

# OIL & GAS JOURNAL

## High sulfur recovery achieved from lean acid gas

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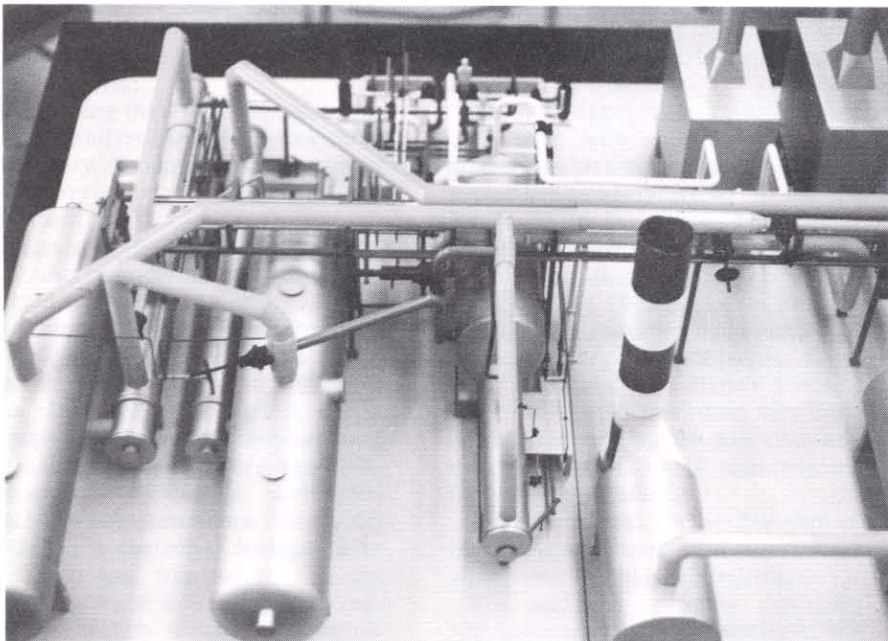
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WITH the present emphasis on sulfur recovery from sour natural gas, a considerable amount of information has been developed that relates to sulfur plants with favorable acid-gas feeds, i.e., H<sub>2</sub>S to CO<sub>2</sub> ratios greater than 1 to 1.

However, as the amount of H<sub>2</sub>S in the acid-gas feed declines to less than 25%, there is a noticeable lack of design and operating information available. This proved particularly so when the authors were faced with selecting the design parameters for a sulfur-recovery facility with a feed stream of only 8% H<sub>2</sub>S and 92% CO<sub>2</sub>.

Paper titled "Sulfur Recovery from Lean Acid Gases," presented at the Canadian Natural Gas Processing Association Second Quarterly Meeting, Calgary, Alta., Canada, June 14, 1978.



MODEL served as guide for construction and for operator training at Carstairs-Crossfield plant.

The facility is the Carstairs-Crossfield gas plant located 7 miles west of Carstairs, Alta., which has a current design raw-gas inlet volume of 320 MMscfd. The plant is operated by Home Oil Co. Ltd.

**The problems.** The major problem with sulfur recovery, as indicated, is due to the H<sub>2</sub>S/CO<sub>2</sub> ratio. The raw inlet gas (Table 1) contains about 0.45% H<sub>2</sub>S and 5.76% CO<sub>2</sub>, resulting in an acid-gas feed to the sulfur plant (Table 2) of 8.0% H<sub>2</sub>S and 91% CO<sub>2</sub>, with the remaining 1% being hydrocarbons.

With this high amount of CO<sub>2</sub>, the acid gas is better suited as a fire-extinguishing agent, rather than a substance that can be burned to produce sulfur.

A plant expansion in 1961 resulted in the installation of a split-flow, Claus sulfur-recovery unit producing approximately 40 lt/d. Several problems were encountered, and a number of modifications were required to enable the unit to operate satisfactorily and meet a minimum recovery level of 80%.

In 1967, a further plant expansion required additional sulfur-recovery

Table 1

## Plant inlet analysis

Carstairs—Crossfield plant	
Component	Mole %
N <sub>2</sub>	0.65
CO <sub>2</sub>	5.76
H <sub>2</sub> S	0.45
C <sub>1</sub>	79.74
C <sub>2</sub>	7.02
C <sub>3</sub>	2.42
iC <sub>4</sub>	0.61
nC <sub>4</sub>	0.78
iC <sub>5</sub>	0.31
nC <sub>5</sub>	0.35
C <sub>6</sub>	0.72
C <sub>7</sub> +	1.19
	<b>100.00</b>

Table 2

## Acid-gas analysis

Carstairs—Crossfield plant	
Component	Mole %
H <sub>2</sub> S	8.0
CO <sub>2</sub>	91.08
C <sub>1</sub>	0.73
C <sub>2</sub>	0.03
C <sub>3</sub>	0.02
iC <sub>4</sub>	0.01
nC <sub>4</sub>	0.01
iC <sub>5</sub>	Trace
nC <sub>5</sub>	Trace
C <sub>6</sub>	0.03
C <sub>7</sub> +	0.09
	<b>100.00</b>

\*The C<sub>7</sub>+ is made up of the following:

<b>Paraffins</b>	
Heptanes	6.18
Octanes	4.21
Nonanes	2.90
Decanes	3.59
Undecanes	2.57
Dodecanes	0.98
Tridecanes	Trace
<b>Aromatics</b>	
Benzene	16.65
Toluene	31.67
Ethyl Benzene	
M + P xylene	16.36
O-xylene	7.29
1-2-4 Trimethyl Benzene	2.50
C <sub>9</sub> aromatics	1.85
<b>Napthenes</b>	
Cyclopentane	Trace
Methylcyclopentane	0.55
Cyclohexane	0.74
Methylcyclohexane	1.96