The Sour Gas, Sulfur and Acid Gas Book

Technology and Application in Sour Gas Production, Treating and Sulfur Recovery

(SI Units)

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Preface

The objective of **The Sour Gas, Sulfur and Acid Gas Book** is to describe the historical development and current applications of the procedures and processes used in the sour natural gas industry to safely produce, gather and treat sour gas, recover sulfur and dispose of waste products in an environmentally friendly manner.

The production of sour natural gas in large volumes started in the 1950's at Jumping Pound, Alberta, and at Lacq, France, and grew rapidly in the following years in Canada and the United States. This required the development of new technologies to handle the production and processing of the sour gas so that it could be used for industrial and domestic purposes. The evolution of improvements in metallurgy for sour gas, well completion techniques, sour gas treating methods and the increases in sulfur recovery efficiency can be traced by reviewing the papers published in the technical literature or presented at various gatherings of industry experts, such as the Laurance Reid Gas Conditioning Conference (LRGCC) held annually near the end of February in Norman, Oklahoma. Up to about the mid-1950's the topics at such technical conferences dealt mainly with research on natural gas properties and natural gas dehydration. Since that time, the papers dealing with various improvements in sour gas treating and enhancements in sulfur recovery outnumber all other topics at the LRGCC. Currently (2018) the main sour gas developments are taking place in the Middle East, where a major technical conference on Sour Oil and Gas Advanced Technology (SOGAT) takes place annually.

Along with the evolution of the sour gas technology there has been the development and evolution of the internet and the personal computer together with powerful software to simulate and refine any operation in sour gas and any other aspect in the hydrocarbon industry. It is now possible for a design engineer to enter any technical term or phrase into a search engine on the internet and extract detailed information on the topic. So why does one need a book? The intention of this book is to provide a historical perspective and a basic description of the various processes and procedures to get the sour gas safely out of the formation to surface, send it through a network of gathering lines to the central treating plant, separate the acid gas components and then describe the processes for handling the acid gas. With the use of computer simulation software it is possible to elaborate on any aspects of the path of the sour gas from reservoir to the ultimate disposal of the various components in the sour gas. Reference is frequently made to key articles published over the years in trade journals and technical publications, as well as papers presented at various conferences, which provide details on the many topics covered in this book.

There are several sources of information dealing with the above topics that are available for downloading for free. An attempt will be made to reference such sources throughout the book. Additionally, there are simulation programs available for a fee from providers such as AspenTech, Virtual Materials Group (VMGsim), Bryan Research in Texas, Ops Group, FlowPhase and Optimized Gas Treating, Inc.

The book uses SI units (metre-kilogram-second). In a few instances, equivalent Imperial (British) units (foot-pound-second) are also given. A comprehensive explanation of the SI units is available from the Canadian Association of Petroleum Producers (CAPP). The brochure can be downloaded by going to a search engine and entering "Supplementary Metric Practice Guide", then clicking on the appropriate topic, and "Download". The conversion constants between Imperial units and SI units are listed in Table 4-2 on pages 26 to 29 of the CAPP document.

OVERVIEW OF CONTENTS

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PART 3 DESIGN CONSIDERATIONS FOR ACID GAS COMPRESSION AND INJECTION FACILITIES

List of Figures

On the following six pages are shown example illustrations (Figures) from the text, one for each Chapter.

