# PATENT SPECIFICATION

NO DRAWINGS

**844,042**

*Inventors*:— HERMAN SAMUEL BLOCK
and GEORGE LADISLAV HERVERT.

*Date of Application and filing Complete Specification:* *April* 9, 1959.

*No.* 11971/59.

*Complete Specification Published August* 10, 1960.

**Index at Acceptance: Class 2(3), B2.**
**International Classification: C07c.**

## Process of producing benzene alkylates.

COMPLETE SPECIFICATION

We, UNIVERSAL OIL PRODUCTS COMPANY, a corporation organised under the laws of the State of Delaware, United States of America, of No. 30, Algonquin Road, Des Plaines, Illinois, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a process for producing benzene alkylates which are utilizable as intermediates in the synthesis of water-soluble detergents and surface active agents and in which the alkyl group attached to the aryl nucleus by the alkylation reaction is a long chain aliphatic radical. More specifically, the invention concerns an alkylation process wherein benzene is condensed with an olefin of from 9 to 18 carbon atoms per molecule in the presence of sulfuric acid alkylation catalyst and a diluent.

An object of this invention is to produce the benzene alkylate in a manner which permits this product to be readily washed for the removal of acidic contaminants without troublesome emulsification of the hydrocarbon and aqueous phases. Another object of the invention is to provide a benzene alkylation process in which both the benzene and the alkylation catalyst are conserved so that a more economical alkylate production results.

The process according to the present invention comprises alkylating benzene with an olefin containing from 9 to 18 carbon atoms per molecule in substantially liquid phase in the presence of sulfuric acid alkylation catalyst and in ~~mixture~~ with from 5 to 100%, by weight of the quantity of the benzene charged, of an inert diluent which is free from tertiary carbon atoms, boils at a lower temperature than said olefin, and is selected from the group consisting of the saturated hydrocarbons and the saturated halogen-substituted hydrocarbons boiling below 100°C., and thereafter separating the resulting reaction mass into a used catalyst phase and a hydrocarbon phase comprising alkylate in admixture with said diluent.

In the consideration of benzene with an olefin in the presence of acidic catalysts which promote the condensation reaction, several competing reactions between the reagents and charging stocks take place within the reaction mixture aside from the desired condensation of the aromatic and olefinic reactants. The extent to which these side reactions take place determine to a large extent the yield of the desired alkylate product. Thus, when utilizing benzene, which has more than one nuclearly substitutable hydrogen atom capable of replacement by an entering alkyl substituent, a polyalkylate may be produced, although usually in relatively minor yields. In contact with a highly acidic alkylation catalyst, the olefin-acting alkylating agent may undergo polymerization and/or hydrogen-exchange reactions to form a higher molecular weight polymer of the alkylating agent and/or a saturated analog of the alkylating agent, in addition to a more highly unsaturated product resulting from the loss of hydrogen from the alkylating agent or a polymer thereof in the exchange reaction. Still another side reaction during contact of the acidic catalyst with the reactions occurs as the result of the presence of branched chain isomers in most alkylating agents and particularly when the latter is a long chain olefinic hydrocarbon generally comprising a mixture of the various isomers of a given molecular weight; this side reaction is the fragmentation or cracking of the alkylating agent, resulting in the formation of alkyl benzenes with undesired small alkyl groups. These side reactions all of which produce measurable yields of undesired products of the alkylation reaction occur at least to some extent in all aromatic hydrocarbon

