CLAIMS

What is claimed is:

1 A system comprising:

a DMS stream connected to a methyl mercaptan production plant, wherein the DMS stream comprises dimethyl sulfide;

a H_2S stream connected to the methyl mercaptan production plant, wherein the H_2S stream comprises hydrogen sulfide;

a combined feed stream connected to the DMS stream and to the H_2S stream, wherein the combined feed stream comprises the dimethyl sulfide and the hydrogen sulfide;

a preheater connected to the combined feed stream, wherein the preheater is configured to heat the combined feed stream;

a reactor connected to the preheater, wherein the reactor contains a catalyst comprising alumina, NiMo on an alumina support, CoMo on an alumina support, or a combination thereof, wherein the reactor is configured to contact the dimethyl sulfide and the hydrogen sulfide in the presence of the catalyst to yield a reactor effluent;

a reactor effluent stream connected to the reactor and comprising the reactor effluent, wherein the reactor effluent stream comprises i) methyl mercaptan in an amount of 5 mole % to 76 mole % based on the total moles in the reactor effluent stream, and ii) carbon disulfide in an amount of less than 2 mole % based on a total moles of methyl mercaptan, hydrogen sulfide, dimethyl disulfide, and carbon disulfide in the reactor effluent stream;

a separation vessel connected to the reactor effluent stream and configured to separate the reactor effluent stream into an enriched H_2S stream comprising the hydrogen sulfide and an enriched MeSH stream comprising the methyl mercaptan;

wherein the enriched H_2S stream is connected to the separation vessel and to the methyl mercaptan production plant, wherein the enriched H_2S stream is configured to recycle the hydrogen sulfide to the methyl mercaptan production plant; and

wherein the enriched MeSH stream is connected to the separation vessel and to a separation stage of the methyl mercaptan production plant, wherein the enriched MeSH stream is configured to recycle the methyl mercaptan to the separation stage of the methyl mercaptan production plant.

2. The system of claim 1, wherein the preheater is additionally connected to the reactor effluent stream, wherein the preheater is further configured to cool the reactor effluent stream using the combined feed stream.

3. The system of claim 1, further comprising: the methyl mercaptan production plant having a MeSH product stream comprising methyl mercaptan and less than 5 ppmw carbon disulfide based on a total weight of the MeSH product stream.

4. The system of claim 3, wherein the methyl mercaptan production plant further comprises: one or more purge streams comprising equal to or less than 10 mole % carbon disulfide based on a total moles in the one or more purge streams.

5. The system of claim 4, wherein the one or more purge streams comprises an organic liquid purge stream, an aqueous purge stream, and a gaseous purge stream.

6. The system of claim 4, wherein the organic liquid purge stream comprises less than 20 ppm by weight carbon disulfide based on the total weight of the organic liquid purge stream.

7. The system of claim 4, wherein the one or more purge streams comprises dimethyl sulfide in an amount which is less than 5 wt % based on the weight of dimethyl sulfide in the DMS stream.

8. A system comprising:

a DMS stream connected to a methyl mercaptan production plant, wherein the DMS stream comprises dimethylsulfide;
a H_2S stream connected to the methyl mercaptan production plant, wherein the H_2S stream comprises hydrogen sulfide; and
a combined feed stream connected to the DMS stream and to the H_2S steam, wherein the combined feed stream comprises the dimethyl sulfide and the hydrogen sulfide;
a preheater connected to the combined feed stream, wherein the preheater is configured to heat the combined feed stream;
a reactor connected to the preheater and configured to contact the dimethyl sulfide and the hydrogen sulfide in the presence of a catalyst to yield a reactor effluent, wherein the reactor effluent comprises methyl mercaptan in an amount of 5 mole % to 76 mole % based on the total moles in the reactor effluent; and
a DMS reactor effluent stream connected to the reactor and to a location in the methyl mercaptan production plant that is in or downstream of a MeSH reactor effluent stream of the methyl mercaptan production plant, wherein the DMS reactor effluent stream comprises the reactor effluent.

9. The system of claim 8, further comprising: a mixing device connected to the DMS stream, the H_2S stream, and to the combined feed stream.

10. The system of claim 2, wherein the preheater comprises a cross-flow heat exchanger.

11. The system of claim 1, further comprising a mixing device connected to the DMS stream, the H_2S stream, and to the combined feed stream wherein the mixing device is configured to mix the DMS stream and the H_2S stream to yield the combined feed stream.

12. The system of claim 11, wherein the mixing device comprises a junction of piping, a static mixer, a propeller, or an impeller.

13. The system of claim 12, wherein the mixing device comprises the static mixer.

14. The system of claim 1, wherein the reactor comprises a hydrogen sulfide to dimethyl sulfide mole ratio of 10:1, a weight hourly space velocity of 1.5 g dimethyl sulfide/g cat./hr, and a weight average temperature of 285° C.

15. The system of claim 1, wherein the reactor comprises a hydrogen sulfide to dimethyl sulfide mole ratio of at least 3:1 and less than 100:1, a weight average temperature in a range of from 265° C. to 305° C., and a weight hourly space velocity of 0.2 to 15 g dimethyl sulfide/g cat./hr.

16. The system of claim 8,
wherein carbon disulfide is present in the reactor effluent in an amount of less than 2 mole % based on a total moles of methyl mercaptan, hydrogen sulfide, dimethyl disulfide, and carbon disulfide in the reactor effluent;
wherein the reactor is configured to convert greater than 50% of dimethyl sulfide at a selectivity to methyl mercaptan of greater than 95%; and wherein the reactor comprises a hydrogen sulfide to dimethyl sulfide mole ratio of at least 3:1 and less than 100:1, a weight average temperature in a range of from 265° C. to 305° C., and a weight hourly space velocity of 0.2 to 15 g dimethyl sulfide/g cat./hr.

17. The system of claim 8, further comprising:
a first 3-way valve placed in the DMS stream; and
a second 3-way valve placed in the H_2S stream;
wherein the reactor is configured to contact the dimethyl sulfide and the hydrogen sulfide in the presence of a catalyst to yield a reactor effluent when the first 3-way valve is in a first position and the second 3-way valve is in a first position.

18. The system of claim 17, wherein the first 3-way valve and the second 3-way valve are configured to control a composition of the combined feed stream.

19. The system of claim 17, wherein the first 3-way valve is configured to i) allow dimethyl sulfide to flow into the combined feed stream when in the first position, ii) discontinue all or a portion of the flow of dimethyl sulfide into the combined feed stream when in a second position, and iii) allow flow of dimethyl sulfide to a DMS product stream when in the second position; and wherein the second 3-way valve is configured to i) allow hydrogen sulfide to flow into the combined feed stream when in the first position, ii) discontinue all or a portion of the flow of hydrogen sulfide into the combined feed stream when in a second position, and iii) allow flow of hydrogen sulfide back to the methyl mercaptan production plant when in the second position.

20. The system of claim 1, wherein the reactor is configured to convert greater than 50% of dimethyl sulfide at a selectivity to methyl mercaptan of greater than 95%.