This invention relates to the synthetic production of alcohols. It is particularly concerned with an improvement in that process of producing alcohols in which the formation of alcohols is brought about by the condensation of alkylene oxides, or substances which are capable of forming alkylene oxides, with hydrocarbons or substituted hydrocarbons in the presence of anhydrous metal halides.

The present application is a continuation in part of my co-pending application Serial No. 645,753, filed December 5, 1932, for Manufacture of aromatic alcohols.

In the prior art, the process above referred to was carried out by the direct addition of the alkylene oxide to the suspension of metal halide in the hydrocarbon. As thus carried out, the process has a relatively low yield, the reason being that the alkylene oxide comes into contact with the metal halide in a concentrated state so that it reacts with itself, forming undesirable by-products rather than with the hydrocarbon, forming the desired alcohol. According to the present invention, this disadvantage is overcome by forming a more or less dilute solution of the alkylene oxide in the hydrocarbon or in an inert solvent and running this solution into a suspension of the metal halide in another quantity of the hydrocarbon or in a solution of the hydrocarbon in an inert solvent. The quantity of hydrocarbon used should be such that, when a molecule of alkylene oxide comes in contact with the metal halide, it is surrounded by a great number of molecules of the hydrocarbon, the latter being present in excess, so that it is disposed to react with these molecules rather than with another molecule of itself. The yield of the alcohol, therefore, is much higher as compared to the yield in the above described processes of the prior art.

The greater the excess of hydrocarbon in the solvent used both for dissolving the ethylene oxide and for suspending the aluminum chloride, the higher the yield will be.

Suitable hydrocarbons are any of the paraffin hydrocarbon series, for example, hexane, heptane, dodecane, octadecane, etc. Also, the cyclo-paraffins, for instance, cyclopentane and cyclohexane. Then the aromatic hydrocarbons, such as, benzol, toluol, cycme, naphthalene, etc., and also any of these hydrocarbons which have substituted chlorine or bromine atoms, for instance, monochlor benzene or monobrom benzene, or the like. Any mixtures of these hydrocarbons may be used just as well. They may occur naturally, or may be mixed artificially. For instance, gasoline or petroleum fractions or coal tar products, etc., may be used. Heterocyclic compounds such as pyridine, quinoline, thiophene, etc., may be used also. Nitro derivatives, ethers and esters of the aromatic hydrocarbons are also suitable. It will be noted that all the materials specified in this paragraph are materials capable of undergoing a Friedel-Crafts condensation with an alkylene oxide or substance capable of forming such oxide. In the appended claims these materials will be referred to generally as Friedel-Crafts reactants.

Examples of the alkylene oxides are ethylene oxide, trimethylene oxide, propylene oxide, isobutylene oxide and the like. Substances which form alkaline oxides by elimination of hydrochloric or hydrobromic acid, as, for example, ethylene chlorhydrin and propylene bromhydrin, may also be used. The term alkylene oxide is used in the appended claims intended to include both alkylenepoloxides and arylene oxides in accordance with the Geneva nomenclature, and is intended also to include substances, as specified above, capable of forming such oxides.

Examples of metal halides which may be used are anhydrous aluminum halides, such as aluminum chloride and aluminum bromide, anhydrous ferric chloride and boron fluoride.

The method of the present invention consists in bringing about a reaction of an alkylene oxide with a substantial excess of Friedel-Crafts reactant in the presence of an anhydrous metal halide. In case the Friedel-Crafts reactant is capable of dissolving the alkylene oxide the process is preferably carried out by first forming the solution of the alkylene oxide in an excess of Friedel-Crafts reactant and then bringing about a reaction between this solution and a suspension of the metal halide, preferably in another quantity of the Friedel-Crafts reactant. The temperature at which this reaction is caused to take place should be low enough to prevent as much as possible of the alcohol which is first formed from undergoing a secondary reaction, namely, of combining with another molecule of hydrocarbon and forming undesired hydrocarbons.

For example, for the synthetic production of betaphenyl ethyl alcohol the ethylene oxide or a substance capable of forming ethylene oxide, such as ethylene chlorhydrin or ethylene bromhydrin, is dissolved in dry benzol or a mixture of dry benzol and some inert solvent, such as petrolic ether, at a temperature low enough to prevent volatilization of the ethylene oxide (or the hydrocarbon solvent for that matter,) and this solution
Similarly, by substituting dried monobrom benzene for benzol in the example relating to beta-phenyl ethyl alcohol, a yield of about ten per cent of theory of brom phenyl ethyl alcohol is obtained.

It will be then seen that many other alcohols may be produced in accordance with the present invention, by carrying the same out with other combinations of hydrocarbons and alkylene oxides.

I have described what I believe to be the best manner of carrying out my invention. I do not wish, however, to be confined to the examples given, but what I desire to cover by Letters Patent is set forth in the appended claims.

I claim:

1. The process for the synthetic production of alcohols, which consists in forming a solution of an alkylene oxide in a Friedel-Crafts reactant to form a suspension of an anhydrous metal halide in such reactant and causing said solution and suspension to react with each other.

2. The process for the synthetic production of alcohols, which consists in forming a solution of an alkylene oxide in a Friedel-Crafts reactant to form a suspension of an anhydrous metal halide in such reactant and causing said solution and suspension to react with each other at a temperature below that at which the alcohol first formed reacts with the Friedel-Crafts reactant present under the influence of the anhydrous metal halide.

3. The process for the synthetic production of betaphenyl ethyl alcohol, which consists in dissolving ethylene oxide in dry benzol, and causing this solution to react with a suspension of an anhydrous metal halide in dry benzol.

