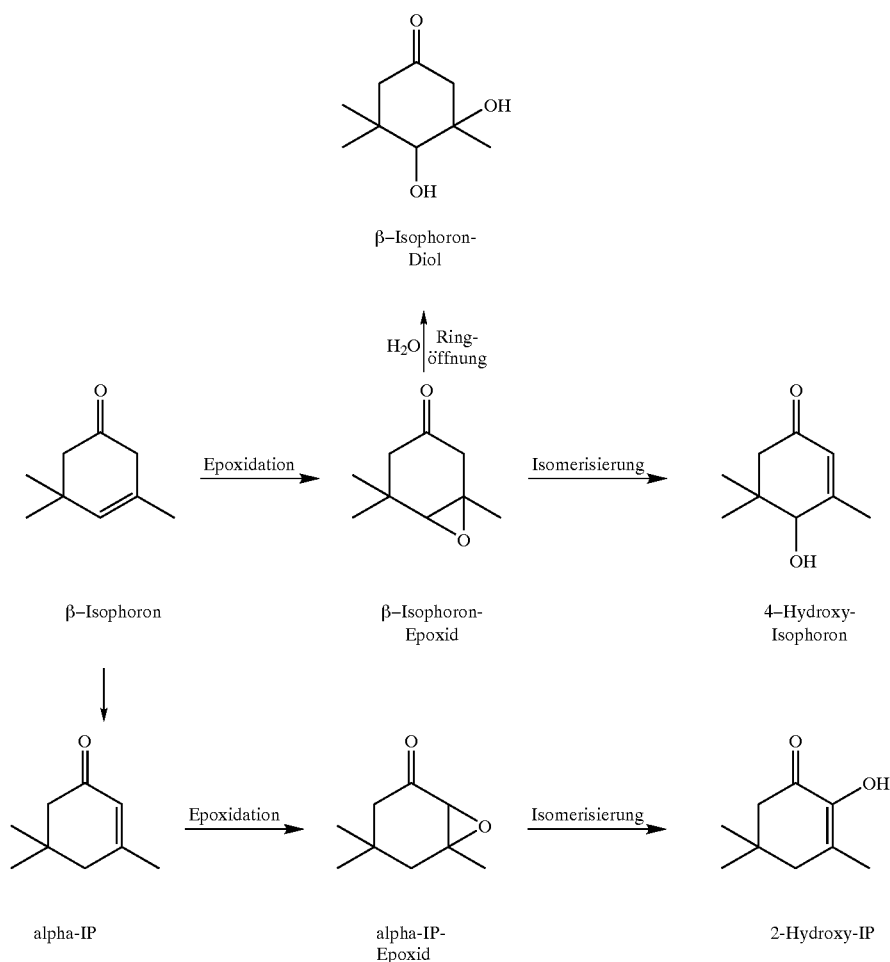


of  $\beta$ -IP epoxide and HIP in a ratio of 1:1, and alpha-isophorone. It is obvious that, according to this process, neither the undesirable re-isomerization to alpha-IP nor the consecutive reaction to HIP can be suppressed. After hydrolysis at a basic pH, 87% HIP is isolated. This procedure is unsatisfactory as the pH environment must be

strates, the diols and hydroxyesters being obtained in particular (see W. M. Weigert, *Wasserstoffperoxid und seine Derivate* [Hydrogen peroxide and its derivatives], Hüthig Verlag Heidelberg 1978, page 79 et seq.).

[0011] The following diagram shows the possible secondary and consecutive reactions of  $\beta$ -IP epoxidation:



changed several times to produce HIP, which entails a significant salt load and produces only moderate yields.

[0009] All of these processes have in common that they produce unsatisfactory yields of  $\beta$ -isophorone epoxide, due to the non-selective reaction process or unsuitable oxidizing agent, or to the presence of water in the reaction medium, which both catalyzes the reverse reaction of  $\beta$ -isophorone and destabilizes the epoxide. The formation of the diol can also be detected from the  $\beta$ -IP epoxide as a result of the accumulation of water.

[0010] A further reaction, observed when the reaction is not sufficiently controlled, is the epoxidation of alpha-IP (which is formed "in situ" from  $\beta$ -IP by isomerization) to alpha-IP epoxide, and its consecutive reaction of isomerization to 2-hydroxyisophorone. These principal secondary reactions are observed also in epoxidation with other sub-

[0012] The epoxidation of  $\beta$ -isophorone in the presence of anhydrous peroxidation reagents such as alkylhydroperoxides is also described (Hutter, Baiker et al., *Journal Mol. Cat.* 172, 427-435, 1997). A heterogenous contact  $SiO_2$ - $TiO_2$  mixed oxide activates the peroxide, expensive pre-treatment of the catalyst, or the addition of further auxiliary substances such as bases, being necessary to achieve higher selectivities, partly in order to suppress the formation of HIP. Although this process has achieved the best epoxide selectivities hitherto, it is not advantageous to use alkylhydroperoxides, which are spent stoichiometrically, for an industrial process. It is also undesirable to use a heterogeneous contact, which is costly to prepare.

[0013] DP 38 06 835 describes the oxidation of  $\beta$ -IP to HIP by reaction with aqueous hydrogen peroxide in the presence of formic acid.  $\beta$ -IP epoxide is discharged as an