(4):

$CS_2 + 3\ H_2 \rightarrow CH_3SH + H_2S$ (4)

[0009] Dimethyl disulfide is conventionally synthesized by oxidation with sulfur according to reaction (5) below:

$2\ CH_3SH + S \rightarrow CH_3SSCH_3 + H_2S$ (5)

[0010] This oxidation of alkyl mercaptans with sulfur, catalyzed with homogeneous or heterogeneous, organic or mineral basic agents, in batch mode or continuous mode, is accompanied by a formation of hydrogen sulfide and also of dialkyl polysulfides, noted as RSxR with a sulfur rank x of greater than 2 (for example dimethyl polysulfides CH_3SxCH_3 in the case of the synthesis of DMDS). Moreover, this synthetic step generally requires a large excess of methyl mercaptan.

[0011] Now, in the context of the current ecological considerations, there is at the present time a real need for a process for the synthesis of alkyl mercaptans and of dialkyl disulfides that is more environmentally friendly, while at the same time maintaining high yields.

Summary

[0012] Thus, in an aspect, there is provided a process for the co-production of alkyl mercaptan and of dialkyl disulfide, comprising the following successive steps:

a) reaction of a C_1-C_4 alcohol in the presence of hydrogen sulfide (H_2S) to form a stream (M) comprising an alkyl mercaptan, water, and possibly unreacted hydrogen sulfide,

b) purification of the stream (M) to obtain a stream (N) enriched in alkyl mercaptan,

c) recovery of a first portion of the stream (N) including the alkyl mercaptan purified in step b),

d) oxidation with sulfur of the second portion of the stream (N) of alkyl mercaptan, to form a stream (O) comprising a dialkyl disulfide, hydrogen sulfide, and possibly unreacted alkyl mercaptan,

e) purification of the stream (O) to separate, on the one hand, an enriched dialkyl disulfide and, on the other hand, the hydrogen sulfide and possibly the alkyl mercaptan that has not reacted in step d),

f) recycling of the hydrogen sulfide and possibly of the alkyl mercaptan isolated in step e) into the stream (M) obtained from step a),

g) recovery of the dialkyl disulfide isolated in step e).

[0013] This process allows the continuous synthesis of alkyl mercaptan and of dialkyl disulfide. This co-production of products makes it possible to reduce the energy cost of the synthesis. This energy saving is a first ecological advantage.

[0014] It also enables the production of each product to be modulated according to the demand. For example, the synthesis of alkyl mercaptan may be favoured

Claims

[Claim 1] Process for the co-production of alkyl mercaptan and of dialkyl disulfide, comprising the following successive steps:

a) reaction of a C_1-C_4 alcohol in the presence of hydrogen sulfide (H_2S) to form a stream (M) comprising an alkyl mercaptan, water, and possibly unreacted hydrogen sulfide,

b) purification of the stream (M) to obtain a stream (N) enriched in alkyl mercaptan,

c) recovery of a first portion of the stream (N) including the alkyl mercaptan purified in step b),

d) oxidation with sulfur of the second portion of the stream (N) of alkyl mercaptan, to form a stream (O) comprising a dialkyl disulfide, hydrogen sulfide, and possibly unreacted alkyl mercaptan,

e) purification of the stream (O) to separate, on the one hand, an enriched dialkyl disulfide and, on the other hand, the hydrogen sulfide and possibly the alkyl mercaptan that has not reacted in step d),

f) recycling of the hydrogen sulfide and possibly of the alkyl mercaptan isolated in step e) into the stream (M) obtained from step a),

g) recovery of the dialkyl disulfide isolated in step e).

[Claim 2] Process according to Claim 1, characterized in that the recycling step f) leads the stream to be recycled before the purification step b), which removes the hydrogen sulfide from the stream (M) to be purified, preferably by distillation.

[Claim 3] Process according to Claim 1 or 2, characterized in that all of the stream including the hydrogen sulfide, and possibly the alkyl mercaptan that has not reacted in step d), is recycled into the stream (M) obtained from step a).

[Claim 4] Process according to any one of the preceding claims, characterized in that the C_1-C_4 alcohol is chosen from methanol, ethanol, *n*-propanol, isopropanol, *n*-butanol, *sec*-butanol and *tert*-butanol, and preferably the alcohol is methanol.

[Claim 5] Process according to any one of the preceding claims, characterized in that the hydrogen sulfide/alcohol mole ratio of step a) is between 0.1 and 100, preferably between 1 and 50, even more preferentially between 1 and 20.

[Claim 6] Process according to any one of the preceding claims, characterized in that the reaction of step a) is performed in the presence of a catalyst chosen from catalysts based on alumina, thorium dioxide ThO_2, preferably deposited on a silicate support, catalysts based on cadmium sulfide, preferably on an alumina support, catalysts based on the following oxides: MgO, ZrO_2, TiO_2 rutile (R) and

anatase (A), CeO_2, and γ-Al_2O_3, catalysts based on metal oxides, preferably doped with alkali metals and optionally supported on SiO_2, Al_2O_3 or Nb_2O_5, catalysts based on alkali metal carbonates, catalysts based on alkali metal salts with certain transition metal acids impregnated on γ-alumina, potassium tungstate on alumina K_2WO_4/Al_2O_3.

[Claim 7] Process according to any one of the preceding claims, characterized in that the alkyl mercaptan/sulfur mole ratio of the oxidation step d) is between 0.1 and 100, preferably between 1 and 50, even more preferentially between 1 and 20.

[Claim 8] Process according to any one of the preceding claims, characterized in that the reaction temperature of the oxidation step d) is between 20°C and 200°C and the pressure is between 2 and 30 bar absolute.

[Claim 9] Process according to any one of the preceding claims, characterized in that the reaction of the oxidation step d) is performed in the presence of a basic catalyst chosen from homogeneous, two-phase or heterogeneous catalysts; preferably, the catalyst is a heterogeneous basic catalyst; more preferentially, the catalyst is a basic ion-exchange resin.

[Claim 10] Process according to any one of the preceding claims, characterized in that the purification step e) includes one or more distillation steps, and optionally one or more basic catalysis steps.