In the case of methyl mercaptan, the sulfhydrolysis reaction is written according to equation (6) below:

$$CH_3SCH_3 + H_2S \rightarrow 2\ CH_3SH \quad (6)$$

A sulfhydrolysis unit may thus be integrated into a main unit for producing mercaptans obtained from at least one alcohol and H_2S. However, adding a new unit to a pre-existing industrial unit may raise technical integration issues. In particular, the present inventors have observed surprising clogging phenomena in the reactor or downstream of the sulfhydrolysis unit, when the latter is integrated into a main mercaptan production unit.

There is thus a need for a unit for producing mercaptans from alcohol(s) and H_2S incorporating a sulfhydrolysis reaction, which is industrially viable, safe and inexpensive.

One objective of the present disclosure is to provide an integrated process for preparing mercaptans, notably from at least one alcohol and H_2S, in which the dialkyl sulfide byproducts are treated by sulfhydrolysis, in an industrially viable and safe manner.

Another objective of the present disclosure is to provide a process for preparing mercaptans, notably from at least one alcohol and H_2S, incorporating a sulfhydrolysis process that is easy to perform, in particular using simple and inexpensive facilities.

Specifically, it has been observed that the preparation of mercaptan(s) from at least one alcohol and H_2S can lead to the formation of dialkyl disulfide impurities (noted DADS and of the type R-S-S-R). Without wishing to be bound by theory, these DADS could be formed according to the following balanced equation (7) (example starting from methanol):

$$2CH_3SH + CH_3OH \rightarrow CH_3\text{-}S\text{-}S\text{-}CH_3 + CH_4 + H_2O \quad (7)$$

The present inventors have determined that these DADS end up with the dialkyl sulfide(s) and then in the reactor in which the sulfhydrolysis is performed. Over time, they may lead to pressure losses on the catalyst and/or to clogging in this reactor or further downstream in the process. This phenomenon might be explained by coking of the catalyst due to parasitic or secondary reactions of the sulfhydrolysis reaction with the DADS. The sulfur products or impurities formed by such reactions may accumulate and create blockages in industrial facilities, giving rise to obvious safety and production problems. This may be all the more problematic when it comes to recycling the outlet stream from the sulfhydrolysis reactor into the main mercaptan production unit.

In particular, when methyl mercaptan is formed from methanol and H_2S, dimethyl disulfide (DMDS) may be formed secondarily. When this DMDS is present during the sulfhydrolysis reaction, it has been observed that the facilities (in the reactor and downstream of the sulfhydrolysis reactor) are clogged with sulfur impurities.

The present inventors have discovered, surprisingly, that when sulfhydrolysis is performed on a dialkyl sulfide previously separated from the DADS, these phenomena of pressure losses and/or clogging are no longer observed.

Thus, the present disclosure relates to a process for preparing, preferably continuously, at least one mercaptan, comprising the following steps:

A) H_2S and at least one alcohol are introduced into a first reactor;

B) the H_2S and said at least one alcohol are reacted to obtain an outlet stream comprising at least one mercaptan, at least one dialkyl sulfide and at least one dialkyl disulfide (DADS) and possibly unreacted H_2S;

C) said outlet stream obtained from step B) is separated into:

- a stream F1 comprising the mercaptan(s),
- a stream F2 comprising the dialkyl sulfide(s) and the DADS(s), and
- optionally a stream F3 comprising H_2S;

D) a purification step is performed on stream F2 in order to separate:

- a stream F2' comprising the dialkyl sulfide(s); and
- the DADS(s);

E) stream F2' is introduced with H_2S into a second reactor;

F) a sulfhydrolysis reaction of the dialkyl sulfide(s) with H_2S is performed to obtain an outlet stream F4 comprising said mercaptan(s), and possibly unreacted H_2S;

G) optionally, stream F4 obtained from step F) is recycled into step A).

In an aspect, there is provided a process for preparing at least one mercaptan, comprising the following steps:

A) H_2S and at least one alcohol are introduced into a first reactor;

B) the H_2S and said at least one alcohol are reacted to obtain an outlet stream comprising at least one mercaptan, at least one dialkyl sulfide and at least one dialkyl disulfide (DADS) and possibly unreacted H_2S;

C) said outlet stream obtained from step B) is separated into:

- a stream F1 comprising the mercaptan(s),
- a stream F2 comprising the dialkyl sulfide(s) and the DADS(s), and
- optionally a stream F3 comprising H_2S;

D) a purification step is performed on stream F2 in order to separate:

- a stream F2' comprising the dialkyl sulfide(s); and
- the DADS(s);

E) stream F2' is introduced with H_2S into a second reactor;

F) a sulfhydrolysis reaction of the dialkyl sulfide(s) with H_2S is performed to obtain an outlet stream F4 comprising said mercaptan(s), and possibly unreacted H_2S;
G) optionally, stream F4 obtained from step F) is recycled into step A).

Sulfides, disulfides and mercaptans

The term “sulfide” notably means any organic compound comprising a –C-S-C- function.
The term “disulfide” notably means any organic compound comprising a –C-S-S-C- function.
The term “dialkyl sulfide” notably means a compound of general formula (I) below:

R-S-R’ (I)

in which R and R’, which may be identical or different, are, independently of each other, a saturated, linear, branched or cyclic, optionally substituted hydrocarbon-based radical.
Preferably, R and R’, which may be identical or different, are, independently of each other, a linear, branched or cyclic alkyl radical containing between 1 and 18 carbon atoms, preferably between 1 and 12 carbon atoms.
R and R’, which may be identical or different, may be chosen, independently of each other, from the group consisting of methyl, ethyl, propyl, butyl, pentyl, hexyl, heptyl, octyl, nonyl, decyl, undecyl and dodecyl (and also positional isomers thereof). Preferably, R and R’, which may be identical or different, may be chosen, independently of each other, from the group consisting of methyl, ethyl, octyl and dodecyl.