Description

The invention relates to a process for the preparation of a silver-containing catalyst suitable for the preparation of ethylene oxide, to a new catalyst and to the use of the catalyst for the preparation of ethylene oxide, and the ethylene oxide thus obtained.

It is generally known for a silver-containing catalyst to be employed in the preparation of ethylene oxide from ethylene. See for example British patent specification No. 1413251 and also the literature cited therein. In order to obtain improved silver catalysts, efforts have been directed for many years towards modifying the silver catalysts with the aid of promoters. For example, in the above-mentioned British patent specification No. 1413251 is described a process in which a silver compound is applied to a carrier, after which the applied silver compound is reduced to silver and in which additionally a promoter in the form of potassium, rubidium or cesium salts or a mixture thereof is present on the carrier. According to GB-A 1 133 484 the promoter can be a tin compound. In accordance with FR-A 2 107 735 the catalyst comprises a composition of silver and tin exhibiting enhanud activity.

The applicant has found new silver catalysts with a higher activity. The applicant has also found that the silver particles on the surface of the carrier are better dispersed.

The invention relates to a process for the preparation of a silver-containing catalyst suitable for the oxidation of ethylene to ethylene oxide, in which a silver compound is applied to a carrier, after which the silver compound is reduced to metallic silver, and which process is characterized in that the carrier has been prepared by mixing an aluminium compound with a tin compound and by calcining the resulting mixture.

The invention also relates to a silver catalyst, suitable for the oxidation of ethylene to ethylene oxide comprising silver as an active component and a tin modified alumina as a carrier.

The aluminium compounds can preferably be modifications of aluminium oxide, which when calcined at between 1200 °C and 1700 °C can produce alpha-aluminium oxide, such as gamma-aluminium oxide. Another possibility is to use a hydrated aluminium oxide, such as boehmite, which on calcining at up to 1100 °C can produce gamma-aluminium oxide and on further calcining at temperatures of between 1200 °C and 1700 °C can produce alpha-aluminium oxide.

Some examples of tin compounds are tin salts such as stannic chloride, stannic bromide, stannic fluoride, stannic iodide, stannic nitrate, stannic sulphate, stannic tartrate and stannic chromate. Salts of divalent tin are also suitable. Stannic sulphate is the most preferred. The quantity of tin compound mixed with the aluminium compound is preferably 1 to 30 wt%, calculated on the weight of the aluminium compound.

It has been found that the Sn/Al atom ratio at the surface of the carrier is greater than the weighed-out Sn/Al atom ratio. It has also been found that the tin particles at the surface of the carrier have a great influence on the distribution of the metallic silver over the surface. It appears that if the catalyst is prepared according to the invention, the silver particles on the catalyst surface have a size of 0.08 µm or even less, whereas the size of the silver particles on known commercial catalysts is 0.2-0.5 µm. The particles on the catalyst prepared according to the invention are so small and so uniformly distributed that we can speak of a silver mirror on the surface of the carrier.

The catalysts according to the invention are, moreover, much more active than the commercial catalysts.

For the preparation of the tin modified carrier, preferably an aluminium compound is mixed with water and the tin compound, the mixture thus obtained being extruded to shaped particles which are subsequently calcined. Calcination can take place in one or more steps, depending on the choice of starting material. In general, sufficient water is added to make the mixture extrudable. The extrudable paste obtained is then extruded in an extruder to form shaped pieces. These shaped pieces are heated, during which water still present is evaporated. The solid pieces are calcined at a temperature of between 1200 °C and 1700 °C. Suitable starting materials are powders of gamma-aluminium oxide, alpha-aluminium oxide monohydrate, alpha-aluminium oxide trihydrate and beta-aluminium oxide monohydrate, which are sintered during the calcination, with fusion of the powder particles taking place.

The effective catalyst surface area can vary from between 0.2 and 5 m^2/g.

