

Candidate's Answer Paper B (Chemistry)

Claims

- 1) Process for preparing a Catalyst comprising vanadium pentoxide and rutile titanium dioxide, said catalyst containing 1 - 50% by weight of vanadium pentoxide + having a specific surface area ranging from 5 to 100 m²/g;

the process comprising

mixing an aqueous solution of Ti(IV) with an aqueous solution of V(IV) followed by coprecipitation of the titanium and vanadium oxides, drying, oxidating and calcining the precipate characterised in that the calcination temperature is from 500 to 600 °C.

- 2) Process as claimed in claim 1, comprising the following steps:

- (a) preparation of a solution of Ti(IV) with a final pH below 1.0 by partial hydrolysis of $TiCl_4$ in an aqueous solution,
- (b) preparation of a solution of V(IV) by dissolving solid V_2O_5 suspended in an aqueous oxalic acid solution,
- (c) mixing solutions a) and b),
- (d) coprecipitation of vanadium and titanium oxides, and
- (e) separation of the precipitate obtained in (d), drying, oxidation and calcination thereof at temperatures from 500 °C to 650 °C.

- 3) Process as claimed in claim 1 or 2 wherein the calcination temperature is 500 °C.
- 4) Process as claimed in claim 1 or 2 wherein the calcination temperature is 550 °C.
- 5) Process as claimed in claim 1 or 2 wherein the calcination temperature is 600 °C.
- 6) Catalyst obtainable by the process of claims 1 to 5.
- 7) Use of a catalyst as defined in claim 6 for oxidizing hydrocarbons in the gas phase with oxygen or oxygas containing gases.
- 8) Use as claimed in claim 7, wherein the hydrocarbon is a butene or a hydrocarbon mixture containing a butene.
- 9) Use as claimed in claim 7, wherein the hydrocarbon is o-xylene.

EPO
Munich, Germany

Dear Sirs
Re: EP patent application no.

I write in response to the official communication pursuant to A 96(2) + R 51(2) EPC. Please replace claims 1 to 4 currently in file with revised claims 1 to 9, enclosed in triplicate.

Added matter A 123(2) EPC

Claim 1 is now directed to a process for preparing a catalyst of the present invention. Basis for new claim 1 is found in old claim 4 and In 1 - 3, pg 2000/B(C)/e/3 (*Compendium p. 80, l. 12 - 17 = C 80/12 - 17*).

The specific feature of the calcination temperature range in new claim 1 ("500 - 600 °C") finds basis on pg 2000/B(C)/e/3, In 22 (*C 80/55*).

Claim 2 finds basis on pg 2000/B(C)/e/3, In 10 - 17 (*C 80/31 - 45*).

Claim 3 to 5 find basis in examples 5 to 7 respectively.

Claim 6 is directed to the catalyst obtainable by the process of claim 1 to 5. Basis for this claim is found in 2000/B(C)/e/3, In 1 - 3 (*C 80/12 - 17*).

Claim 7 is based on old claim 1, limited to the specific process as described In 1 - 3, pg 2000/B(C)/e/3 (*C 80/12 - 17*). Claims 8 + 9 are based on old claims 2 + 3 respectively, with corresponding limitation to the specific catalyst.

The amendments now made are directly + unambiguously desirable from the application as filed (C-VI, 5.4).

Therefore: Requirements of A 123 (2) EPC are met.

Novelty (A 54 EPC)

Claim 1 is directed to a process for preparing a catalyst, involving mixing aqueous solution of Ti(IV) with aqueous solution of V(IV).

D1 discloses 3 ways of preparing $\text{TiO}_2/\text{V}_2\text{O}_5$ catalysts. However, none of the preparation processes disclose the steps of new claim 1: claim 1 is novel over D1.

DII discloses a process for preparing a catalyst which is based on rutile (TiO_2) + V_2O_5 . DII discloses that calcination is used as the last step in the preparation of the catalyst and that calcination requires temp. $>250^\circ\text{C}$ (2000/B(C)/e/13, In 24) (*C 104/46 - 47*). The only specific temp. given is 350°C (2000/B(C)/e/14, In 20) (*C 106/36*).

While the new range "500-600 °C" in new c. 1 is "above 250 °C", the temperature range is

- 1) narrow
- 2) sufficiently removed from the example of DII (ie 350°C)
- 3) purposive, as the catalysts treated with this temp. range give higher solutivity for butene (see table 2000/B(C)/e/7, columns 5 - 7) (*C 90, col 5 - 7*).

