Item #16

Computation of combustion temperatures of mixtures consisting of H_2S and CO_2

Presumptions

Net calorific value of H_2S = 5587 kg. cal./m^3, 0°C./760mm Hg
True specific heats according to table 4 of gas constants, Eckhard-Kah. Gases before the combustion are free from water, volume 0°, 760 mm. of Hg. No formation of SO_3.
Such an excess of air that the dry combustion gases contain 1% oxygen.
Oxygen content of the air: 20.9%

Combustion temperatures

1. H_2S-CO_2 mixture with 20% H_2S

from 200 vol. H_2S
800 " CO_2
and 1540 " air
are obtained:
200 vol. SO_2 = 8.2%
200 " H_2O = 8.2%
800 " CO_2 = 32.8%
1218 " N_2 = 49.9%
22 " O_2 = 0.9% = 1% in the dry gas mixture.

Total 2,440 vol. moist combustion gases or 100 vol. H_2S generate 1,220 vol. combustion gases.
For such a composition of the combustion gases the true specific heat at 1200°C. is:

$$\frac{(8.2 \times 0.583) + (8.2 \times 0.443) + (32.8 \times 0.583) + (50.8 \times 0.337)}{100} =$$

0.446 kg cal./Nm^3

The temperature increase of the gases is $\frac{100 \times 5,587}{1,220 \times 0.446}$ = 1,023°C.

2. H_2S-CO_2 mixture with 40% H_2S

From 400 vol. H_2S, 600 vol. CO_2 and 3,038 vol. air are obtained:
400 vol. SO_2 = 10.4%
400 " H_2O = 10.4%
600 " CO_2 = 15.6%
2,403 " N_2 = 62.7%
35 " O_2 = 0.9% = 1.0% in the dry combustion gases.

Total 3,838 vol. moist combustion gases, or 100 vol. H_2S generate 960 vol. combustion gases.
For such a composition the true spec. heat at 1,300°C. is

$$\frac{(10.4 \times 0.629) + (10.4 \times 0.489) + (15.6 \times 0.629) + (63.6 \times 0.352)}{100} =$$

0.438 kcal/Nm^3

The temperature increase is

$$\frac{100 \times 5,587}{960 \times 0.438} = 1,325°C.$$

3. H_2S-CO_2 mixture with 60% H_2S

From 600 vol. H_2S, 400 vol. CO_2 and 4,520 vol. air are obtained:
600 vol. SO_2 = 11.5%

600 vol. H_2O = 11.5%
400 " CO_2 = 7.7%
3574 " N_2 = 68.4%
46 " O_2 = 0.9% = 1.0% in the dry combustion gases

Total 5,220 vol. moist combustion gases, or 100 vol. H_2S generate 870 vol. combustion gases.
For such a composition the true spec. heat at 1,450°C. is 0.437 kg.cal. per Nm^3

The temperature increase is $\frac{100 \times 5,587}{870 \times 0.437} = 1,468°C.$

4. H_2S-CO_2 mixture with 80% H_2S
From 800 vol. H_2S, 200 vol. CO_2, and 6,020 vol. air are obtained:
800 vol. SO_2 = 12.1%
800 vol. H_2O = 12.1%
200 vol. CO_2 = 3.0%
4763 vol. N_2 = 72.0%
57 vol. O_2 = 0.8% = 1.0% of the dry combustion gases

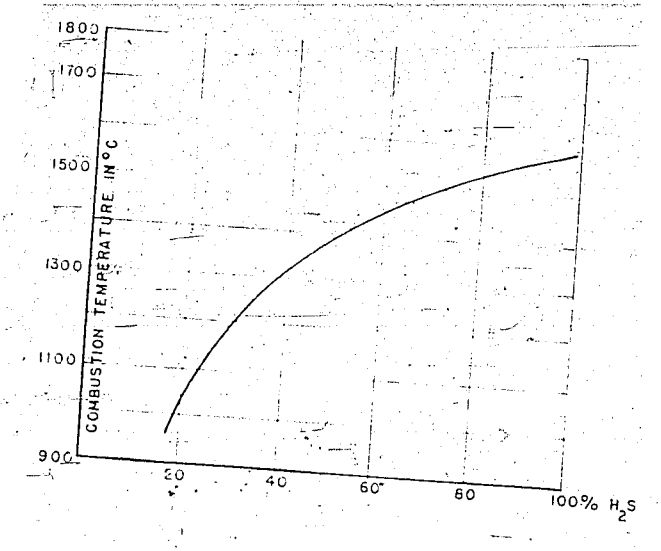
Total 6,620 vol. moist combustion gases, or 100 vol. H_2S generate 828 vol. combustion gases.
For such a composition the true spec. heat at 1,550°C. = 0.436 k. cal. per Nm^3.
The temperature increase of the combustion gases is 1,547°C.

5. 100% H_2S
From 1000 vol. H_2S and 7,520 vol. air are obtained:
1000 vol. SO_2 = 12.45%
1000 vol. H_2O = 12.45%
5950 vol. N_2 = 74.20%
70 vol. O_2 = 0.90% = 1.0% of the dry combustion gases.
Total 8,020 vol. moist combustion gases or 100 vol. H_2S generate 802 vol. combustion gases. For such a composition the true spec. heat at 1,600°C. is 0.433 k.cal./Nm^3.

The temperature increase of the combustion gases is

$$\frac{100 \times 5587}{802 \times 0.433} = 1,610°C.$$

COMBUSTION TEMPERATURES OF
$H_2S - CO_2$ MIXTURES
(FOR THE CLAUS REACTION)



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