In order to prepare a catalyst, the tin modified carrier is impregnated with a solution of a silver compound sufficient to apply, as wished, 1 to 25 weight per cent of silver, calculated on the weight of the total catalyst, to the carrier. The impregnated carrier is separated from the solution and the precipitated silver compound is reduced to silver.

Preferably a promoter is added, for example one or more of the alkali metals: potassium, rubidium or cesium. The promoters can be applied to the carrier before, during or after the impregnation with silver compound. The promoter can also be applied to the carrier after the silver compound has been reduced to silver.

In general, the carrier is mixed with an aqueous solution of a silver salt or silver complex, so that the carrier is impregnated with this solution, after which the carrier is separated from the solution and subsequently dried. The impregnated carrier is then heated to a temperature of between 100 °C and 400 °C for a period necessary for the silver salt (or complex) to decompose and form a finely distributed layer of metallic silver which adheres to the surfaces. A reducing or inert gas can be passed over the carrier during the heating.

Various methods are known for adding the silver. The carrier can be impregnated with an aqueous solution of silver nitrate, then dried, after which the silver nitrate is reduced with hydrogen or hydrazine. The carrier can also be impregnated with an ammoniacal solution of silver oxalate or silver carbonate, the deposition of silver metal being effect-

ed by thermally decomposing the salt. Special solutions of a silver salt with certain solubilizing and reducing agents, such as combinations of vicinal alkanolamines, alkyldiamines and ammonia also serve the purpose.

The quantity of added promoter is generally between 20 and 1000 parts by weight of an alkali metal, such as potassium, rubidium or cesium (as metal) per million parts by weight of total catalyst. 50 to 300 parts by weight of alkali metal is particularly suitable. Suitable compounds to serve as starting material for promoters are, for example, nitrates, oxalates, carboxylic acid salts or hydroxides. The most preferred promoter is cesium, the cesium being preferably employed as cesium hydroxide or cesium nitrate.

Some excellent methods are known for adding the alkali metals in which these metals can be applied at the same time as the silver. Suitable alkali metal salts are generally salts which are soluble in the silver-depositing liquid phase. Besides the above-mentioned salts, it is also worth mentioning nitrates, chlorides, iodides, bromides, bicarbonates, acetates, tartrates, lactates and isopropoxides. The use of alkali metal salts which react with the silver present in the solution and thus cause silver salts to be prematurely precipitated from an impregnating solution should, however, be avoided. For example, potassium chloride should not be used for impregnating techniques in which an aqueous silver nitrate solution is used, but potassium nitrate can be used instead. Potassium chloride can be suitably used in a process in which an aqueous solution of silver amine complexes, from which no silver chloride will precipitate, is used.

In addition, the amount of alkali metal deposited on the carrier can be adjusted within certain limits by washing out a part of the alkali metal with, preferably, anhydrous methanol or ethanol. This method is employed subsequently if the concentration of the applied alkali metal is found to be too high. The temperatures, contact times and the drying with gases can be adjusted. Care should be taken to ensure that no traces of alcohol remain in the carrier.

A preferably employed process consists of the carrier being impregnated with an aqueous solution containing both alkali metal salt and silver salt, the impregnating solution being composed of a silver salt of a carboxylic acid, an organic amine, a salt of potassium, rubidium or cesium and an aqueous solvent. For example, a potassium-containing silver oxalate solution can be prepared in two ways. Silver oxide can be reacted with a mixture of ethylene diamine and oxalic acid, giving a solution containing a silver oxalate ethylene diamine complex, to which a certain amount of potassium and possibly other amines such as ethanolamine is added. Silver oxalate can also be precipitated from a solution of potassium oxalate and silver nitrate, the silver oxalate thus obtained then being repeatedly washed in order to remove the attached potassium salts until the desired potassium content is obtained. The potassium-containing silver oxalate is then solubilized with ammonia and/or amine. Solutions containing rubidium and cesium can also be prepared in this way. The thus impregnated carriers are then heated to a temperature of between 100 °C and 400 °C, preferably between 125 °C and 325 °C.