CHAPTER 1

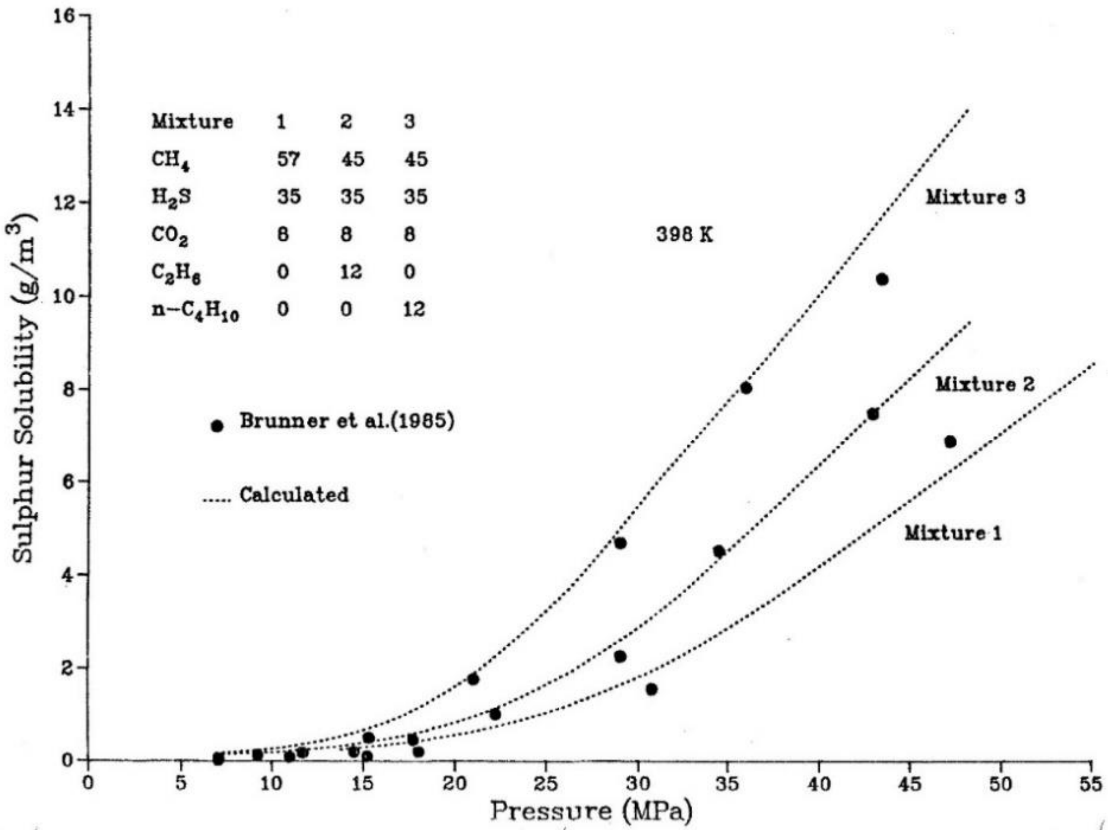


Figure 1.1 Chart Showing Sulfur Solubility at Saturation in Natural Gas Containing 35% H_2S vs. Pressure and Different Compositions. (Reproduced with permission from the Canadian Institute of Mining, Metallurgy and Petroleum.)

