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**D E C I S I O N**  
**of 29 May 1998**

**Case Number:** T 0263/95 - 3.3.5

**Application Number:** 87311118.1

**Publication Number:** 0320549

**IPC:** B01J 23/62

**Language of the proceedings:** EN

**Title of invention:**

Layered dehydrogenation catalyst particles

**Patentee:**

UOP

**Opponent:**

- (01) Degussa AG  
(02) SÜD-CHEMIE AG

**Headword:**

Catalyst/UOP

**Relevant legal provisions:**

EPC Art. 54, 56

**Keyword:**

"Novelty (yes) - method of preparation disclosed in the citation(s) does not inevitably lead to the claimed product"  
"Inventive step (yes)"  
"Improvement not expectable in view of prior art"

**Decisions cited:**

T 0002/83

**Catchword:**



Case Number: T 0263/95 - 3.3.5

**D E C I S I O N**  
**of the Technical Board of Appeal 3.3.5**  
**of 29 May 1998**

**Appellant:**  
(Opponent 01)

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**Decision under appeal:** Decision of the Opposition Division of the European Patent Office posted 23 January 1995 rejecting the opposition filed against European patent No. 0 320 549 pursuant to Article 102(2) EPC.

**Composition of the Board:**

**Chairman:** R. K. Spangenberg  
**Members:** M. M. Eberhard  
M. B. Günzel

## Summary of Facts and Submissions

- I. European patent No. 0 320 549 based on application No. 87 311 118.1 was granted on the basis of nine claims. Claim 1 as granted reads as follows:

"1. A particulate catalyst comprising a combination of catalytically effective amounts of platinum group metal component and a modifier metal component selected from tin, germanium, and mixtures thereof, with a solid refractory oxide support characterized in that said solid support has a nominal equivalent diameter of at least 850 micrometres, and the platinum group metal and modifier metal components are impregnated on the surface of the catalyst particles, the average concentration of the platinum group component and modifier metal component in the outside 100 micrometre layer of the catalyst particle are each at least twice the concentration of the respective component in the 200 micrometre diameter centre core of the catalyst particle."

Claim 8 is directed to a hydrocarbon conversion process in which a convertible hydrocarbon is contacted with the claimed catalyst.

- II. The Appellant (Opponent 01) and Opponent 02 (party to the appeal proceedings as of right pursuant to Article 107 EPC) filed notices of opposition requesting revocation of the patent on the grounds of lack of novelty and lack of inventive step. During the opposition procedure, the parties relied inter alia on

the following documents:

D5: EP-A-0 094 684,  
D6: US-A-3 909 451,  
D8: US-A-4 049 581,  
D11: GB-A-1 590 124.

III. In a decision posted on 23 January 1995, the Opposition Division rejected the opposition. It took the view that the catalyst according to granted claim 1 was not implicitly disclosed in D6 as shown by the Respondent's experimental report of 12 December 1994. Novelty was also acknowledged with respect to D5 on the ground that D5 did not quantify the distribution of tin throughout the support. Concerning inventive step, the Opposition Division held that the higher total normal olefin selectivity achieved with the claimed catalyst in comparison with a catalyst support having a uniform distribution of tin could not be predicted from D5. Furthermore, a technical prejudice had to be overcome to arrive at the present non-uniform distribution taking into account the teaching of D8. The claimed catalyst was also not obvious in view of the teaching of D5 and D11 since rhenium was not equivalent to Sn or Ge.

IV. The Appellant lodged an appeal against this decision. It relied on an additional document, ie Heterogeneous catalysis in practice, 1980, MacGraw-Hill Book Company, pages 82-84 (hereinafter D14) and submitted additional experimental data in both its letters of 1 June 1995 and 14 May 1996. The Respondent (Patentee) filed five

sets of amended claims as First, Second, Third, Fourth and Fifth auxiliary requests with its letter dated 10 March 1997. Oral proceedings were held on 29 May 1998. Opponent 02, although duly summoned, was not represented at these oral proceedings.