Thus, as required by T 198/84, the selection of the temp. range is novel over DII.

Claim 6

It is believed that the product of the process of c. 1 per se is novel over the catalysts in DI + DII (C-III, 4.7b) for the following reasons:

- 1) Calcination effects a "physical or chemical change" (2000/B(c)/e, In 30). (*Compendium p. ...*) Therefore calcination at different temperature is expected to result in physically and/or chemically different products. This is evident when observing columns 2 and 4 - 8 in example 10; the only difference between them is the calcination temperature, yet their activities are mildly different.
- 2) The method of manufacture of the catalysts appears to influence the properties displayed. Even though Ex. 1 - 3 in the present application all fall within the definition of old claim 4, they display very different activities (compare columns 1, 2 + 3 in Ex. 10). Thus, the catalyst described in DII (calcined at 350 °C) does not destroy novelty of new claim 6, owing the different calcination temperature. Similarly, the catalysts in DII (which aren't even made by the same process) do not destroy novelty of new claim 6, owing to the different processes by which the catalysts are made.

Therefore: Claim 6 is novel over DI + DII (A 54).

Inventive step (A 56)

Independent claim 1 + 6

The closest prior art is considered to be DII. The process of preparing the catalyst in DII is different from claim 1 only in that the calcination temperature is 350 °C, rather than 500 - 600°C.

In view of DII, it is considered that the technical problem to be solved is: how to provide a catalyst which has a high reactivity whilst improving the selectivity (2000/B(C)/e/1, In 30) (C 78/5 - 6).

The present claims solve this problem by having a calcination temperature of 500 - 600 °C.

The only discussion in DII relating to calcination is found in 2000/B(C)/e/13, In 24, (C 104/46 - 47) where a very general statement regarding calcination is made. No mention of possible advantages of altering the temperatures is made in DII. Although in the example in DII, a calcination temperature of 350 °C is used, no technical advantages are attached to this particular choice of temp.

Therefore: The skilled person, faced with the problem of improving the activity of the catalyst, would not be led to even try a different temperature by reading DII.

Yet, the range of 500 - 600 °C evidently gives a catalyst which is better in terms of selectivity than catalysts made exactly the same way but with a temperature of 350 °C. In the table of Ex 10 catalysts made in Ex 5, 6 + 7 show improved (ie increased) acetic acid selectivity as well as improved (ie decreased) ratio of oxides of Carbon.

DI is less relevant than DII, as it discusses processes which are different from claim I. Again, no mention of possibility of changing the calcination temp. (which is, again, 350°C) is made.

Therefore: The claims are inventive over DI and DII.

Dependent claims

Inventive step and novelty of dependent claims are not discussed as the independent claims are novel and inventive (C-IV, 9.5a).

Insofar as any subject matter is deemed to be abandoned by virtue of any amendments made, the applicant reserves the right to file a divisional application thereon. Specifically it is noted that the use of a catalyst as prepared by the process as described in pg 2, In 26 - 27 (C 80/1 - 5) in oxidising butene, represents novel + inventive subject matter on which a divisional may be filed.

It is believed that the points raised in the official communication have been fully responded to. Oral Proceedings are requested under A 116 EPC only if the Examining Division is minded to refuse the application.

Yours faithfully,

.....

Divisional claim

Use of a catalyst obtainable by preparing a TiO_2 hydrogel, mixing it with an aqueous solution of V(IV), precipitating the vanadium oxide, spray-drying + calcining the resulting suspension, in a process for oxidising butene.

Divisional to be filed, limited to use of a catalyst obtainable by the process described on 2000/B(C)/e/2, In 26 - 28 (C 80/1 - 5) + Ex. 3 in oxidising butene.

The process and catalyst are disclosed in DI (Ex. 1). However DI exemplifies use of the catalyst in conversion of naphthalene + o-xylene.

While DI mentions that oxidation of butanes to acetic and/or maleic acid may be done (2000/B(C)/e/10, In 3 - 4) (C 98/7 - 8) it gives no indication that the catalyst would be particularly good for this. However, in the table in Ex. 10, the catalyst produced according to the process in DI gives by far the best butene conversion %. This is unexpected so may be inventive. (No such unexpected adv. for catalyst of Ex. 1).

Not considered to have unity with main set of claims because I have argued that different processes result in different products. So no single special technical feature which is common (A 82 + R 30 EPC).