distillation or fractionating crystallization and also separation by nanofiltration, but none of these achieve adequate results according to the description of US 6,337,421.

The purification of methanesulfonic acid comprising oxidizable compounds is described in EP-A 0 505 692 and EP-A 0 373 305. EP-A 0 505 692 discloses supplying chlorine to convert the impurities into methanesulfonyl chloride which is hydrolyzed to afford methanesulfonic acid and HCl in a further step. EP-A 0 373 305 discloses supplying ozone which converts methyl thiosulfate into methanesulfonic acid. However, the disadvantage of these two processes is that high-boiling components such as sulfuric acid cannot be removed, thus necessitating further purification steps.

The fractionating crystallization of methanesulfonic acid and also of ethanesulfonic acid is known in principle from R. A. Craig et al., J. Am. Chem. Soc., 1950, Vol. 72, pages 163 bis 164 or A. Berthoud, Helv. Chim. Acta, 1929, Vol. 12, page 859, but no indication is given as to how the processes described therein could be implemented in production and purification processes on a large industrial scale.

The present disclosure accordingly has for its object the provision of a process which is less energy intensive than the prior art processes, which allows sufficient purification of alkanesulfonic acids and enables removal of all impurities, and which may be implemented on a large industrial scale.

In an aspect, there is provided a process for purifying alkanesulfonic acids which comprises the steps of:

(a) distilling a melt comprising crude alkanesulfonic acid to completely or partly remove low boilers, wherein the low boilers are drawn off at the top of a distillation column or of a one-stage evaporation apparatus and a material stream comprising alkanesulfonic acid, high boilers and residual low boilers is withdrawn at the bottom of the distillation column or of the one-stage evaporation apparatus,

(b) sending the stream comprising alkanesulfonic acid, high boilers and residual low boilers into a melt crystallization as the starting melt to form crystals of the alkanesulfonic acid, of hydrates of the alkanesulfonic acid or of a mixture of both suspended in mother liquor,

(c) performing a solid-liquid separation to remove the crystals from the mother liquor,

(d) optionally washing the crystals to remove mother liquor adhering to the crystals.

It has now been found that, surprisingly, the combination of a distillation to completely or partly remove low boilers and a subsequent melt crystallization makes it possible to remove impurities from the alkanesulfonic acid while simultaneously reducing the necessary energy requirements

compared to prior art processes for purifying alkanesulfonic acid. The process according to the disclosure further permits production both of various alkanesulfonic acids and of hydrates of alkanesulfonic acids.

Another advantage is that, in contrast to hitherto employed processes of distillative purification of alkanesulfonic acid, the process as defined above makes it possible to achieve high purities in simple fashion in particular in the purification of methanesulfonic acid. Thus, for example, the proportion of methyl methanesulfonate in the product may be markedly reduced in the process as defined above. The process as defined above moreover also removes the majority of high boilers from the alkanesulfonic acid which is achieved in the prior art only through energy intensive distillation by converting the alkanesulfonic acid into the gas phase.

In accordance with the invention the distillation in step (a) also comprises a simple gas removal from liquids which may also comprise solids. Such a gas removal is for example a flash process which takes place for example during a decompression of a pressurized liquid when low boilers are transferred into the gas space after a pressure reduction.

The distillation may be performed either in a distillation column or in a one-stage evaporation apparatus. When the term "distillation column" is used hereinbelow it is also always alternatively possible to employ a one-stage evaporation apparatus, for example a falling film evaporator, a thin film evaporator, a rotary evaporator or any other evaporator known to one skilled in the art.

The crude alkanesulfonic acid supplied in step (a) originates from a conventional process for producing alkanesulfonic acids. Appropriate processes are described in WO-A 00/31027, GB- A 1350328, EP-A 0 675 107, CN-A 1810780 or WO-A 2015/071365 for example. Depending on the production process employed the crude alkanesulfonic acid comprises different low boilers and high boilers as impurities.

Low boilers typically present in crude alkanesulfonic acid, in particular crude methanesulfonic acid, include, for example, water, short-chain hydrocarbons having 1 to 8 carbon atoms, short-chain alcohols having 1 to 8 carbon atoms, nitric acid, hydrochloric acid, chlorine, alkyl mercaptans, dialkyl disulfides, dialkyl polysulfides, esters, for example methyl methanesulfonate, partly and fully chlorinated alkanesulfonic acids, methanesulfonyl chloride, sulfur dioxide, ammonia, dimethyl sulfate, monomethyl sulfate and dimethyl sulfone. The process described in WO-A 00/31027 typically generates water, alkyl mercaptans, dialkyl disulfides, dialkyl polysulfides, alkyl alkanethiosulfonates such as methyl methanethiosulfonate, alkyl alkanethiosulfinates, dialkyl disulfoxide, C_1-C_x-alcohols, nitric acid, nitrogen oxides, methyl methanesulfonate and sulfur dioxide as low boilers. Typical low boilers in the process described in GB- A 1350328 are water, alkyl mercaptans, dialkyl disulfides, dialkyl polysulfides, alkyl alkanethiosulfonates such as methyl methanethiosulfonate, alkyl alkanethiosulfinates, dialkyl disulfoxides, alkanesulfonyl halides such methanesulfonyl chloride, halogens such as chlorine or bromine, hydrogen halides such

19. The process according to any of claims 1 to 18, wherein the melt crystallization is a suspension crystallization or a layer crystallization.