- V. The Appellant's arguments as regards granted claim 1 can be summarised as follows:

The subject-matter of claim 1 lacked novelty over the disclosure of D5 or D6 since a catalyst having the metal distribution defined in claim 1 was inevitably obtained by following the preparation procedure disclosed in D5 or D6. The Appellant's experimental reports submitted at the appeal stage were based on an exact repetition of the procedure used in example 1 of D5 and confirmed that tin was deposited on an outer layer of the support. The ZnO:Al<sub>2</sub>O<sub>3</sub> mole ratio was exactly the same as in example 1 and the repetitions thereof with starting products having a different loss on ignition (LOI) or with higher amounts of acid (experiments of 14 May 1996) all led to the same results, ie to the claimed concentration profile. These experimental results were not inconsistent with the Respondent's results submitted on 20 December 1993 since the Respondent had not exactly repeated example 1 of D5. The tin distribution measured by the Respondent could be attributed to the selected composition of the support and to the very strong acidity of the impregnation solution. At the oral proceedings the Appellant further argued that it was clear to the skilled person without duplication of example 1 of D5 that tin was concentrated in a layer at the surface of the particles. As D5 disclosed a stoichiometric excess of zinc oxide and the tin chloride solution sprayed onto the surface of the support was hydrolysed, deposition of the tin component occurred at the surface of the support. Furthermore, impregnation to incipient wetness led, according to D14, to the metal being concentrated in an outer shell. As D5 did not teach adding acid to the tin chloride, the skilled person



would have added only a small amount thereof, and according to D14 this resulted in a non-uniform deposit.

The catalysts of D6 were prepared by using the same starting products and the same process as in the patent in suit. Therefore, they inevitably exhibited the same metal distribution as the claimed catalysts.

The claimed catalyst did not involve an inventive step in view of the teaching of D5, D6 and D11. As D6, contrary to D5, dealt with the selectivity of the catalyst, it was the closest prior art. An improved selectivity over the catalysts of D6 was not achieved since according to D6 a catalyst containing an alkali or an alkaline earth component already led to a minimisation of the side reactions. The technical problem of providing a catalyst having in particular an improved selectivity for the dehydrogenation of n-paraffins into n-olefins was addressed in D6. D6 prescribed no particular distribution for Pt and Sn and contained no technical prejudice in this respect. The problem in D5 was to provide a catalyst suitable for the dehydrogenation of n-paraffins, which exhibited improved activity and stability. It was obvious to combine the teaching of D6 and D5 to arrive at a dehydrogenation catalyst having the noble metal concentrated in a layer at the surface of the support. It was common general knowledge before the filing date that side reactions such as isomerisation, aromatisation and cracking were caused by a long time of contact of the reactants and products with the

catalyst. With the metals being concentrated in an outer shell, the contact time was shorter, and thus, it was obvious to deposit tin as a layer at the particle surface. Furthermore, D6 required an intimate association of tin and platinum and the skilled person knew from D11 that tin and rhenium were both modifiers and produced similar effects in a dehydrogenation catalyst. Thus, in view of the teaching of D5 and D11, the skilled person would have deposited Sn, like Re, as an outer layer on the pellets. As D8 concerned reforming catalysts the skilled person would not have considered its teaching.

