WO2004041399 discloses an anhydrous processing of methane into methane sulfonic acid by a radical process to avoid the creation of waste and salts as byproducts in order to improve the selectivity and yield. The generation of water is avoided but no special attention is given to minimize the formation of sulfuric acid. Thus a purification of MSA by distillation is energy intensive and the yield of MSA is still optimizable.

WO2007136425 discloses the manufacture of dimethyl ether or olefins from methane via methane sulfonic acid, using di(methyl-sulfonyl) peroxide as radical initiator. Methane sulfonic acid anhydride is disclosed to be present when methane sulfonic acid is heated. Di(methyl-sulfonyl) peroxide is formed by electrolysis of MSA and starts a chain reaction that bonds methane to sulfur trioxide. The use of di(methyl-sulfonyl) peroxide can reduce the formation of sulfuric acid. MSA is used as solvent in order to promote greater methane solubility in the solvent. Still the amount of sulfuric acid formed in the process is not minimized and a purification of MSA by distillation is energy intensive.

WO2015071455 discloses the manufacture of MSA from methane using a mixed peroxide derived from sulfuric acid and methane sulfonic acid as radical starter or mixtures thereof as for example with sulfuric acid and/or methane sulfonic acid. The use of oleum as part of the radical initiator solution implies that unnecessary sulfuric acid is introduced into the system which makes a distillation of MSA energy consuming.

SUMMARY

In the light of the prior art the technical problem underlying the present disclosure was the provision of a process for manufacturing of methane sulfonic acid (MSA) that overcomes the disadvantages of those processes known in the art. The process of the present disclosure is cost-efficient due to reduced energy consumption, shows increased selectivity and offers the possibility to achieve a high MSA yield. The process for manufacturing of methane sulfonic acid (MSA) enables applying of mild process conditions regarding temperature and pressure and overcomes the disadvantages known in the art.

The problem is solved by the features of the independent claims. Preferred embodiments of the present disclosure are provided by the dependent claims.

In an aspect, there is provided a process for the manufacturing of methane sulfonic acid by reaction of a radical initiator composition with methane and sulfur trioxide comprising the steps:

a) Preparation of the initiator composition by reacting aqueous hydrogen peroxide with the components methane sulfonic acid and methane sulfonic acid anhydride,
b) Reaction of initiator composition from step a) with sulfur trioxide and methane to form methane sulfonic acid.

In another aspect, there is provided the use of methane sulfonic acid anhydride as water scavenger for the manufacturing of methane sulfonic acid, in the step a) for the preparation of the initiator composition.

In another aspect, there is provided the use of an initiator composition comprising methane sulfonic acid, methane sulfonic acid anhydride and aqueous hydrogen peroxide for the manufacturing of methane sulfonic acid by radical reaction.

In another aspect, there is provided a methane sulfonic acid manufactured by a process as defined above, whereas after purification in step c) the methane sulfonic acid content is in the range from 98 wt-% to 100 wt-% or 99 wt-% to 100 wt-%, and the sulfuric acid content is in the range from 0 ppm to 500 ppm or 0 ppm to 200 ppm.

The disclosure therefore relates to a process for the manufacturing of methane sulfonic acid by reaction (preferably radical reaction) of a radical initiator composition with methane and sulfur trioxide comprising the steps:

a) Preparation of the initiator composition by reacting aqueous hydrogen peroxide with the components methane sulfonic acid and methane sulfonic acid anhydride,
b) Reaction of initiator composition from step a) with sulfur trioxide and methane to form methane sulfonic acid by radical reaction.

In a preferred embodiment the initiator composition in step a) further comprises sulfur trioxide.

In a preferred embodiment after step a), after the initiator composition is formed, the water content is in the range from 0 wt-% to 1 wt-%, and the content of sulfuric acid is in the range from 0 wt-% and 5 wt-% or 0 wt-% to 1 wt-%.

In a preferred embodiment after step b), after methane sulfonic acid is formed, the content of sulfuric acid is in the range from 0 wt-% to 25 wt-%, preferably 0 wt-% to 22 wt-%, more preferably 0 wt-% to 20 wt-%, even more preferably from 0 wt-% to 2 wt-%.

In a preferred embodiment after step c), after methane sulfonic acid is purified, the content of sulfuric acid is in the range from 0 ppm to 500 ppm or 0 ppm to 200 ppm.

In a preferred embodiment the temperature in step a) is in the range from -5°C to 25°C or -5 °C to 20 °C, the temperature in step b) is in the range from 25°C and 80°C, and the temperature in step c) in the bottom of the column is in the range from 130°C to 240°C. If step a) is divided into two sub-steps a1) and a2), the temperature of a1) is in the range from 25°C to 80°C and the temperature of step a2) is in the range from -5°C to 20°C.

In a preferred embodiment a cooling step is done between the steps a1) and a2).

In a preferred embodiment the pressure in step a) is about 1013 mbar or beyond 1013 mbar, the pressure in step b) is in the range from 10 bar to 150 bar, and the pressure in step c) at the head of the column is in the range from 1 mbar to 1000 mbar.

The disclosure further relates to the use of methane sulfonic acid anhydride as water scavenger for the manufacturing of methane sulfonic acid, in the step a) for the preparation of the initiator composition. According to the disclosure, step a) can be divided into two steps a1) and a2).

In a preferred embodiment MSA anhydride is used as water scavenger, whereas methane sulfonic acid is manufactured by reaction of an initiator composition comprising aqueous hydrogen peroxide, methane sulfonic acid, optionally sulfur trioxide, optionally a recycle stream from step c) and methane sulfonic acid anhydride.

The disclosure further relates to the use of an initiator composition comprising methane sulfonic acid, methane sulfonic acid anhydride, optionally a recycle stream from step c) and aqueous hydrogen peroxide for the manufacturing of methane sulfonic acid.

In a preferred embodiment an initiator composition is used, whereas the initiator composition additionally comprises sulfur trioxide.

The disclosure further relates to MSA, whereas after purification in step c) the methane sulfonic acid content is in the range from 98 wt-% to 100 wt-% or 99 wt-% to 100 wt-%, and the sulfuric acid content is in the range from 0 ppm to 500 ppm or 0 ppm to 200 ppm.