*(Price 3s. 6d.)*

alkylation reactions employing alkylating agents containing more than 8 carbon atoms per molecule. The amounts of such by-products which appear in admixture with the desired mono-alkylate having a single long chain alkyl group per aromatic nucleus depends upon the relative rates of the above reactions in competition with the desired mono-alkylation reaction, and these rates vary for each aromatic hydrocarbon selected as charging stock and for the reaction conditions utilized. On the basis of extensive investigations of alkylation reactions utilizing various types of alkylating agents, aromatic hydrocarbon charging stocks, and acidic alkylation catalysts, certain fundamental generalizations have been derived which correlate the yield and physical properties of the alkylate with the above factors. It has been observed, for example, that alkylate produced in a reaction catalyzed by sulfuric acid containing not more than 10%, and preferably from 1.5 to 5%, by weight of water is much more desirable for certain purposes than alkylate formed in the presence of other catalysts such as hydrogen fluoride or aluminum chloride. The product of sulfuric acid catalyzed reactions, for example, produces a more suitable charging stock to be sulfonated for detergent products because of the production of a different isomeric form of the alkylate which when sulfonated yields a product of more desirable physical properties and detergency. Another observation from such research is that the rate of benzene alkylation is much slower than for toluene or other nuclearly-substituted aromatic hydrocarbons, and as a result of such reduced rate of alkylation, the effects of the above-indicated side reactions become more pronounced, the yield of the desired mono-alkylate of benzene per mole of charge stock introduced into the reaction being substantially reduced, accompanied by a corresponding increase in the production of undesirable by-products such as polyalkylate, cracked and polymerized products of olefinic character and hydrogen exchange reaction products. The consumption of sulfuric acid catalyst per mole of mono-alkylate produced is also substantially greater in benzene alkylation because of the production of such by-products and the tendency of the catalyst to combine therewith to form a sludge. The net result of these various effects in the alkylation of benzene is to greatly increase the cost of the desired product and to create a waste acid disposal problem of greater magnitude.

It has now been discovered that the process for alkylating benzene may be greatly improved in respect of yield and recovery of mono-alkylate product, and in respect of reduced consumption of benzene, olefin and sulfuric acid catalyst by carrying out the alkylation reaction in the presence of the inert diluent specified above which is free of tertiary compounds. It has now been further discovered that the use of a saturated, inert diluent which comprises compounds containing one or more tertiary carbon atoms (that is, a carbon atom having three substituents other than hydrogen) results in a yield of alkylate which is lower than the yield obtained in an alkylation reaction utilizing a saturated, inert diluent in which tertiary carbon atoms form no portion of the molecular structure of such diluent. It has been noted that in the continuous alkylation of benzene with an olefinic hydrocarbon in the presence of an inert paraffinic hydrocarbon diluent, the amount of paraffinic product corresponding in molecular weight to the olefinic hydrocarbon feed stock (on the basis of the number of carbon atoms in the respective paraffinic and olefinic components present in the alkylation reaction product) varies directly with the amount of paraffinic hydrocarbons containing tertiary carbon atoms which are present in the paraffinic inert diluent charged to the alkylation reaction. Thus, for example, when an isoparaffin is present in a mixture of paraffins utilized as inert diluent in the alkylation of benzene, or when the diluent contains isonaphthenes (naphthenes having a nuclear alkyl substituent), the amount of paraffins in the product corresponding in molecular size to the olefinic feed stock (for example, dodecane when the olefin feed is a dodecylene such as propylene tetramer) is directly proportional to the content of said isoparaffins and isonaphthenes contained in the diluent, notwithstanding the fact that no paraffins having the molecular size of the olefinic feed were originally present in the organic diluent. Furthermore, the elimination of organic compounds containing tertiary carbon atoms from the inert diluent, such as the elimination of isoparaffins and isonaphthenes from a paraffinic hydrocarbon diluent, increases the yield of alkylate substantially while correspondingly reducing the production of paraffins corresponding in molecular size to the olefinic feed stock. The role of isoparaffins and isonaphthenes or other saturated compounds containing tertiary carbon atoms in reducing the yield of alkylate is believed to be that of a component capable of forming a carbonium ion by hydrogen exchange with another carbonium ion in the presence of active acid-acting catalysts. In the case of an isoparaffin present in a saturated, paraffinic hydrocarbon inert diluent charged to an alkylation reaction, a hydrogen exchange reaction between the isoparaffin and olefinic charging stock is believed to occur by virtue of the following reaction mechanism:

$$C_nH_{2n} \xrightarrow[+\text{Proton Donor}]{\text{Acidic Catalyst}} (C_nH_{2n+1})^+$$

Olefin — Carbonium Ion

$$R_1-\underset{\displaystyle H}{\overset{\displaystyle R}{\underset{|}{\overset{|}{C}}}}-R_2+(C_nH_{2n+1})^+ \longrightarrow (R_1-\overset{\displaystyle R}{\overset{|}{C}}-R_2)^+ + C_nH_{2n+2}$$