VI. The Respondent has put forward inter alia the following arguments:

An exact comparison with example 1 of D5 could not be carried out as the loss on ignition of the starting materials was not given in D5. Furthermore, it was well known that  $\text{SnCl}_2 \cdot 2\text{H}_2\text{O}$  could not be dissolved in water to form a true solution unless acid was added. Therefore, either the inventors of D5 also added acid or they attempted to spray a suspension. Thus, the teaching of D5 was ambiguous as to how to operate. The Appellant had not exactly repeated the disclosure of example 1 in the experimental report of 14 May 1996 since the mole ratio  $\text{ZnO}:\text{Al}_2\text{O}_3$  was outside the range specified on page 4 of D5. According to the case law of the Boards (for example T 0793/93) the standard of proof as regards implicit lack of novelty was "beyond all reasonable doubt". In the present situation, it was not beyond all reasonable doubt that the reworking of

example 1 of D5 gave a product as defined in claim 1. Concerning D6, the quantity of acid stated in D6 was much greater than the amount of 1% by weight of the support used in the patent in suit. The Respondent's data submitted on 12 December 1994 about the duplication of the impregnation procedure disclosed in D6 showed uniform distribution of the platinum.

As regards inventive step, the Respondent considered that D6 was the closest prior art since tin was an essential part of the catalytic material whereas in D5 it was part of the support. It was not common general knowledge at the filing date that the side reactions were diminished by decreasing the contact time of the reactants and products with the catalyst. The Appellant's affirmation was not supported by any document. There was nothing in the cited documents which could have suggested to the skilled person that any improvement in selectivity could be achieved by depositing both the Pt and Sn components on an outer layer. Rhenium could not be similar to both tin and the noble metals and its properties were manifestly closer to those of the noble metals. The fact that D6 required intimate association of Sn and Pt did not mean that they both had to be surface impregnated.

VII. The Appellant requested that the decision under appeal be set aside and that the patent be revoked. The Respondent requested as main request that the appeal be dismissed and the patent maintained. As auxiliary requests 1 to 5, the Respondent requested that the decision under appeal be set aside and that the patent

be maintained on the basis of any of the auxiliary requests 1 to 5 as filed with the Respondent's letter dated 10 March 1997, in the order indicated in that letter. No request was presented by the party to the proceedings as of right.

### **Reasons for the Decision**

1. The appeal is admissible.

*Novelty of claim 1 of the main request*

2. D5 discloses a supported noble metal catalyst containing from 0.0001 to 10 wt% noble metal selected from Pt, Ir, Os, Pd, Rh, Ru, the support being selected from aluminas, titania, zirconia, magnesia, thoria, chromia, zinc titanate, zinc aluminate, and SnO/ZnAl<sub>2</sub>O<sub>4</sub>. The noble metal content is concentrated in the surface range of the support, ie it is positioned as a relatively thin layer on, at, or very near the surface of the support, with very little noble metal involved in the interior portions of the support. A preferred support for butane dehydrogenation is SnO/ZnAl<sub>2</sub>O<sub>4</sub>. The catalyst particle ranges upward in size from about 1/8 inch (3.175 mm) pellets, spheres, or aggregates of equal volume (see claims 9 and 6; page 3, lines 8-11; page 4, lines 4-15). Example I describes the preparation of a SnO/ZnAl<sub>2</sub>O<sub>4</sub> support, comprising the steps of spraying a solution of SnCl<sub>2</sub>.2H<sub>2</sub>O onto zinc aluminate granules, drying, and calcining in air. In examples III and IV, 1/8 inch cylindrical pellets of the SnO/ZnAl<sub>2</sub>O<sub>4</sub> support are impregnated with an aqueous solution of (NH<sub>4</sub>)<sub>6</sub>Pt(SO<sub>3</sub>)<sub>4</sub>, dried and calcined. The resulting catalyst contains Pt for example in 28.7 vol.% of the catalyst particle, this value being calculated from the thickness of the impregnated layer. It was not contested that the platinum distribution obtained in the catalyst of D5 falls within the platinum concentration profile as defined in claim 1 of the patent in suit. However, D5 is silent about the distribution of the tin component on the support. Novelty of the claimed catalyst depends on whether or not the method of preparation of the SnO/ZnAl<sub>2</sub>O<sub>4</sub> support as described in example I **inevitably** leads to an

average concentration of the tin component as defined in claim 1. The Appellant and the Respondent have both submitted experiments which, so they argued, represented an exact repetition of the procedure of example I, but similar results as regards the tin distribution were not achieved.