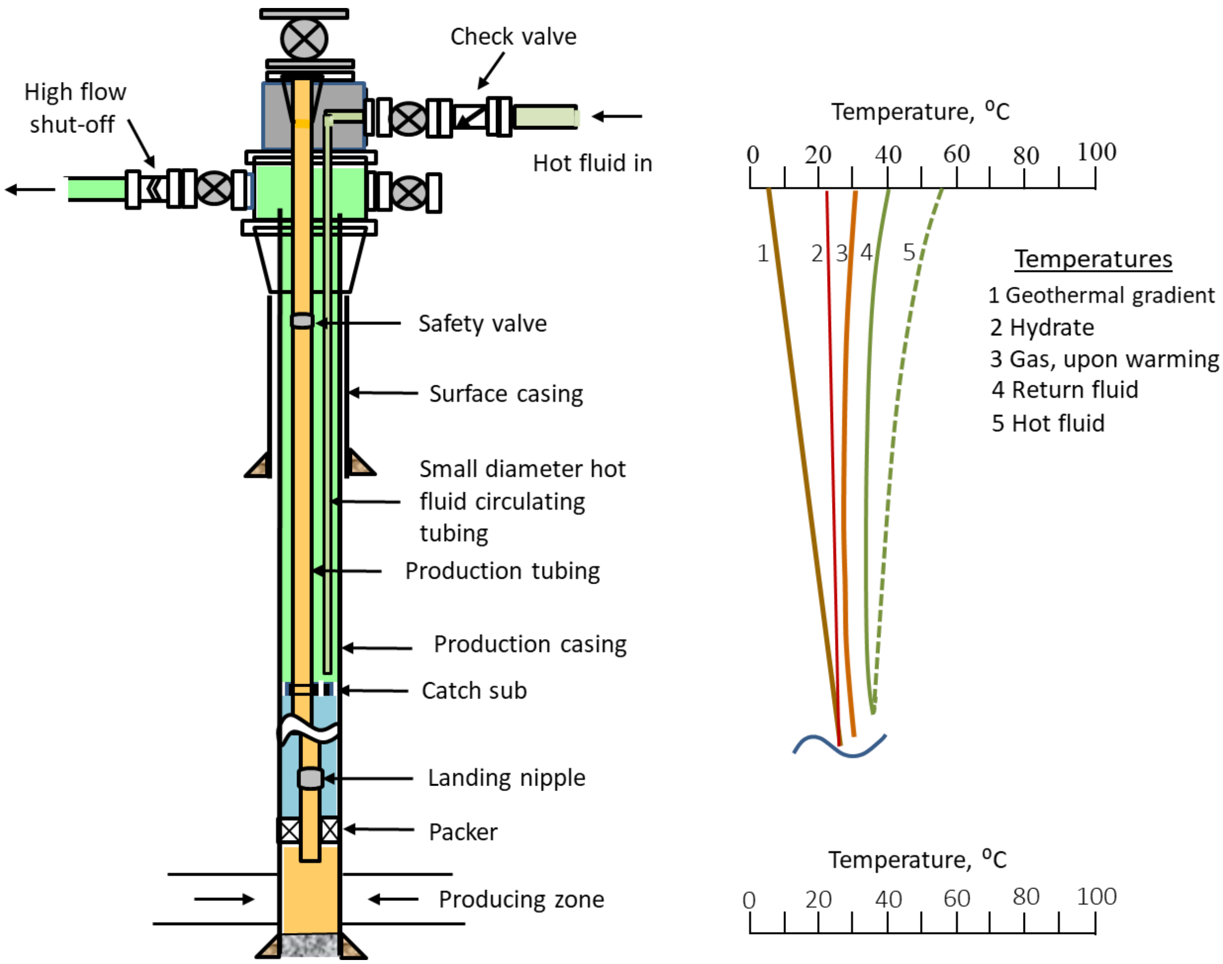


Figure 2.2 Schematic Drawing of a Well Completion with Hot Fluid Circulating String.