Isoparaffin Diluent — Carbonium Ion — Paraffin

where the cation $(C_nH_{2n+1})^+$ represents a carbonium ion derived from the long chain olefin charged to the alkylation reaction and the compound $C_nH_{2n+2}$ represents the corresponding paraffin formed by virtue of the hydrogen exchange reaction occurring in the alkylation reaction catalyzed by means of the acid catalyst. The carbonium ion $(R_1-\overset{\displaystyle R}{\overset{|}{C}}-R_2)^+$ thus formed as a result of the hydrogen exchange which occurs during the alkylation reaction may then alkylate a benzene nucleus, may add to an olefinic hydrocarbon and form a polymer, or it may undergo other side reactions to form undesirable by-products of the reaction. Whatever type of reaction the latter carbonium ion enters into, an undesirable consumption of either the benzene or the olefinic alkylation agent charged to the reaction occurs and ultimately reduces the yield of desired alkylate by reducing the amount of benzene and alkylating agent available for the formation of alkylate.

Since benzene particularly resists alkylation to a greater extent than toluene or other substituted aromatic compounds, the use of an inert diluent free of tertiary carbon atoms is especially important to effect an increase in the yield of mono-alkylate product. Toluene and other nuclearly-substituted aromatic compounds, in fact, alkylate with such ease that the effect of other side reactions during the alkylation is hardly noticeable and the alkylation reaction does not have to compete with such side reactions. Consequently, no substantial advantage is realized in utilizing the present diluent for such alkylation reactions. In the case of benzene, however, the side reactions proceed at a faster rate than the desired alkylation reaction and a considerable proportion of the olefin-acting alkylating agent may be consumed prior to the formation of the desired alkylate. It follows, therefore, that in an alkylation reaction utilizing benzene and an olefin as charging stocks, and in the absence isoparaffins, isonaphthenes or other saturated organic compounds containing tertiary carbon atoms, the desired alkylation reaction does not have to compete with side reactions separately from the aromatic hydrocarbon involving compounds containing tertiary carbon atoms for the olefinic alkylating agent; consequently, a greater proportion of the latter olefins are consumed in the formation of the desired alkylate. Furthermore, it has been found that the presence of the diluent in the benzene alkylation process produces a greater yield of alkylate, with less benzene and sulfuric acid consumption, than an alkylation reaction in which the diluent is absent.

Olefinic hydrocarbons containing from 9 to 18 carbon atoms per molecule for use as alkylating agent in the present process may be derived from any suitable source, including the dehydrogenation of paraffinic hydrocarbons, dehydration of alcohols, and catalytic polymerization of lower molecular weight olefins, such as the various fractions of propylene polymerization products. The propylene polymers containing from 9 to 18 carbon atoms per molecule are especially suitable for the production of alkylates utilizable as intermediates in the ultimate production of alkylaryl sulfonate detergents. The olefinic alkylating agent may consist of one or more individual olefinic hydrocarbons of homologous or analogous structure and may consist of primary, secondary or tertiary olefins and the olefinic bond may occur between any pair of carbon atoms in the molecular chain.

The material utilized as inert diluent in the present alkylation process is characterized as a saturated organic compound which is free of tertiary carbon atoms and is selected from the saturated hydrocarbons and their halogen-substituted analogues. It is thus intended to specifically exclude from the organic diluent any substantial proportion of such compounds as the isoparaffins and isonaphthenes and their derivatives containing one or more tertiary carbon atoms in their molecular structures. The inert diluent to be used in the present process, moreover, boils at a temperature below 100°C. and therefore also considerably below the initial boiling point of the alkylate. Consequently the organic mixture which separates as so-called hydrocarbon phase from the used catalyst phase of the alkylation reaction mixture can be readily fractionated to recover the diluent separately from the aromatic hydrocarbon

alkylate without formation of azeotropes. Suitable diluents having these characteristics include, for example, n-butane, n-pentane, n-hexane, n-heptane, and mixtures thereof. The diluent is selected for use in the present process in relation to the particular olefin used as alkylating agent so that the diluent boils at a lower temperature than the olefin.

The catalyst utilized herein to effect the condensation of the benzene with the olefin is sulfuric acid of at least 90% concentrations (i.e. not over 10% water), and preferably of from 95 to 98.5% sulfuric acid. A particularly preferred catalyst is sulfuric acid containing at least 95% and preferably 98.5% sulfuric acid and particularly a used iso-paraffin alkylation catalyst. Such used sulfuric acid iso-paraffin alkylation catalysts may contain up to about 15% by weight of organic material and up to about 7.5% by weight of water. The organic material in such catalysts usually comprises alkyl sulfates which reduce olefin consumption in the present process and in other respects promote the alkylation reaction by virtue of their emulsifying action on the hydrocarbon and acid phases. Such used isoparaffin alkylation catalyst is preferably fortified with a reagent capable of reacting with the water in the spent acid to form sulfuric acid, such as concentrated sulfuric acid, oleum, or sulfur trioxide to reduce its water content to from 5 to 2.5% by weight. A portion of the partially spent acid phase of the present process, separated from the hydrocarbon alkylation products by decantation therefrom, may be recycled in combination with fresh alkylation catalyst.