- 2.1 According to example I, 1.90 lb of  $\text{SnCl}_2 \cdot 2\text{H}_2\text{O}$  are **dissolved** in the volume of water representing the pore volume of the calcined zinc aluminate granules and the **solution** is sprayed onto the granules with an atomiser (impregnation to incipient wetness). The Respondent has pointed out that the addition of  $\text{SnCl}_2 \cdot 2\text{H}_2\text{O}$  into water as performed by the Appellant in his experiments of 1 June 1995 did not give a clear solution but a white cloudy solution with white solid particles. However, both the Appellant and the Respondent agreed that a clear and stabilised solution can be obtained by addition of a certain amount of hydrochloric acid, even if it remained unclear which minimum amount of HCl had to be added in order to stabilise the stannous chloride in the form of a clear solution during the period of preparation. As, in example I of D5, the addition of an acid is not mentioned although  $\text{SnCl}_2 \cdot 2\text{H}_2\text{O}$  is said to be dissolved in the water and the resulting solution sprayed, D5 obviously lacks information as to how the inventors have operated. As pointed out by the Respondent and not contested by the Appellant, the inventors of D5 might have added a certain amount of hydrochloric acid to the mixture in order to stabilise the stannous chloride in form of a true solution or

they might have sprayed a suspension. D5 is silent about the distribution of tin on the catalyst support, and therefore, the skilled person who repeats the method of example I is not restricted in the choice of the missing operating conditions to those conditions leading to a specific distribution of tin. Furthermore, the loss on ignition (LOI) of the starting products used in example I is not indicated so that it is not clear from the amounts of zinc oxide and alumina stated in this example whether or not the  $\text{ZnO}:\text{Al}_2\text{O}_3$  mole ratio is 1.18 or, in other words, whether or not a stoichiometric excess of zinc oxide was used. It should be noted in this context that according to page 4 of D5, the  $\text{ZnO}:\text{Al}_2\text{O}_3$  mole ratio in suitable zinc aluminate is preferably in the range of about 1.0-1.06, more preferably about 1.00-1.01. Therefore, to repeat example 1 of D5, assumptions have to be made as to (i) whether a solution or suspension was sprayed, (ii) as to how a solution was prepared, in particular to which extent it was acidified, and (iii) as to which  $\text{ZnO}:\text{Al}_2\text{O}_3$  mole ratio was used to prepare the zinc aluminate support. From the Appellant and Respondent's submissions in the course of the appeal procedure, it can be inferred that the said  $\text{ZnO}:\text{Al}_2\text{O}_3$  mole ratio and the amount of acid used to stabilise the stannous chloride affect the distribution of tin (see in particular page 4 of the Appellant's letter dated 1 June 1995, page 3 of the Respondent's letter dated 10 March 1997, and pages 3-4 of the Respondent's letter of 23 October 1995). It is immediately apparent that spraying a suspension or a solution may also influence the tin distribution, as indicated by the Respondent.

Furthermore, it can also be inferred from the number of experiments submitted by the parties that the operating conditions or parameters not given in example 1 of D5, in particular the HCl concentration and the true ZnO:Al<sub>2</sub>O<sub>3</sub> mole ratio (the ZnO:Al<sub>2</sub>O<sub>3</sub> mole ratio calculated taking into account the LOI) have such an influence on the tin distribution that a tin distribution falling either within the concentration profile defined in claim 1 or outside can be obtained depending on the choice of these parameters (see the Respondent's experiments of 20 December 1993; the repetition of these experiments by the Appellant using the same high HCl concentration but a different ZnO:Al<sub>2</sub>O<sub>3</sub> mole ratio on page 4 of the Appellant's letter dated 1 June 1995; the Appellant's experiments in the letters dated 1 June 1995 and 14 May 1996 with stannous chloride solutions having HCl concentrations lower than in the Respondent's experiments of 20 December 1993 and a ZnO:Al<sub>2</sub>O<sub>3</sub> mole ratio of 1.18 or greater). For the preceding reasons, the Board is not convinced that by following the procedure of example I of D5, a skilled person would **inevitably** arrive at a catalyst having the tin distribution as defined in claim 1.