It should be noted that, irrespective of the nature of the silver in the solution before the precipitation onto the carrier, reference is always made to reduction to metallic silver, whereas it could also be referred to as decomposition on heating. It is preferred to think in terms of reduction, since positively charged Ag ions are converted into metallic Ag. The reduction times can be simply adapted to the starting materials employed.

As mentioned above, a promoter is preferably added to the silver. Cesium is the most preferred promoter in view of the fact that its selectivity for ethylene oxide has been found to be the highest in comparison with the use of potassium or rubidium as promoter.

The silver catalysts prepared by the process according to the present invention appear to be particularly active catalysts for the direct catalytic oxidation of ethylene to ethylene oxide with the aid of molecular oxygen. The conditions for carrying out the oxidation reaction in the presence of the silver catalysts according to the invention are fairly similar to those already described in the literature. This applies to, for example, suitable temperatures, pressures, residence times, diluents such as nitrogen, carbon dioxide, steam, argon, methane or other saturated hydrocarbons, the presence or absence of moderating agents to control the catalytic action, for example 1,2-dichloroethane, vinyl chloride or chlorinated polyphenyl compounds, the desirability of employing either recirculating treatments or successive conversions in different reactors to enhance the yield of ethylene oxide, as well as any other special conditions which may be chosen for processes for the preparation of ethylene oxide. Usually, the pressures employed vary from about atmospheric pressure to about 35 bar. Higher pressures are, however, by no means excluded. The molecular oxygen employed as reactant can be obtained from conventional sources. The oxygen supply can consist of substantially pure oxygen, of a concentrated oxygen stream consisting of a large amount of oxygen with smaller amounts of one or more diluents, such as nitrogen, argon, etc., or of another oxygen-containing stream, such as air.

In a preferably employed application of the silver catalysts according to the present invention, ethylene oxide is prepared by contacting an oxygen-containing gas that has been separated from air and that contains not less than 95% oxygen with ethylene in the presence of the catalysts in question at a temperature withing the range of 210 °C to 285 °C and preferably between 225 °C and 270 °C. Gas hourly space velocities may range from 2800 to 8000 h^{-1}.

In the reaction of ethylene with oxygen to ethylene oxide, the ethylene is present in at least a double molecular quantity, but the quantity of ethylene employed is generally much higher. The conversion is therefore calculated according to the quantity of converted oxygen in the reaction and we therefore speak of oxygen conversion. This oxygen conver-

sion is dependent on the temperature of the reaction and is a measure of the activity of the catalyst. The values T_{30}, T_{40} and T_{50} refer to the temperatures at 30 mol%, 40 mol% and 50 mol% conversion respectively of the oxygen in the reactor. The temperatures are generally higher for a higher conversion and are highly dependent on the catalyst employed and the reaction conditions.

Example 1

6.1 g stannic sulphate in 160 ml water was mixed with 133.3 g Kaiser aluminium oxide (26405) ($Al_2O_3.H_2O$) by adding stannic sulphate in water to aluminium oxide, and the mixture was kneaded for 8 minutes in a masticator. The paste obtained was then extruded. The resulting shaped pieces were dried at 120 °C and subsequently calcined at progressively higher temperatures. Calcination was started with the temperature rising at a rate of 200 °C/h up to 500 °C. Calcination was then continued for 1 hour at 500 °C, after which the temperature was raised in 2 hours to 1400 °C. Finally, calcination was continued for 1 hour at 1400 °C. The pore volume of the shaped pieces was 0.45 $ml.g^{-1}$ and the average pore diameter was 1.0 µm. The tin/aluminium ratio at the surface is greater than the weighed-out tin/aluminium ratio. The resulting shaped pieces were impregnated with an aqueous solution of silver oxalate to which cesium hydroxide was added. The impregnation was carried out for 10 minutes under vacuum, after which the shaped pieces were separated from the solution and placed in a hot air stream at a temperature of 250-270 °C for 10 minutes in order to convert the silver salt to silver. The aqueous solution of silver oxalate was a 28 wt% Ag-containing aqueous solution in which the silver oxalate was complexed with ethylene diamine and to which solution cesium hydroxide was added. After the hot air treatment the thus impregnated shaped pieces contained 21 wt% Ag (calculated on total catalyst) and 480 parts by weight of cesium per million parts by weight of total catalyst.