The condensation of the olefin with benzene may be effected in the presence of the indicated sulfuric acid alkylation catalyst and in admixture with the inert diluent at temperatures between −10° and 100°C., preferably from 0° to 50°C., and at pressures sufficient to maintain the reactants and catalyst in substantially liquid phase during the course of the reaction. For the purpose of producing the monoalkyl alkylate product, it is generally preferred to charge an excess of the benzene reactant into the alkylation zone, based upon the quantity of olefin required to form the monoalkylate, generally from 1:1 to about 10:1 molecular proportions of benzene to olefin. The inert diluent is desirably charged to the alkylation reaction in admixture with one of the reactants in an amount of from 5% to 100% by weight of the benzene charged to the reaction. The mixture is preferably thoroughly stirred during the reaction, usually for a period of from about 0.2 to about 2 hours. Following the reaction, the mixture is permitted to settle in order to stratify the used catalyst phase from the hydrocarbon product in admixture with inert diluent, the separated phase being recovered by simple decantation. The recovered hydrocarbon phase is washed with water or caustic before separating the diluent, alkylate, and unused benzene therefrom, and it is in this stage of the process that the presence of the diluent in the product is highly advantageous in eliminating the problem of emulsification between the hydrocarbon and aqueous phases, a problem associated with the alkylation in which no diluent is utilized. The inert diluent is preferably separated from the hydrocarbon phase, for example, by distillation of the washed hydrocarbon phase and thereafter is recycled to the alkylation zone, since the inert diluent thus separated is substantially completely free from reactive components.

EXAMPLE

Four alkylation operations were effected under otherwise identical continuous flow conditions, but under differing conditions with respect to the presence or absence of an organic diluent in the alkylation reaction mixture to determine the relative effects of the diluent and its composition on the yield and quality of alkylate product. In each of the four operations a dodecylene in the form of a propylene tetramer fraction boiling from 170° to 225°C. was used as olefin charge, a temperature of 0°C. was maintained during the alkylation reaction and the hydrocarbon reactants were likewise mixed at this temperature, the benzene to olefin molar ratio (moles of benzene per mole of dodecylene) was maintained at 10:1 in the reaction mixture, the reactants were mixed and allowed to contact the acid catalyst for a space time of approximately 40 minutes in each case, the hydrocarbon to acid catalyst volume ratio was maintained throughout the reaction at 3:1, and the fresh acid catalyst was 98.5% sulfuric acid charged into the alkylation reaction mixture at a make-up rate of 1.25 kilograms per kilogram of olefin charged to the reaction. In operation A, an acid-treated light naphtha fraction containing 47% n-hexane, 3% cyclohexane, 12% methylcyclopentane and 38% $C_6-C_7$ isoparaffins was used as diluent in an amount representing 43% by weight of the benzene charged to the alkylation reaction mixture. In operation B, conducted at otherwise identical reaction conditions as the operation A, normal heptane in an amount equivalent to 43% by weight of the benzene charged was utilized as diluent. In operation C, no diluent whatsoever was utilized in the alkylation reaction conducted at otherwise identical reaction conditions as operations A and B. Methylcyclopentane was utilized as diluent in the operation D which was conducted at the above reaction conditions and utilizing 43% by weight of diluent based on the benzene charged. The following Table presents the results of the operations in tabulated form:

TABLE

| *Operation*: | A | B | C | D |
|---|---|---|---|---|
| Inert Diluent | Naphtha fraction | n-$C_7H_{16}$ | None | Methylcyclopentane |
| *Yields*: | | | | |
| Dodecylbenzene, 275-325°C., kgs/kg olefin feed | 0.81 | 1.02 | 0.97 | 0.50 |
| Percent of theoretical | 55 | 70 | 66 | 23 |
| Dodecane in hydrocarbon product kgs/kg olefin | 0.15 | 0.03 | 0.03 | 0.46 |
| *Benzene Consumption*: | | | | |
| Moles benzene/mole dodecylbenzene | 1.9 | 1.5 | 1.7 | 2.1 |
| *Acid Consumption*: | | | | |
| Kgs/kg of Alkylate | 1.6 | 1.2 | 1.3 | 2.62 |
| *Behavior of Alkylate in Caustic Scrubbing*: | | | | |
| Emulsion formation | no | no | yes | no |