- 2.2 The Appellant's arguments that it was clear to the skilled person without repeating example I of D5 that tin was deposited as an outer shell (see point V above) cannot be accepted. They are based on the affirmation that a stoichiometric excess of zinc oxide is used in example 1; however, as indicated above, such an excess cannot in fact be deduced from D5 since example I contains no data about the LOI of the starting



products, and the preferred values stated on page 4 for the ZnO:Al<sub>2</sub>O<sub>3</sub> mole ratio are 1.00 to 1.01. Furthermore, these arguments rely on the disclosure of D14 about the distribution of platinum on an alumina support, which has been impregnated by the incipient-wetness method using chloroplatinic acid in the presence or not of nitric or hydrochloric acid in the solution (see page 83, last paragraph). The Appellant has given no reasons why the impregnation of **stannous chloride** on a **zinc aluminate** support should give a tin distribution similar to the platinum distribution resulting from an impregnation of **chloroplatinic acid** on an **alumina** support. Moreover, the statement on page 84 of D14 (last four lines of the third paragraph) does not disclose a metal concentration profile as defined in claim 1. It follows from the above that the subject-matter of claim 1 is new vis-à-vis the teaching of D5.

3. D6 discloses a hydrocarbon dehydrogenation catalyst comprising a combination of catalytically effective amounts of a platinum group component and a tin component with a porous refractory carrier material such as alumina. This catalyst is prepared by impregnating the porous carrier material with a solution of a complex chlorostannate (II) chloroplatinate anionic species, said solution being stabilised in contact with said carrier with an aqueous halogen acid, for example with aqueous hydrochloric acid at a pH of less than about 1, drying and calcining the impregnated carrier material. Particularly good results are obtained when the catalyst also contains an alkali or alkaline earth component. Spherical particles

of gamma-alumina having a diameter of 1/16 inch (1587  $\mu\text{m}$ ) are used in the examples of D6 (see col. 3, lines 33-51; col. 13, lines 1-14; claims 1, 9 and 12). D6 does not indicate the distribution of the platinum group metal and tin component on the support.

To support his arguments that the catalysts of D6 were prepared using the same starting products and the same process as in the patent in suit and, thus, had the same metal distribution, the Appellant has in particular compared the preparation of the impregnation solution described in column 13, lines 19-33 of D6 with that of example 2 of the patent in suit. In the preparation method disclosed in D6, the aqueous impregnation solution containing a complex chlorostannate (II) chloroplatinate anionic species is stabilised by adding concentrated hydrochloric acid in an amount equivalent to about 10 wt% of the alumina particles to be impregnated (see col. 13, lines 19-33). As pointed out by the Respondent in his letter dated 23 October 1995, the addition of "1% of HCl" indicated in example 2 of the patent in suit is based on the weight of the support and not on the solution. Therefore, the amount of hydrochloric acid used in example 2 of the patent in suit is not the same as that indicated in col. 13, lines 30-33 of D6. Furthermore, Fig. 3 of the patent in suit shows that the process of example 2 leads to a non-uniform distribution of Sn and Pt as defined in claim 1 and the Respondent's experimental report in his letter of 12 December 1994 shows that under the conditions disclosed in col. 13 of D6 the platinum is uniformly distributed throughout the

support. In view of the different amounts of acid used in D6 and in example 2 of the patent in suit and of the said distribution data, the Board concludes that the teaching of D6 does not destroy the novelty of the catalyst according to claim 1.

