In an aspect, there is provided a process for producing alkyl sulfonic acid in a reaction apparatus (41) which contains a liquid phase comprising aqueous nitric acid, wherein dialkyl disulfide is fed submerged into the liquid phase in the reaction apparatus (41) and a crude reaction product is formed in the reaction apparatus (41) by chemical reaction of the dialkyl disulfide with the nitric acid, wherein feeding the dialkyl disulfide comprises at least one of:

- the liquid dialkyl disulfide is fed into the reaction apparatus (41) through an orifice (28, 29; 33) having a hydraulic diameter of less than 5 mm;
- the liquid dialkyl disulfide is fed into the reaction apparatus (41) with an inlet velocity of at least 0.6 m/s.

The term “orifice” here refers to any opening in the reaction setup through which liquid dialkyl disulfide may be fed into the liquid phase in the reaction apparatus. Orifices may for example be openings on lines or at the end of lines and nozzles or feeding points of dialkyl disulfide into lines containing nitric acid or the liquid phase from the reactor.

The hydraulic diameter is defined as the diameter of a circular area which has the same cross-sectional area as the described orifice and can be calculated by

$$d_h = \frac{4A}{U}$$

with the hydraulic diameter d_h, the cross-sectional area of the orifice A, and the perimeter of the orifice U.

The crude reaction product obtained in the reaction usually is fed into a purifying process to obtain pure alkyl sulfonic acid. In the purifying process, by-products and reactants which did not react, usually are removed by distillation, wherein distillation preferably is carried out in at least two distillation stages. If the alkyl sulfonic acid is methanesulfonic acid or ethyl sulfonic acid, the sulfuric acid is a high boiler compared to the alkyl sulfonic acid and for this reason accumulates in the bottom of each distillation column. As sulfuric acid is detrimental to product quality and the sulfuric acid concentration in the pure alkyl sulfonic acid preferably is below 50 ppm, it is necessary to remove the sulfuric acid by a purge stream. Due to the technical limitations of the separation process, the purge stream which is withdrawn at the bottom of the distillation column still contains a high concentration of the alkyl sulfonic acid. For reducing the amount of alkyl sulfonic acid being withdrawn from the process and thus increasing the yield of alkyl sulfonic acid, it is necessary to minimize the purge stream. However, if the amount of sulfuric acid produced as by-product in the reaction is reduced, the purge stream can be reduced, too.

Surprisingly it has been shown that by using an orifice having a hydraulic diameter of less than 5 mm, more preferred of less than 3 mm and particularly of less than 2 mm, by feeding the liquid dialkyl disulfide into the reactor with an inlet velocity of at least 0.6 m/s, preferably of at least 1.8 m/s, particularly preferably at least 2.5 m/s, the formation of by-products produced in the reaction of dialkyl disulfide with nitric acid for producing alkyl sulfonic acid, particularly the formation of sulfuric acid, can be reduced. By additionally and further preferably feeding the dialkyl disulfide into the reactor through a plurality of orifices, wherein

the number of orifices is larger than 1.0 orifices per cubic meter reaction volume, more preferred larger than 1.2 orifices per cubic meter reaction volume and particularly of larger than 1.7 orifices per cubic meter reaction volume, a further reduction of by-products may be possible. “Reaction volume” in this context refers to the volume of liquid reactants present in the reactor.

Further, by the reduction of the by-products formed in the reaction, like sulfuric acid, the purification process of the alkyl sulfonic acid can be facilitated, too, and simultaneously, the losses of product also are reduced.