Prior to distillation of the hydrocarbon layer of the alkylation reaction product it is necessary to wash this hydrocarbon layer with an aqueous alkaline solution in order to remove acid sulfate esters, entrained sulfuric acid catalyst and other acidic materials to thereby avoid discoloration and decomposition of the alkylate which would otherwise occur if the alkylate were to be distilled without a wash for removal of these acidic substances. The alkylate prepared in the presence of the paraffinic diluent permitted washing with caustic solution readily and without a tendency toward emulsification of the hydrocarbon phase in the aqueous caustic; no problem was therefore encountered in separating the washed alkylate from the aqueous phase, and the mixture of alkylate and diluent separated as a distinct clear, hydrocarbon phase with no intermediate emulsion between the aqueous and hydrocarbon layers immediately after shaking the caustic solution and hydrocarbon mixture together. The hydrocarbon layer separated from the acid phase in the operation C, in which no diluent was present during the reaction, produced an emulsion which was difficult to separate into hydrocarbon and aqueous phases when shaken with dilute aqueous caustic solution and then only by adding a large quantity of salt to precipitate the emulsion.

The above results indicate the outstanding advantage of utilizing the inert diluent having no tertiary carbon atoms in the molecular structure. Indeed, the presence of a diluent in which 50% of the hydrocarbons contain tertiary carbon atoms actually reduces the yield of dodecylbenzene below the yield obtained in the absence of diluent. Only a diluent free from tertiary carbon atoms combines the advantages of freedom from emulsification troubles with an actual improvement in alkylate yield and a decrease in reactant and catalyst consumption.

WHAT WE CLAIM IS:

1. Process for producing benzene alkylates which comprises alkylating benzene with an olefin containing from 9 to 18 carbon atoms per molecule in substantially liquid phase in the presence of a sulfuric acid alkylation catalyst and in admixture with from 5 to 100%, by weight of the benzene charged, of an inert diluent which is free from tertiary carbon atoms, boils at a lower temperature than said olefin, and is selected from the group consisting of the saturated hydrocarbons and the saturated halogen-substituted hydrocarbons boiling below 100°C., and thereafter separating the resultant reaction mass into a used catalyst phase and a hydrocarbon phase comprising alkylate in admixture with said diluent.

2. The process of claim 1 further characterized in that the inert diluent consists of at least one paraffinic hydrocarbon selected from the group consisting of n-pentane, n-hexane and n-heptane.

3. The process of claim 1 further characterized in that a major proportion of said olefin is dodecylene.

4. The process of any of the claims 1 to 3 further characterized in that the sulfuric acid alkylation catalyst comprises a used isoparaffin alkylation acid catalyst containing not more than 7.5% by weight water.

5. The process of claim 4 further characterized in that the alkylation catalyst comprises a used isoparaffin sulfuric acid alkylation catalyst which has been fortified with a reagent which yields sulfuric acid in contact with water and is selected from the group consisting of concentrated sulfuric acid containing less than 5% water, sulfur trioxide and sulfuric acid oleum.

6. The process of any of the claims 1 to 5 further characterized in that the hydrocarbon phase upon its separation from the reaction mass is freed from acidic substances by washing with an aqueous alkaline solution and the benzene alkylate is thereafter

TABLE

| Operation: | A Naphtha fraction | B n-$C_7H_{16}$ | C None | D Methylcyclopentane |
|---|---|---|---|---|
| Inert Diluent | | | | |
| *Yields*: | | | | |
| Dodecylbenzene, 275-325°C., kgs/kg olefin feed | 0.81 | 1.02 | 0.97 | 0.50 |
| Percent of theoretical | 55 | 70 | 66 | 23 |
| Dodecane in hydrocarbon product kgs/kg olefin | 0.15 | 0.03 | 0.03 | 0.46 |
| *Benzene Consumption*: Moles benzene/mole dodecylbenzene | 1.9 | 1.5 | 1.7 | 2.1 |
| *Acid Consumption*: Kgs/kg of Alkylate | 1.6 | 1.2 | 1.3 | 2.62 |
| *Behavior of Alkylate in Caustic Scrubbing*: Emulsion formation | no | no | yes | no |