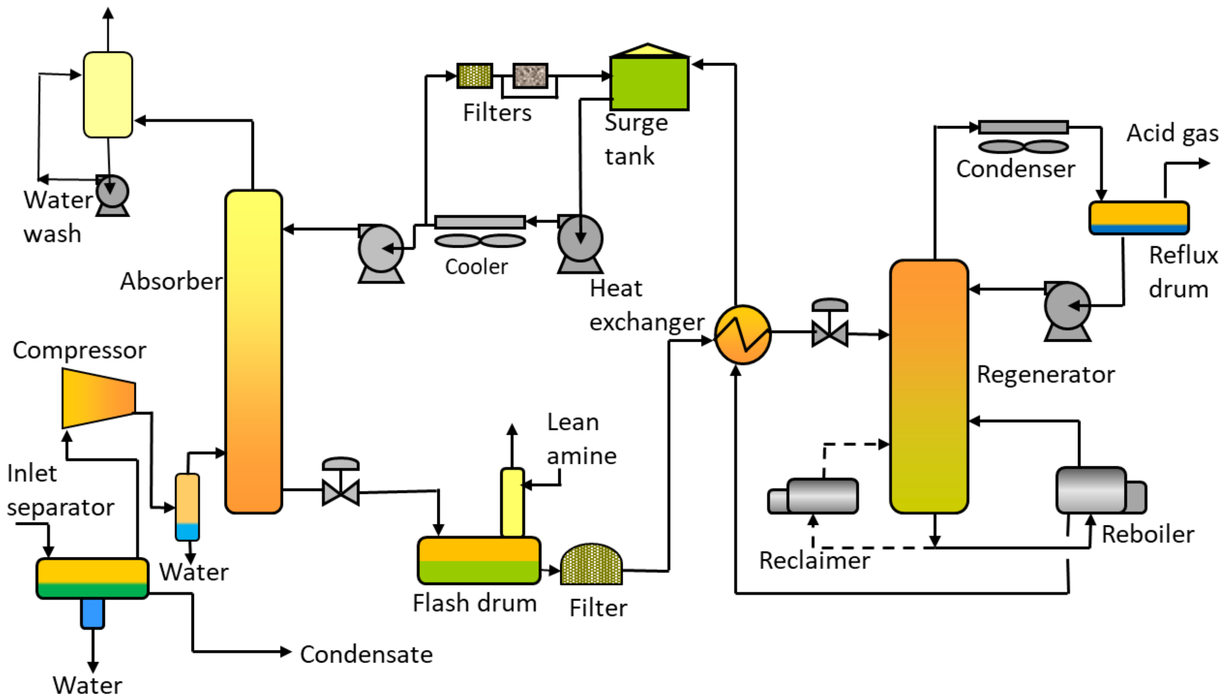


Figure 3.2 Schematic Drawing of Typical Sweetening Process Equipment.