4. The Board is satisfied that the subject-matter of claim 1 is also new with respect to the disclosure of the other cited documents. This not being in dispute, there is no need to give reasons for this finding.

*Inventive step of claim 1 of the main request*

5. At the oral proceedings both the Appellant and the Respondent considered that D6 represents the closest prior art. Taking into account that D6 deals with the problem of providing catalysts with improved activity, selectivity and stability when employed in the dehydrogenation of dehydrogenable hydrocarbons, whereas D5 is silent about the selectivity of the catalysts and discloses that the tin oxide forms part of the support, the Board can follow this approach.

- 5.1 As indicated in point 3 above, D6 discloses a catalyst comprising a tin component in combination with a platinum group metal component on a refractory oxide support. According to D6, such a catalyst prepared by the method described therein (see point 3 above) exhibits an improved activity, selectivity and stability in the dehydrogenation of dehydrogenatable hydrocarbons. When the catalyst contains an alkali or alkaline earth component in addition to the said tin

and platinum group components, it is particularly useful in the dehydrogenation of long chain normal paraffins to produce the corresponding normal mono-olefins with minimisation of undesirable side reactions such as cracking, skeletal isomerisation and aromatisation (see col. 3, line 33 to col. 4, line 2).

With respect to this prior art, the technical problem underlying the claimed catalyst can be seen in providing a dehydrogenation catalyst of comparable activity and stability which exhibits an improved selectivity in the dehydrogenation of n-paraffins into n-olefins. The patent in suit proposes solving this problem by a catalyst having an average concentration of the platinum group component and of the tin (or germanium) component as defined in claim 1. In view of the statement in column 4, lines 18-35, of the patent in suit, examples 1 to 3 and Figures 1-2, which illustrate the n-paraffin conversion as a function of the period on stream and the total n-olefin selectivity for both the claimed catalyst and a catalyst having the platinum and tin components uniformly distributed throughout the support, it is credible that the said technical problem has actually been solved by the claimed catalyst. The Appellant contested at the oral proceedings that the problem of improving the n-olefin selectivity had been solved. The mere affirmation that an improvement in selectivity was not achieved because the catalyst according to D6 already led to a minimisation of the side reactions cannot be accepted in view of the comparative examples in the patent in suit and of Fig. 2 which show that further improvement

in this respect was obtained. The fact that side reactions were minimised with the catalyst disclosed in D6 does not exclude the possibility that another catalyst further improves the n-olefin selectivity.

5.2 It can be inferred from D6 that, in the dehydrogenation of long chain n-paraffins to produce the corresponding normal mono-olefins, minimisation of side reactions is achieved with the catalyst comprising an alkali or alkaline earth component. However, D6 contains no information as to how the n-olefin selectivity of this catalyst might be improved. As the distribution of the platinum group component and of the tin component throughout the support are not mentioned in D6, this document would not have suggested to the skilled person that the said distribution might have an influence on the n-olefin selectivity.

5.3 D5, which has been analysed above (see point 2), discloses dehydrogenation catalysts having the noble metal deposited on the outermost layer of the catalyst support pellets, with very little noble metal involved in the interior portion of the support. The catalysts of D5 are particularly suitable for the dehydrogenation of butane to provide butenes and butadiene. In addition to the noble metal of the platinum family the catalysts may also contain rhenium as a further noble metal (see claim 2 and page 5, lines 26-27). D5 teaches that particularly for the diffusion limited hydrocarbon conversion processes, only the outer layer of the catalyst is of importance for the activity, and any noble metal inside the catalyst support is