The catalyst obtained was then used for the preparation of ethylene oxide from ethylene and oxygen. A cylindrical steel reactor with a length of 40 cm and a cross-section of 5 mm was filled entirely with catalyst particles of about 1 mm in size. The reactor was placed in a bath in which silicon oxide and aluminium oxide particles were present in a fluidized bed. A gas mixture with the following composition was passed through the reactor: 30 mol% ethylene, 8.5 mol% oxygen, 7 mol% carbon dioxide, 54.5 mol% nitrogen and 5.5 parts per million parts of gas, of vinyl chloride as moderator. The space velocity was 3300 $1.1^{-1}.h^{-1}$. The pressure was 15 bar and the temperature was dependent on the set oxygen conversion. The measuring equipment was connected to the reactor and to a computer such that the conversion and the temperature could be accurately controlled. The concentrations of the reaction components were determined with the aid of gas chromatography and mass spectrometry. After 24 h the reaction temperature was measured at 40% oxygen conversion and found to be 212 °C.

A similar test with the standard catalyst S839 gave a T_{40} of 236 °C. It appeared, therefore, that the silver-containing catalyst according to the invention had a T_{40} which was 24 °C lower than the T_{40} of the standard catalyst S839 under the same reaction conditions.

Example 2

A silver-containing catalyst prepared in the same way as in Example 1, but in which 5 times as much stannic sulphate was used in the carrier preparation, and which catalyst contained 18 wt% silver and 290 ppm cesium, was tested at 50% oxygen conversion. The size of the silver particles on the catalyst was 60 nanometre (nm). The reaction conditions were the same as in Example 1, except that the gas mixture passed into the reactor contained no carbon dioxide.

It appeared that this silver-containing catalyst according to the invention had a T_{50} which was 17 °C below the T_{50} of the standard catalyst S839 under the same reaction conditions.

It also appeared that the surfaces of the catalysts prepared by means of the process according to Examples 1 and 2 were almost entirely covered by silver particles (found with the aid of electron microscopy and scanning auger electron spectroscopy).

Claims

1. A process for the preparation of a silver-containing catalyst suitable for the oxidation of ethylene oxide, in which a silver compound is applied to a carrier, after which the silver compound is reduced to metallic silver, characterized in that the carrier has been prepared by mixing an aluminium compound with a tin compound and by calcining the obtained mixture.

2. A process according to claim 1, characterized in that the tin compound is a tin salt.

3. A process according to claim 2, characterized in that stannic sulphate is employed.

4. A process according to one or more of claims 1-3, characterized in that the aluminium compound is mixed with 1-30 wt% of tin compound, calculated on the weight of the aluminium compound.

5. A process according to one or more of claims 1-4, characterized in that the aluminium compound is an aluminium oxide or a hydrate of an aluminium oxide.

6. A process according to claim 5, characterized in that boehmite or gamma-aluminium oxide is employed.

7. A process according to one or more of claims 1-6, characterized in that the aluminium compound is mixed with water and a tin compound, the resulting mixture being extruded to shaped carrier particles which are then calcined.

8. A process according to one or more of claims 1-7, characterized in that the carrier is impregnated with a solution of a silver compound sufficient to apply 1 to 25 weight per cent of silver, calculated on the weight of the total catalyst, to the carrier, the im-

sion is dependent on the temperature of the reaction and is a measure of the activity of the catalyst. The values T_{30}, T_{40} and T_{50} refer to the temperatures at 30 mol%, 40 mol% and 50 mol% conversion respectively of the oxygen in the reactor. The temperatures are generally higher for a higher conversion and are highly dependent on the catalyst employed and the reaction conditions.