4. The process for the synthetic production of beta-phenyl ethyl alcohol, which consists in dissolving ethylene oxide in dry benzol, and causing this solution to react with a suspension of metal halide in dry benzol at a temperature between approximately 5° C. and 60° C.

5. The process for the synthetic production of beta-phenyl ethyl alcohol, which consists in dissolving ethylene oxide in dry benzol, and causing this solution to react with a suspension of an anhydrous metal halide in dry benzol at a temperature below approximately 60° C.

6. The process for the synthetic production of hydratropyl alcohol which consists in dissolving propylene oxide in dry benzol, and causing this solution to react with a suspension of metal halide in dry benzol.

7. The process for the synthetic production of alcohols, which consists in bringing about a re-action of an alkylene oxide with a substantial excess of a Friedel-Crafts reactant in the presence of an anhydrous metal halide, the molar ratio of Friedel-Crafts reactant to alkylene oxide being greater than approximately 10:1.

8. The process for the synthetic production of alcohols, which consists in forming a solution of alkylene oxide in a substantial excess of Friedel-Crafts reactant and then bringing about a re-action between this solution and a suspension of an anhydrous metal halide.

9. The process for the synthetic production of alcohols, which consists in forming a solution of alkylene oxide in a substantial excess of Friedel-Crafts reactant and then bringing about a re-action between this solution and a suspension of an anhydrous metal halide, in another quantity of Friedel-Crafts reactant.

10. The process for the synthetic production of
alcohols, which consists in bringing about a reaction of an alkylene oxide with a substantial excess of Friedel-Crafts reactant in the presence of an anhydrous metal halide, the molar ratio of Friedel-Crafts reactant to alkylene oxide being greater than approximately 10:1.

12. The process for the synthetic production of alcohols, which consists in bringing about a reaction of ethylene oxide with a substantial excess of a Friedel-Crafts reactant in the presence of an anhydrous metal halide, the molar ratio of Friedel-Crafts reactant to ethylene oxide being greater than approximately 10:1.

13. The process for the synthetic production of alcohols, which consists in bringing about a reaction of ethylene oxide with a substantial excess of aromatic hydrocarbon in the presence of an anhydrous metal halide, the molar ratio of Friedel-Crafts reactant to ethylene oxide being greater than approximately 10:1.

14. The process for the synthetic production of betaphenyl ethyl alcohol, which consists in bringing about a reaction of ethylene oxide with a substantial excess of dry benzo in the presence of an anhydrous metal halide, the molar ratio of Friedel-Crafts reactant to ethylene oxide being greater than approximately 10:1.

15. The process for the synthetic production of betaphenyl ethyl alcohol, which consists in bringing about a reaction of ethylene oxide with a substantial excess of dry benzol in the presence of an anhydrous aluminum chloride, the molar ratio of Friedel-Crafts reactant to ethylene oxide being greater than approximately 10:1.

16. The process for the synthetic production of betaphenyl ethyl alcohol, which consists in bringing about a reaction of ethylene oxide with a substantial excess of dry benzol in the presence of an anhydrous metal halide at a temperature between approximately 5° and 60° C., the molar ratio of Friedel-Crafts reactant to ethylene oxide being greater than approximately 10:1.

17. The process for the synthetic production of betaphenyl ethyl alcohol, which consists in bringing about a reaction of ethylene oxide with a substantial excess of dry benzol in the presence of an anhydrous metal halide at a temperature of approximately 10° C., the molar ratio of Friedel-Crafts reactant to ethylene oxide being greater than approximately 10:1.

18. The process for the synthetic production of betaphenyl ethyl alcohol, which consists in bringing about a reaction of ethylene oxide with a substantial excess of dry benzol in the presence of anhydrous aluminum chloride at a temperature between approximately 5° and 60° C., the molar ratio of Friedel-Crafts reactant to ethylene oxide being greater than approximately 10:1.

19. The process for the synthetic production of betaphenyl ethyl alcohol, which consists in bringing about a reaction of ethylene oxide with a substantial excess of dry benzol in the presence of anhydrous aluminum chloride at a temperature of approximately 10° C., the molar ratio of Friedel-Crafts reactant to ethylene oxide being greater than approximately 10:1.

20. The process for the synthetic production of betaphenyl ethyl alcohol, which consists in bringing about a reaction of ethylene oxide with a substantial excess of dry benzol in the presence of an anhydrous metal halide.

21. The process herein described comprising suspending anhydrous aluminum chloride in dried benzol, dissolving ethylene oxide in dried benzol at a temperature of between 5° and 10° C., and running the ethylene oxide solution thus formed into the suspension of aluminum chloride in benzol at a temperature of between approximately 6° to 10° C.

22. The process herein described comprising suspending anhydrous aluminum chloride in dried benzol, dissolving ethylene oxide in dried benzol at a temperature of between 5° and 10° C., and running the ethylene oxide solution thus formed into the suspension of aluminum chloride in benzol at a temperature of between approximately 6° to 10° C. and adding water, holding the temperature of the mass at between 0° and 10° C. approximately.

23. The process herein described comprising suspending anhydrous aluminum halide in dried benzol, dissolving ethylene oxide in dried benzol at a temperature of between approximately 5° and 10° C., and causing the ethylene oxide to react with the suspension of aluminum halide in benzol at a temperature sufficiently low that the predominant product of the reaction will be beta-phenyl ethyl alcohol as distinguished from di-benzyl.

ERNST T. THEIMER.