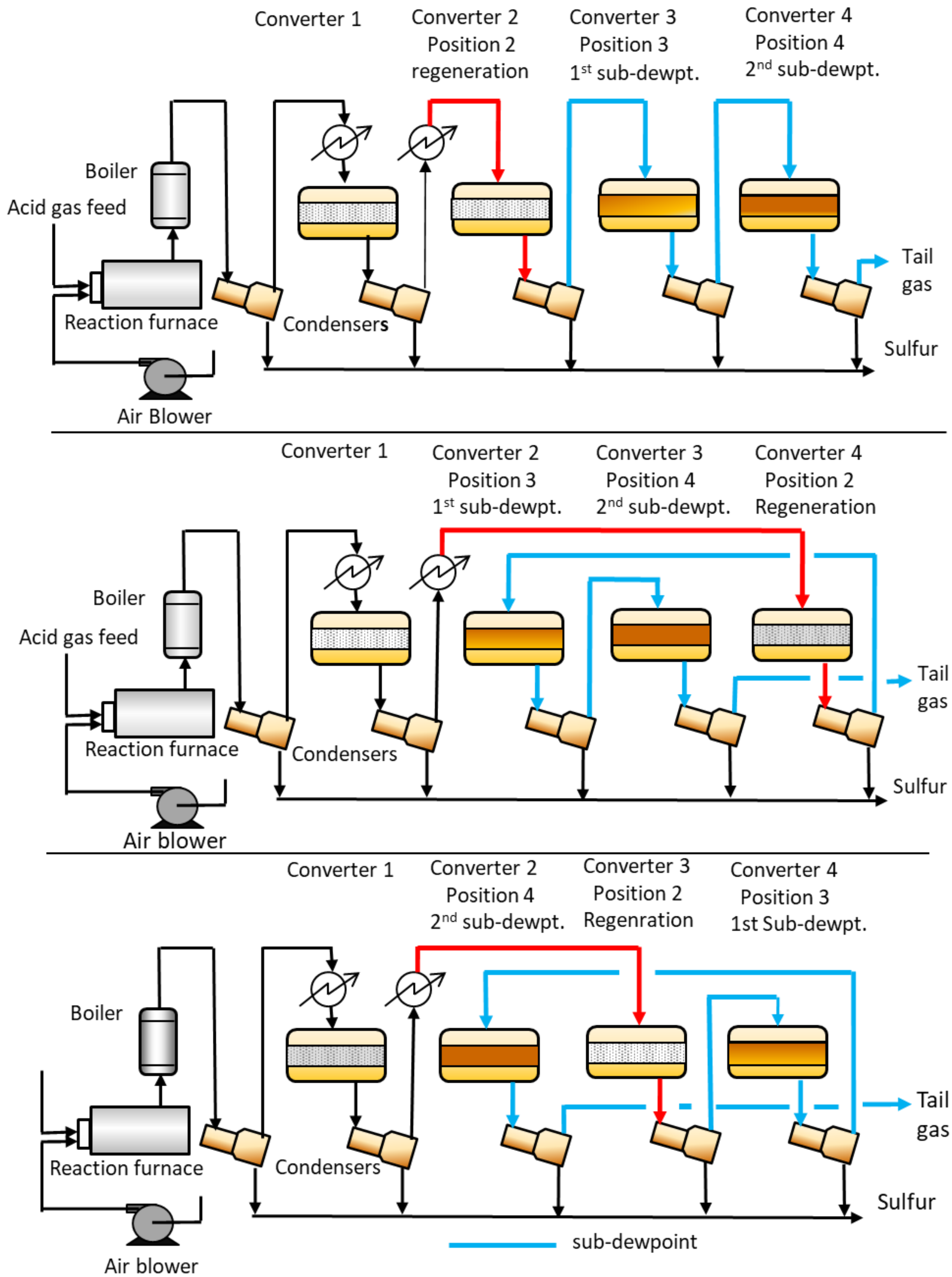


Figure 4.17 Schematic Drawing Showing Process Cycle for Four-Converter Claus MCRC TGCU Equipment.

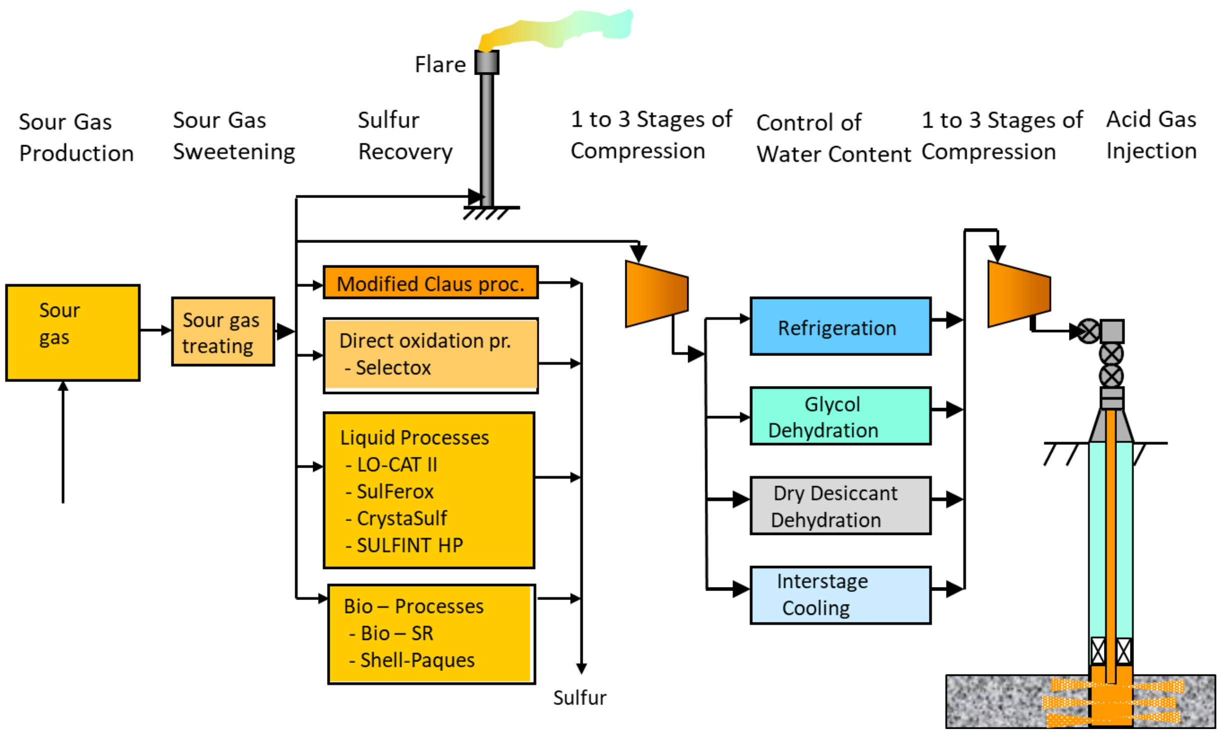


Figure 5.1 Schematic Drawing Showing Options for Handling Acid Gas.

CHAPTER 6

(There are no figures in Chapter 6, so the space allocated to Chapter 6 is used for an additional figure from Chapter 5.)