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6.1 g stannic sulphate in 160 ml water was mixed with 133.3 g Kaiser aluminium oxide (26405) ($Al_2O_3.H_2O$) by adding stannic sulphate in water to aluminium oxide, and the mixture was kneaded for 8 minutes in a masticator. The paste obtained was then extruded. The resulting shaped pieces were dried at 120 °C and subsequently calcined at progressively higher temperatures. Calcination was started with the temperature rising at a rate of 200 °C/h up to 500 °C. Calcination was then continued for 1 hour at 500 °C, after which the temperature was raised in 2 hours to 1400 °C. Finally, calcination was continued for 1 hour at 1400 °C. The pore volume of the shaped pieces was 0.45 $ml.g^{-1}$ and the average pore diameter was 1.0 μm. The tin/aluminium ratio at the surface is greater than the weighed-out tin/aluminium ratio. The resulting shaped pieces were impregnated with an aqueous solution of silver oxalate to which cesium hydroxide was added. The impregnation was carried out for 10 minutes under vacuum, after which the shaped pieces were separated from the solution and placed in a hot air stream at a temperature of 250-270 °C for 10 minutes in order to convert the silver salt to silver. The aqueous solution of silver oxalate was a 28 wt% Ag-containing aqueous solution in which the silver oxalate was complexed with ethylene diamine and to which solution cesium hydroxide was added. After the hot air treatment the thus impregnated shaped pieces contained 21 wt% Ag (calculated on total catalyst) and 480 parts by weight of cesium per million parts by weight of total catalyst.

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1. A process for the preparation of a silver-containing catalyst suitable for the oxidation of ethylene oxide, in which a silver compound is applied to a carrier, after which the silver compound is reduced to metallic silver, characterized in that the carrier has been prepared by mixing an aluminium compound with a tin compound and by calcining the obtained mixture.

2. A process according to claim 1, characterized in that the tin compound is a tin salt.

3. A process according to claim 2, characterized in that stannic sulphate is employed.

4. A process according to one or more of claims 1-3, characterized in that the aluminium compound is mixed with 1-30 wt% of tin compound, calculated on the weight of the aluminium compound.

5. A process according to one or more of claims 1-4, characterized in that the aluminium compound is an aluminium oxide or a hydrate of an aluminium oxide.

6. A process according to claim 5, characterized in that boehmite or gamma-aluminium oxide is employed.

7. A process according to one or more of claims 1-6, characterized in that the aluminium compound is mixed with water and a tin compound, the resulting mixture being extruded to shaped carrier particles which are then calcined.

8. A process according to one or more of claims 1-7, characterized in that the carrier is impregnated with a solution of a silver compound sufficient to apply 1 to 25 weight per cent of silver, calculated on the weight of the total catalyst, to the carrier, the im-

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pregnated carrier being separated form the solution and the precipitated silver compound being reduced to silver.

9. A process according to one or more of claims 1-8, characterized in that a promoter is applied to the carrier.

10. A process according to claim 8 or 9, characterized in that besides the silver compound applied to the carrier, a sufficient quantity of one or more compounds of potassium, rubidium or cesium is applied, either simultaneously or not, to the carrier to deposit between 20 and 1000 parts by weight of alkali metal (measured as metal) per million parts by weight of total catalyst.

11. Catalyst prepared with the aid of the process according to claims 1-10.

12. A silver catalyst suitable for the oxidation of ethylene to ethylene oxide, comprising silver as an active component and a tin modified alumina as a carrier.

13. A catalyst according to claim 12 comprising
a) from 1 to 25 per cent by weight of silver, calculated on the weight of the total catalyst, on the surface of the carrier and
b) tin modified alpha alumina as a carrier.

14. A catalyst according to claim 12 or 13, comprising also a promoter on the surface of the carrier.

15. A catalyst according to claim 14, comprising between 20 and 1000 parts by weight of potassium, rubidium or cesium (measured as the metal) per million parts by weight of total catalyst.