substantially wasted and of no benefit. Therefore, by depositing the noble metal near the surface of the support, far less expensive noble metal is needed, representing significant savings in noble metal supported catalyst costs. The surface-impregnated catalyst disclosed in example IV, which contains 0.25 wt% platinum on a SnO/ZnAl<sub>2</sub>O<sub>4</sub> support, is equivalent in activity to a substantially uniformly impregnated catalyst containing 0.6 wt% Pt when used for the dehydrogenation of n-butane and more stable than said catalyst (see page 2, lines 1-20; example IV). However, D5 is silent about the selectivity of the catalyst and does not contain any information from which the skilled person could have inferred that the n-olefin selectivity might be improved by depositing the noble metal, let alone both the noble metal and the tin or germanium component, on the outermost layer of the catalyst support. Without the expectation that an improvement in the n-olefin selectivity might be achieved by the noble metal distribution disclosed in D5, ie without the expectation of solving the technical problem stated above, the skilled person confronted with the said problem would not have been encouraged to combine the teaching of D6 and D5 and, thus, to deposit the noble metal and the modifier on the outermost layer of the support (see T 2/83, OJ EPO 1984, 265).

- 5.4 In the Board's judgment, the teaching of D11 does not change the preceding finding, and the Appellant's arguments concerning the combination of this teaching with those of D5 and D6 (see point V above) are not

convincing for the following reasons: D11 concerns low density alumina particles having a high micropore volume and discloses that these alumina particles are useful as a support for a platinum group component alone or in combination with a tin component, a rhenium component and/or a germanium component to yield an improved reforming catalyst (see page 3, lines 23-25 and 44-48). According to page 4, lines 43-44, the catalysts may be used for the reforming of petrol and the dehydrogenation of a dehydrogenatable hydrocarbon. Catalysts containing Pt and a tin component are said to exhibit improved activity and activity stability with respect to the reforming of gasoline boiling range feed stocks. The method of impregnation described on page 3, lines 32-37, suggests that an even distribution of platinum on the support was aimed at. This document neither suggests depositing the catalyst component(s) on an outermost layer of the support, nor addresses the problem of improving the n-olefin selectivity in the reaction of dehydrogenation of n-paraffins.

Furthermore, Sn, Ge and Re are listed as possible metal or metal component to be used in combination with the platinum group metal, but D11 does not teach that the tin component acts in a similar way as the rhenium component or is equivalent thereto when used in combination with a platinum group component for the dehydrogenation of n-paraffins into n-olefins. In these circumstances, the teaching of D11 would not have given the skilled person an incentive to combine the teaching of D5 and D6 and to deposit the tin component in the outermost layer of the support in order to improve the n-olefin selectivity of the catalysts according to D6.

- 5.5 The Appellant's affirmation at the oral proceedings that it was common knowledge before the filing date that side reactions were caused by a long contact time of the reactants and products with the catalyst (see point V), has been contested by the Respondent and was not supported by any document illustrating the common general knowledge. Taking into account that in such a situation the burden of proof lies on the party which has made this affirmation, this argument cannot be taken into consideration for the assessment of inventive step.
- 5.6 D8 teaches that catalysts containing a platinum group component and a tin component in which both these components are uniformly distributed throughout the catalyst support exhibit excellent activity, stability and selectivity in hydrocarbon conversion processes (see col. 2, lines 5-24; and col. 4, lines 55-60). This teaching would not have encouraged the skilled person confronted with the problem of improving the n-olefin selectivity in the dehydrogenation of n-paraffins to concentrate both the tin component and the platinum group component in an outermost layer of the support.
6. It follows from the above that the catalyst according to claim 1 of the main request involves an inventive step and that claim 1 meets the patentability requirements set out in Article 52(1) EPC.
7. As claim 8 of the main request is directed to a hydrocarbon conversion process which involves the use



of a catalyst according to claim 1, the said process derives its patentability from that of the claimed catalyst. The same applies to the dependent claims 2-7 and 9. Therefore, claims 2 to 9 are also allowable. In these circumstances, there is no need to examine the auxiliary requests.

### **Order**

**For these reasons it is decided that:**

The appeal is dismissed.

The Registrar: The Chairman:

S. Hue

R. Spangenberg