CLAIMS

1. A method for measuring the sulfur solubility of a test gas at a test temperature and test pressure in a laboratory apparatus, comprising:

saturating the test gas with water;

flowing the test gas into a first conduit, wherein the first conduit is packed with elemental sulfur, and is maintained at least at a first temperature that is sufficient to result in the uptake of elemental sulfur by the test gas in excess of the natural equilibrium solubility level of elemental sulfur in the test gas at the test temperature;

introducing the test gas containing elemental sulfur into a second conduit, the second conduit being in fluid communication with the first conduit and maintained at least at a second temperature sufficient to lower the temperature of the test gas to a temperature that is equal to the test temperature, whereby the amount of elemental sulfur in the test gas is reduced to its natural equilibrium solubility level in the test gas at the test temperature;

flowing the test gas into a third conduit that is in fluid communication with the second conduit, wherein at least a portion of the third conduit is maintained at a third temperature sufficient to result in deposition of the elemental sulfur from the test gas into a portion of the third conduit; and

calculating the sulfur solubility of the test gas based on the amount of elemental sulfur deposited in the third conduit.

2. The method of claim 1, wherein the laboratory apparatus is free of direct contact with gas-handling equipment which contains the test gas.

3. The method of claim 1, wherein the test gas comprises CH_4.

4. The method of claim 3, wherein the test gas further comprises CO_2 and H_2S.

5. The method of claim 1, wherein the step of calculating the sulfur solubility comprises:

weighing the sulfur deposited in the third conduit for a select run time; and

measuring the volume of the test gas that passes through the third conduit during the select run time.

6. The method of claim 1, wherein the third conduit comprises a U-shaped tube.

7. The method of claim 1, wherein the first temperature is a maximum of 95°C.

8. The method of claim 1, wherein the test temperature is 10-15°C lower than the first temperature.

9. The method of claim 1, wherein the third temperature is about 0°C.

10. A system for measuring the sulfur solubility of a test gas at a test temperature, comprising:

a source of the test gas;

a first station in fluid communication with the source of test gas, the first station comprising a first conduit packed with elemental sulfur, wherein the first conduit is maintained at conditions sufficient to result in the uptake of elemental sulfur by the test gas as the test gas flows through the first conduit, the uptake of elemental sulfur being in excess of the natural equilibrium solubility level of the elemental sulfur in the test gas at the test temperature;

a second station comprising a second conduit in fluid communication with the first conduit, wherein the second conduit is maintained at conditions sufficient to lower the temperature of the test gas to the test temperature, whereby the amount of elemental sulfur in the test gas is reduced to its natural equilibrium solubility level in the test gas at the test temperature; and

a third station comprising a third conduit in fluid communication with the second conduit, wherein the third conduit is maintained at conditions that cause deposition of the elemental sulfur from the test gas, the third conduit being configured such that the deposited elemental sulfur can be collected and weighed to calculate the sulfur solubility of the test gas based on a measured flow rate of the test gas through the system; and

a fourth conduit in fluid communication with the source of test gas and being upstream of the first conduit, wherein the conditions of the fourth conduit are sufficient to saturate the test gas with water as the test gas flows through the fourth conduit prior to entering the first station.

11. The system of claim 10, wherein the system is a continuous flow loop system.

12. The system of claim 10, wherein the first station includes a first medium for elevating a temperature of the test gas flowing through the first conduit; the second station includes a second medium for decreasing the temperature of the test gas to the test temperature and the third station includes a third medium for quenching the sulfur-saturated test gas by decreasing the temperature thereof.

13. The system of claim 12, wherein the first, second, and third mediums comprise water contained within respective first, second and third baths, the first, second and third conduits being surrounded by the first, second and third mediums, respectively.

14. The system of claim 10, wherein the fourth conduit is located within the second station.

15. The system of claim 10, wherein the first conduit comprises a plurality of first tubes arranged in series and contained within a first medium that is heated to elevate the temperature of the test gas.

16. The system of claim 15, wherein the plurality of first tubes are configured in a serpentine arrangement.

17. The system of claim 10, wherein the second conduit comprises a plurality of second tubes arranged in series and contained within a second medium that is cooled to decrease the temperature of the test gas to the test temperature.

18. The system of claim 17, wherein the plurality of second tubes are configured in a serpentine arrangement.

19. The system of claim 10, wherein the third conduit comprises an inflow section for maintaining the test gas at the test temperature, a trap section for collecting the deposited sulfur, and an outflow section downstream of the trap section for carrying the test gas from the third station, wherein the inflow section and the outflow section are elevated above the trap section.

20. The system of claim 19, wherein the trap section comprises a U-shaped tube.

21. The system of claim 10, further including a flow meter for calculating a flow rate of the test gas through the system, thereby allowing a total volume of test gas to be calculated for a given experimental run.

22. The system of claim 10, further including a pressure regulator for maintaining a pressure of the test gas within a prescribed range as the test gas flows through each of the first, second and third stations.

23. The system of claim 10, further including a temperature controller for monitoring the temperature of the test gas and adjusting the temperature of the test gas.

24. The system of claim 10, wherein the source of test gas comprises a tank of sour gas collected from a gas field of interest.