16. Process for the preparation of ethylene oxide by oxidation of ethylene in the presence of a silver-containing catalyst, characterized in that the process is carried out in the presence of a silver-containing catalyst prepared with the aid of the process according to one or more of claims 1-10 or according to one or more of claims 11-15.

17. Ethylene oxide prepared with the aid of the process according to claim 16.

Patentansprüche

1. Verfahren zur Herstellung eines Silber-Katalysators zur Oxidation von Ethylen zu Ethylenoxid, indem eine Silberverbindung auf einen Träger aufgebracht wird, worauf diese zu metallischem Silber reduziert wird, dadurch gekennzeichnet, daß der Träger hergestellt worden ist durch Mischen einer Aluminiumverbindung und einer Zinnverbindung und Brennen der erhaltenen Mischung.

2. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß die Zinnverbindung ein Zinnsalz ist.

3. Verfahren nach Anspruch 2, dadurch gekennzeichnet, daß Zinnsulfat verwendet wird.

4. Verfahren nach einem der Ansprüche 1 bis 3, dadurch gekennzeichnet, daß die Aluminiumverbindung mit 1 bis 30 Gew.-% Zinnverbindung – bezogen auf Aluminiumverbindung – gemischt wird.

5. Verfahren nach einem der Ansprüche 1 bis 4, dadurch gekennzeichnet, daß die Aluminiumverbindung Aluminiumoxid oder ein Aluminiumoxidhydrat ist.

6. Verfahren nach Anspruch 5, dadurch gekennzeichnet, daß Boehmit oder γ-Aluminiumoxid verwendet wird.

7. Verfahren nach einem der Ansprüche 1 bis 6, dadurch gekennzeichnet, daß die Aluminiumverbindung mit Wasser und einer Zinnverbindung gemischt wird, worauf das Gemisch zu Trägerkörpern geformt wird und diese dann gebrannt werden.

8. Verfahren nach einem oder mehreren der Ansprüche 1 bis 7, dadurch gekennzeichnet, daß der Träger mit einer Lösung einer Silberverbindung zur Aufbringung von 1 bis 25 Gew.-% Silber – bezogen auf das Gesamtgewicht des Katalysators – imprägniert, der imprägnierte Träger aus der Lösung genommen und die ausgefällte Silberverbindung zu Silber reduziert wird.

9. Verfahren nach einem oder mehreren der Ansprüche 1 bis 8, dadurch gekennzeichnet, daß auf den Katalysator ein Promotor aufgebracht wird.

10. Verfahren nach einem der Ansprüche 8 oder 9, dadurch gekennzeichnet, daß außer der Silberverbindung auf dem Träger eine ausreichende Menge einer oder mehrerer Verbindung(en) von Kalium, Rubidium oder Caesium aufgebracht werden, entweder gleichzeitig oder auch nicht, um auf dem Träger 20 bis 1000 Gew.-Teile Alkalimetall – gemessen als Metall – auf 1 000 000 Gew.-Teile Katalysator abzuscheiden.

11. Katalysator, hergestellt nach dem Verfahren der Ansprüche 1 bis 10.

12. Silber-Katalysator zur Oxidation von Ethylen zu Ethylenoxid, enthaltend Silber als aktive Komponente und einen mit Zinn modifizierten Tonerdeträger.

13. Katalysator nach Anspruch 12, enthaltend
a) 1 bis 25 Gew.-% Silber, bezogen auf das Gesamtgewicht des Katalysators, an der Oberfläche des Trägers und
b) mit Zinn modifizierte α-Tonerde als Träger.

14. Katalysator nach Anspruch 12 oder 13, enthaltend zusätzlich an der Oberfläche des Trägers einen Promotor.

15. Katalysator nach Anspruch 14, enthaltend 20 bis 1000 Gew.-Teile Kalium, Rubidium oder Caesium, bestimmt als Metall, je 1 000 000 Gew.-Teile Gesamt-Katalysator.

