar % in raw natural gas feed for Module-1 cases 18

Figure 2.2 Cash cost per 1000 SCF of treated natural gas of natural gas treating plant with varying H2S and CO2 molar % in raw natural gas feed for Module-1 cases 19

Figure 2.3 Gross sweetening cost (incremental product value + by-product sulfur cost) of natural gas treating plant with varying H2S and CO2 molar % in raw natural gas feed for Module-1 cases 20

Figure 2.4 CAPEX of natural gas treating plant (AGRU, SRU, and TGTU) with varying H2S and CO2 molar % in raw natural gas feed for Module-2 cases 22

Figure 2.5 Cash cost per 1,000 SCF of treated natural gas of natural gas treating plant with varying H2S and CO2 molar % in raw natural gas feed for Module-2 cases 23

Figure 3.1 Global increase in natural gas production by country grouping, 2010–40 25

Figure 3.2 Global natural gas consumption by major regions, 2010–40 26

Figure 3.3 World natural gas production and consumption, 1992–2012 29

Figure 3.4 US natural gas consumption breakdown—2012 30

Figure 4.1 Block flow diagram of complete cycle of natural gas production plant, from well to sale gas 34

Figure 4.2 General block flow diagram of acid gas removal and sulfur recovery 35

Figure 4.3 Acid gas removal processes 37

Figure 4.4 Typical acid gas absorption using chemical solvents 38

Figure 4.5 Typical acid gas absorption using physical solvents 38

Figure 4.6 Selection chart for acid gas removal processes 39

Figure 4.7 General process flow diagram for a solvent-based sweetening process 40

Figure 4.8 Chemical structure of primary, secondary and tertiary amines 42

Figure 4.9 Molecular structure of MEA 44

Figure 4.10 Molecular structure of DGA 45

Figure 4.11 Molecular structure of DEA 45

Figure 4.12 Molecular structure of DIPA 46

Figure 4.13 Molecular structure of MDEA 46

Figure 4.14 Molecular structure of piperazine and phosphoric acid 47

Figure 4.15 Process flow diagram of Claus straight through process 50

Figure 4.16 Burner and waste heat boiler (EP 1355719B1) 50

Figure 4.17 Process flow diagram of acid gas bypass scheme of sulfur recovery unit 53

Figure 4.18 Process flow diagram of tail gas treating unit 54

Figure 5.1 Molecular structure piperazine related intermediate compound and MDEA 57

Figure 5.29 CAPEX of natural gas treating plant (AGRU, SRU, and TGTU) with varying H2S and CO2 molar % in raw natural gas feed for Module-1 cases 176

Figure 5.30 Incremental product value of natural gas treating plant with varying H2S and CO2 molar % in raw natural gas feed for Module-1 cases 178

Figure 5.31 Gross sweetening cost (incremental product value + by-product sulfur cost) of natural gas treating plant with varying H2S and CO2 molar % in raw natural gas feed for Module-1 cases 179

Figure 5.32 By-product (sulfur) cost of natural gas treating plant with varying H2S and CO2 molar % in raw natural gas feed for Module-1 cases 180

Figure 6.1 Sulfolane molecular structure 183

Figure 6.2 Typical block flow diagram for treating sour gas requiring multiple process steps 184

Figure 6.3 Gas treating block flow diagram using Sulfino™-X technology is much simpler 185

Figure 6.13 CAPEX of natural gas treating plant (AGRU, SRU, and TGTU) with varying H2S and CO2 molar % in raw natural gas feed for Module-2 cases 225

Figure 6.14 Incremental product value of natural gas treating plant with varying H2S and CO2 molar % in raw natural gas feed for Module-2 cases 226

Figure 5.2 PFD of acid gas removal—Case-1 237