

Claims:

1. Process for the production of alkane sulfonic acid by the reaction of sulfur trioxide and alkane with the help of a starter, selected from the group consisting of inorganic peroxyacids, salts of inorganic peroxyacids, organic peroxyacids, salts of organic peroxyacids, hydrogen peroxide, and mixtures thereof, and/or starter precursor, selected from the group consisting of sulfuric acid, oleum, SO₃, alkanesulfonic acid, the bottom recycle stream from alkanesulfonic acid distillation, inorganic oxoacids, salts of inorganic oxoacids, hydrogen peroxide, and mixtures thereof, wherein the addition of the starter and/or starter precursor to the reactor or the reactor cascade is split, wherein the synthesis is realized as batch process in a reactor cascade and the starter or starter precursor is divided and added in portions to the first reactor and to further reactors of the cascade, or wherein the synthesis is realized as continuous process and the starter or starter precursor is divided and added continuously to the first reactor and to further reactors of the cascade.
2. Process according to claim 1, characterized in that the synthesis is realized as continuous process and the total amount of starter or starter precursor x is continuously divided over the n reactors or over n minus 1 reactors in a homogenous manner, wherein each of the n reactors is supplied with a continuous fraction of x/n mol of the starter.
3. Process according to any of claims 1 or 2, characterized in that the synthesis is realized as continuous process and the largest amount of starter or starter precursor is fed continuously into the first reactor of the cascade while the remaining starter is divided evenly over the remaining reactors of the cascade or over the remaining reactors but the last of the cascade.
4. Process according to any of the preceding claims, characterized in that the synthesis is realized as continuous process and a certain amount of starter or starter precursor is added to the first reactor while all the rest is fed into the last reactor of the cascade.
5. Process according to any of the preceding claims, wherein the starter and/or starter precursor is provided in a solvent, preferred in a solvent that contains sulfuric acid and / or alkanesulfonic acid.
6. Process according to any of the preceding claims, wherein the reaction mixture leaving the last reactor is purified by distillation.

7. Process according to any of the preceding claims, wherein the recycle stream leaving the distillation as a bottom residue is cooled prior to mixing it with the starter solution or the starter precursor solution.
- 5 8. Process according to any of the preceding claims, wherein the recycle stream is cooled to temperatures $< 25^{\circ}\text{C}$.
9. Process according to any of the preceding claims, characterized in that the starter solution and/or starter precursor solution is cooled while mixing it with the recycle stream.
- 10 10. Process according to any of the preceding claims, wherein the starter solution and/or starter precursor solution is cooled in a first step, and then it is mixed under further cooling at temperatures $< 50^{\circ}\text{C}$ with the pre-cooled recycle stream leaving the distillation as a bottom residue.
- 15 11. Process according to any of the preceding claims, characterized in that the alkane is methane and the alkanesulfonic acid is methanesulfonic acid, and wherein optionally methane is supplied to each reactor.
- 20 12. Process according to any of the preceding claims characterized in that the methane pressure is adjusted reactor by reactor within a range of 10 to 200 bar.
13. Process according to any of the preceding claims, characterized in that methane is fed at the same pressure into the first reactor(s) of a cascade, whereas the last reactor is constantly operated at a higher methane pressure than the first reactor(s) of the cascade,
- 25 13. Process according to any of the preceding claims, characterized in that methane is fed at the same pressure into the first reactor(s) of a cascade, whereas the last reactor is constantly operated at a higher methane pressure than the first reactor(s) of the cascade, preferably higher by up to 20 bar.
14. Process according to any of the preceding claims, characterized in that at least one reactor type used in the cascade is a continuously stirred tank reactor.
- 30 15. Process according to any of the preceding claims, characterized in that at least one reactor type used in the cascade is an air lift reactor, a loop reactor, a bubble column or a trickle bed reactor.
- 35 16. Process according to any of the preceding claims, characterized in that the conversion of SO_3 and the formation of MSA are measured with density, and/or the addition of water is measured with a conductivity measurement and/or ultrasound measurements.

17. Process according to any of the preceding claims, characterized in that side products are detected by spectroscopic methods, preferably RAMAN spectroscopy and/or NMR spectroscopy.
- 5 18. Process according to any of the preceding claims, characterized in that the mass flow rate of the purge stream is adjusted according to the amount of unconverted SO₃ and the amount of sulfuric acid formed during the synthesis of the initiator.
- 10 19. Process according to any of the preceding claims, characterized in that the feed to the distillation in has an MSA content of 50 to 99 wt.-%, and/ or the feed to the reaction into the first reactor has a SO₃ content of 30 to 100 wt.-%.
- 15 20. Process according to any of the preceding claims, characterized in that a high conversion of SO₃ to alkane sulfonic acid is achieved and the amount of waste is reduced.
- 20 21. Process according to any of the preceding claims, wherein the addition of the overall starter amount is divided over several addition points in the system.