It is further known e.g. from WO2018/219726 that SO_3 reacts with MSA at elevated temperatures in the range of 100°C to 150°C, however, side products are observed, among others, $CH_3SO_2OSO_2CH_3$ (methane sulfonic acid anhydride, hereinafter “MSAA”), leading to a decreased yield for MSA. In addition, it is stated, that, as these reactions are equilibrium reactions, distillation leads to undesired MSAA and thus further reduces the yield of MSA.

In the above prior art SO_3 was introduced either in pure form as gas or in a liquid form liquid such as in oleum. The addition of pure SO_3 or oleum, however, especially at high pressures and temperatures, is potentially dangerous due to the intrinsic properties of SO_3.

In Canadian Journal of Chemistry, 1966, 44(12): 1437-1444, Robinson et al. investigated the addition of SO_3 to MSA. It was stated, that at low concentrations of SO_3, the polysulfonic acid $CH_3S_2O_6H$ is formed initially and which further reacts with MSA to give MSAA. Furthermore, MSAA is stated to be in rapid equilibrium with $H_2S_2O_7$ and higher polysulfuric acids, at higher SO_3 concentrations.

In general, handling of SO_3 or oleum is difficult and requires multiple safety measures. For example, storage of SO_3 or oleum requires temperature control measures. Furthermore, SO_3 or oleum tend to outgas; gaseous SO_3 reacts with water in the air, which may form undesired depositions in the reactor.

An object of this invention was therefore to find a process for the manufacturing of alkanesulfonic acids, in which the use of pure SO_3 or oleum can be avoided, thus making the manufacture of alkanesulfonic acids, in particular of MSA, much easier as well as safety measures less complex.

A further object of this invention was to find a process for the manufacturing of alkanesulfonic acids, where only alkanesulfonic acid or a mixture of alkanesulfonic acids is the sole reaction product.

An additional object of this invention was to find a process for the manufacturing of alkanesulfonic acids starting from the corresponding anhydrides and sulfuric acid, in which additions of SO_3 are not hindering the reaction.

The ~~invention~~disclosure ~~, in a further aspect,~~ relates to a process for the manufacturing of alkanesulfonic acid, R-SO_3H, (“RSA”), wherein R stands for C_1-C_4 alkyl, by reaction of an anhydride other than SO_3 with sulfuric acid and an alkane, R-H, in the presence of a starter, preferably peroxide starter at ambient temperature or higher and under pressure higher than ambient pressure.

The ~~invention~~disclosure, in another ~~aspect~~example, relates to a process for the manufacturing of alkanesulfonic acid, R-SO_3H, ("RSA"), in which the use of pure SO_3 or oleum is avoided, wherein R stands for C_1-C_4 alkyl, by reaction of an anhydride with sulfuric acid and an alkane, R-H, in the presence of a starter, preferably peroxide starter at ambient temperature or higher and under pressure higher than ambient pressure.

The ~~invention~~ disclosure also relates to a process for the manufacturing of alkanesulfonic acid, R-SO_3H, ("RSA"), wherein R stands for C_1-C_4 alkyl, by reaction of an anhydride with sulfuric acid and an alkane, R-H, in the presence of a starter, preferably peroxide starter at ambient temperature or higher and under pressure higher than ambient pressure, wherein the anhydride is chosen from the group consisting of RSO_2OSO_2R, anhydrides of mineral acids and anhydrides of organic acids, preferably from the group consisting of RSO_2OSO_2R, anhydrides of mineral acids other than SO_3 and anhydrides of organic acids, more preferably chosen from the group consisting of RSO_2OSO_2R and anhydrides of organic acids.

The disclosure, in one aspect, relates to a process for the manufacturing of alkanesulfonic acid, R-SO_3H, wherein R stands for C_1-C_4 alkyl, by reaction of an anhydride with sulfuric acid and an alkane, R-H, in the presence of a peroxide starter at ambient temperature or higher and under pressure higher than ambient pressure, wherein the anhydride is chosen from the group consisting of RSO_2OSO_2R.

The disclosure, in an additional aspect, relates to a use of at least one anyhdride in a process for the manufacturing of alkanesulfonic acid, R-SO_3H, wherein R stands for C_1-C_4 alkyl, by reaction with sulfuric acid and an alkane, R-H, in the presence of a peroxide starter, at ambient temperature or higher and under pressure higher than ambient pressure, wherein the anhydride is chosen from the group consisting of RSO_2OSO_2R.

As mentioned, the anhydride may also be selected from mineral acids, with the exclusion of sulfur trioxide (since it is an aim of the present invention to avoid use of pure SO_3 or oleum). Suitable, preferred anyhdrides from mineral acids are listed below.

C_1-C_4 alkyl stands for methyl, ethyl, n-propyl, i-propyl, n-butyl, sec.-butyl, i-butyl or tert. Butyl, preferably for methyl.

In general, the starter is a peroxide, preferably chosen from the group consisting of aqueous hydrogen peroxide, monomethylperoxydisulfate and salts thereof, dimethylperoxodisulfate and salts thereof, peroxodisulfuric acid and salts thereof, and peroxomonosulfuric acid and salts thereof.

The starter may be added in solid or in liquid form, either in pure form pure or as a solution in a solvent containing sulfuric acid, the RSA or mixtures thereof. Preferably the starter might be added in a liquid form, pure or in a solvent.

As different starters or mixtures of starters can be used, the amount of starter preferably can be expressed in weight-equivalents of pure H_2O_2 compared to the total amount of the reaction mixture. Thus, x mol of the used peroxide are regarded as equivalent to x mol of pure H_2O_2 (molecular weight: 34 g/mol), which correspond to 34*x g of H_2O_2, respectively to (34*x/y)-(wt.-)% (with y being the total mass of the reaction mixture), thus the amount of any used starter can be