CHAPTER 5

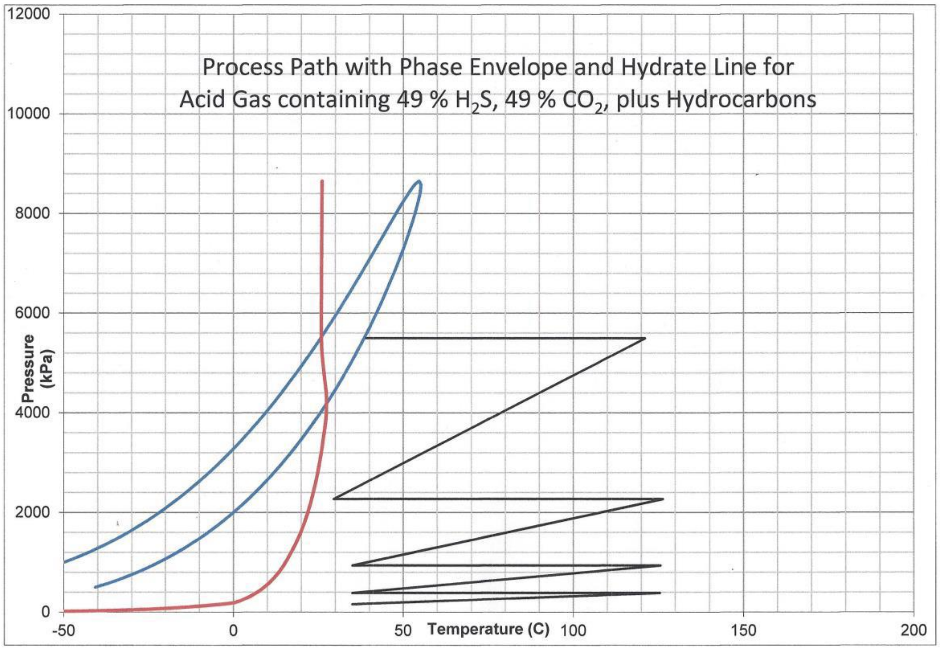
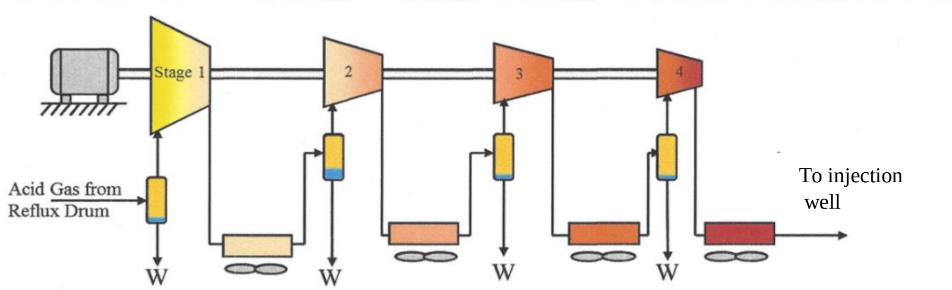


Figure 5.28 Diagram of Phase Envelope, Hydrate Line and Pressure Steps for Acid Gas Mixture of Composition as Shown on Chart.

Acid Gas Rate, $10^3 Sm^3/d$:	30	H2S =	49 %	CO2 =	49 %	C1+ =	2 %



A	B	C	D	E	F	G	H	I	J	K	L
1 Stage #		1		2		3		4		disch.	
2 Pres., kPa		160		387		938		2271		5500	
3 Reflux Drum T, °C		35									
4 Temp. °C	Suction	35		35		35		30.5		39	
5	Disch.	126		126		126		122			
6											
7 Heat removed, kJ/h			235,440		207,276		220,651		247,334		
8 Heat removed, Btu/h			223,154		196,459		209,136		234,427		
9 HP per stage		67.5		65.2		62.4		55.5		Total HP	250.6
10											
11 Water cont. mg/Sm		26,518		11,194		4,882		1,817		1,914	
12 Water removed, mg/Sm3				15,324		6,312		3,065	Water removed		24,701
13 Bbl/d		5.0							Water remaining		1,817
14									If saturated		1,914
15									If saturated at 0 °C		2,195

Figure 5.29 Tabulation of Results of Compression Stages and Data for Figure 5.28.