16. Verfahren zur Herstellung von Ethylenoxid durch Oxidation von Ethylen in Gegenwart eines silberhaltigen Katalysators, dadurch gekennzeichnet, daß der Prozeß in Gegenwart eines silberhaltigen Katalysators durchgeführt wird, der hergestellt worden ist nach einem der Ansprüche 1 bis 10 bzw. einem oder mehreren der Ansprüche 11 bis 15 entspricht.

17. Ethylenoxid, hergestellt nach dem Verfahren des Anspruchs 16.

Revendications

1. Un procédé de préparation d'un catalyseur contenant de l'argent utilisable pour l'oxydation de l'éthylène en oxyde d'éthylène, dans lequel un composé de l'argent est déposé sur un support, après quoi le composé de l'argent est réduit en argent métallique, caractérisé en ce que le support a été préparé en mélangeant un composé de l'aluminium avec un composé de l'étain et en calcinant le mélange obtenu.

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2. Un procédé selon la revendication 1, caractérisé en ce que le composé de l'étain est un sel d'étain.

3. Un procédé selon la revendication 2, caractérisé en ce qu'on utilise du sulfate stannique.

4. Un procédé selon une ou plusieurs des revendications 1–3, caractérisé en ce que le composé de l'aluminium est mélangé avec 1–30% en poids de composé de l'étain, par rapport au poids du composé de l'aluminium.

5. Un procédé selon une ou plusieurs des revendications 1–4, caractérisé en ce que le composé de l'aluminium est un oxyde d'aluminium ou un hydrate d'un oxyde d'aluminium.

6. Un procédé selon la revendication 5, caractérisé en ce qu'on utilise de la boehmite ou de l'oxyde d'aluminium gamma.

7. Un procédé selon une ou plusieurs des revendications 1–6, caractérisé en ce que le composé de l'aluminium est mélangé avec de l'eau et un composé de l'étain, le mélange résultant étant extrudé en particules de support de forme déterminée qui sont ensuite calcinées.

8. Un procédé selon une ou plusieurs des revendications 1–7, caractérisé en ce que le support est imprégné d'une solution d'un composé de l'argent en quantité suffisante pour déposer 1 à 25% en poids d'argent, par rapport au poids du catalyseur total, sur le support, le support imprégné étant séparé de la solution et le composé de l'argent précipité étant réduit en argent.

9. Un procédé selon une ou plusieurs des revendications 1–8, caractérisé en ce qu'un promoteur est déposé sur le support.

10. Un procédé selon la revendication 8 ou 9, caractérisé en ce qu'en plus du composé de l'argent déposé sur le support, une quantité suffisante d'un ou plusieurs composés du potassium, du rubidium ou du césium est appliquée, simultanément ou non, au support pour déposer entre 20 et 1000 parties en poids de métal alcalin (en mesurant en métal) par million de parties en poids de catalyseur total.

11. Catalyseur préparé à l'aide du procédé selon les revendications 1–10.

12. Un catalyseur à l'argent utilisable pour l'oxydation de l'éthylène en oxyde d'éthylène, comprenant de l'argent comme constituant actif et une alumine modifiée par l'étain comme support.

13. Un catalyseur selon la revendication 2 comprenant

a) de 1 à 25% en poids d'argent, par rapport au poids du catalyseur total, sur la surface du support et

b) de l'alpha-alumine modifiée par l'étain comme support.

14. Un catalyseur selon la revendication 12 ou 13, comprenant aussi un promoteur sur la surface du support.

15. Un catalyseur selon la revendication 14, comprenant entre 20 et 1000 parties en poids de potassium, de rubidium ou de césium (en mesurant en métal) par million de parties en poids de catalyseur total.

16. Procédé de préparation d'oxyde d'éthylène par oxydation d'éthylène en présence d'un catalyseur contenant de l'argent, caractérisé en ce que le procédé est mis en œuvre en présence d'un catalyseur contenant de l'argent préparé à l'aide du procédé selon une ou plusieurs des revendications 1–10 ou selon une ou plusieurs des revendications 11–15.

17. Oxyde d'éthylène préparé à l'aide du procédé selon la revendication 16.

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