Prior to distillation of the hydrocarbon layer of the alkylation reaction product it is necessary to wash this hydrocarbon layer with an aqueous alkaline solution in order to remove acid sulfate esters, entrained sulfuric acid catalyst and other acidic materials to thereby avoid discoloration and decomposition of the alkylate which would otherwise occur if the alkylate were to be distilled without a wash for removal of these acidic substances. The alkylate prepared in the presence of the paraffinic diluent permitted washing with caustic solution readily and without a tendency toward emulsification of the hydrocarbon phase in the aqueous caustic; no problem was therefore encountered in separating the washed alkylate from the aqueous phase, and the mixture of alkylate and diluent separated as a distinct clear, hydrocarbon phase with no intermediate emulsion between the aqueous and hydrocarbon layers immediately after shaking the caustic solution and hydrocarbon mixture together. The hydrocarbon layer separated from the acid phase in the operation C, in which no diluent was present during the reaction, produced an emulsion which was difficult to separate into hydrocarbon and aqueous phases when shaken with dilute aqueous caustic solution and then only by adding a large quantity of salt to precipitate the emulsion.

The above results indicate the outstanding advantage of utilizing the inert diluent having no tertiary carbon atoms in the molecular structure. Indeed, the presence of a diluent in which 50% of the hydrocarbons contain tertiary carbon atoms actually reduces the yield of dodecylbenzene below the yield obtained in the absence of diluent. Only a diluent free from tertiary carbon atoms combines the advantages of freedom from emulsification troubles with an actual improvement in alkylate yield and a decrease in reactant and catalyst consumption.

WHAT WE CLAIM IS:

1. Process for producing benzene alkylates which comprises alkylating benzene with an olefin containing from 9 to 18 carbon atoms per molecule in substantially liquid phase in the presence of a sulfuric acid alkylation catalyst and in admixture with from 5 to 100%, by weight of the benzene charged, of an inert diluent which is free from tertiary carbon atoms, boils at a lower temperature than said olefin, and is selected from the group consisting of the saturated hydrocarbons and the saturated halogen-substituted hydrocarbons boiling below 100°C., and thereafter separating the resultant reaction mass into a used catalyst phase and a hydrocarbon phase comprising alkylate in admixture with said diluent.

2. The process of claim 1 further characterized in that the inert diluent consists of at least one paraffinic hydrocarbon selected from the group consisting of n-pentane, n-hexane and n-heptane.

3. The process of claim 1 further characterized in that a major proportion of said olefin is dodecylene.

4. The process of any of the claims 1 to 3 further characterized in that the sulfuric acid alkylation catalyst comprises a used isoparaffin alkylation acid catalyst containing not more than 7.5% by weight water.

5. The process of claim 4 further characterized in that the alkylation catalyst comprises a used isoparaffin sulfuric acid alkylation catalyst which has been fortified with a reagent which yields sulfuric acid in contact with water and is selected from the group consisting of concentrated sulfuric acid containing less than 5% water, sulfur trioxide and sulfuric acid oleum.

6. The process of any of the claims 1 to 5 further characterized in that the hydrocarbon phase upon its separation from the reaction mass is freed from acidic substances by washing with an aqueous alkaline solution and the benzene alkylate is thereafter

separated from the diluent.

7. The process of any of the claims 1 to 6 further characterized in that diluent, unreacted benzene, and a higher boiling benzene alkylate fraction are recovered from the hydrocarbon phase by fractionally distilling the same after its separation from the reaction mass, benzene and diluent thus recovered are recirculated to the alkylation reaction, and said benzene alkylate fraction is withdrawn from the process.

8. The process for producing benzene alkylates substantially as described.

J. Y. & G. W. JOHNSON,
47, Lincoln's Inn Fields,
London, W.C.2.
Chartered Patent Agents.

Sheerness: Printed for Her Majesty's Stationery Office, by Smiths, Printers and Duplicators.—1960.
Published at the Patent Office, 25 Southampton Buildings, London, W.C.2, from which copies may be obtained.

*CLMS*

"Ribbon accompanying seal or fastener was cut or removed during data conversion for the purposes of scanning in the document. Date: - 2 AUG 2000