STUDYING ON EFFECTIVES PARAMETERS ON GAS ADSORPTION IN CHELATED IRON SOLUTION

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Abstract
As low sulfur regulations have been introduced, it's developed innovative ways to meet the reduced sulfur specifications at minimal cost. In recent decade, it is developed industrial plants based on chelated iron solution to convert H2S to innocuous elemental sulfur. This paper describes effectiveness parameters on the effectiveness parameters on gas adsorption in chelated iron solution. The result shows that it is possible to totally remove the H2S from the sour gas by this method. The reaction is quickly occurred when is used co-current pattern to contract gas and liquid phase.

Keywords: Gas; Sweetening; Redox; Chelated iron; Adsorption.

1. Introduction
According to environmental rules that includes in various country, the hydrogen sulphide (H2S) concentration of gas must be decreased 1% or less, therefore it's vital to develop processes with high efficiency.

In recent decade, iron-chelated solution is introduced as H2S absorption process, which has high efficiency, selectivity for H2S removal. Because it's produced no hazardous waste byproducts or toxic chemicals; therefore it’s expressed as a green process.

In the first step of H2S Adsorption processes based on iron chelating, H2S is physically absorbed into water undergoing the dissociation according on following reactions:

\[
2H_2S (g) + H_2O \leftrightarrow H_2S(aq)
\]

As it's presented in equation 4, Hydrogen sulphide is oxidized to innocuous elemental sulfur by the chelated iron:

\[
H_2S + 2Fe^{3+} \leftrightarrow S + 2H^+ + Fe^{2+}
\]
The overall reaction can be expressed as below:

\[
\frac{1}{2} O_2 (aq) + 2 Fe^{2+} \rightarrow Fe^{3+} + 2OH
\]  

(6)

However there are various several chelate agents which can be used for this process; but EDTA (Ethylene-diamine-tetra-acetate) is the most common chelate which have been studied in the literatures \([1-7]\).

2. Material and method

Figure-1 shows the schematic of experimental facilities to investigate on operating condition for gas absorption in iron-chelate solution.

The gas stream is combined to make required composition and is introduced to absorption column where the chelated iron solution is sprayed from the top of column.

The upstream H2S free gas from absorption tower is conducted to analyzer.

The outlet solution is sent to oxidizer and regenerate by air stream.

3. Result and discussion

In figure 2 shows the CH4, N2 and CO2 absorption versus time, which the flow rate of inlet gas (free H2S) was 2 liter per minute with P=1.1 bar, T=24°C and the gas composition (%volumetric) was CH4 (84.4%), CO2 (3.3%) and N2 (12.25 %).

It’s illustrated that the compositions (without H2S) of gases other than H2S are maintained constant, except for the component CO2, which is slightly absorbed at the
beginning of bubbling, thus increasing the outlet composition of the CH4. After the saturation of the catalyst solution with the absorbed CO2 the outlet composition is restored to the inlet value.

![Graph showing gas composition over time](image1)

**Figure 2** Gas composition versus time in batch system

The H2S, CO2 adsorption is investigated in continuous mode in next step. The inlet gas flow rate was 2 lit/min which its composition was CH4 (84.36%), H2S (0.1), CO2 (3.3%) and N2 (12.24%) based on volumetric percent.

![Graph showing H2S, CO2 removal versus Fe-EDTA solution flow rate](image2)

**Figure 3** H2S, CO2 removal versus Fe-EDTA solution flow rate

As it’s clear, the adsorption rate is boosted when the flow rate of iron-chelated solution is increased. This means that above determined flow-rate with an appropriate ratio of gas contacting phases, it is possible to achieve total removal of H2S.

Figure-4 shows the pressure effect on H2S removal, where the gas flow rate and EDTA catalyst solution is 1, 0.063 l/min, respectively.

The pressure is set in 0.1 for case 1 and then it will be increased to 1.1 bar for case 2.

It can be seen; when the gas inlet pressure is increased, then H2S adsorption is decreased As it’s stated before, CO2 and H2S were continuously absorbed into the catalytic solution, while no absorption was observed for other gases such as CH4 or N2.

4. Conclusions

The results show the iron-chelated has high efficiency to remove H2S from gas stream. The adsorption rate is decreased when the pressure is increased.

Because only The CO2 and H2S were continuously absorbed into the catalytic solution, while no absorption was observed for other gases such as CH4 or N2, Therefore this process has high selectivity for H2S adsorption.
Reference


