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D E C I S I O N
of 9 March 2004

Case Number: T 0399/99 - 3.3.7
Application Number: 92119803.2
Publication Number: 0591572
IPC: B01J 35/02
Language of the proceedings: EN

Title of invention:

Catalyst granules, in particular for the oxidative
dehydrogenation of methanol in order to yield formaldehyde

Patentee:

SÜD CHEMIE MT S.r.l.

Opponent:

Perstorp AB

Relevant legal provisions:

EPC Art. 56, 123(2)

Keyword:

"Amendments - reinstating broader claims in appeal proceedings
- (main request and first auxiliary request)"
"Amendments - creation of an originally not disclosed range -
allowable (no) - (main request and first auxiliary request)"
"Amendments - isolation of exemplified values - allowable (no)
- (second and third auxiliary requests)"
"Amendments - allowable (yes) (fourth auxiliary request)"
"Inventive step - (yes) (fourth auxiliary request)"

Decisions cited:

G 0009/92, T 0201/83, T 0343/90, T 0526/92, T 1067/97,
T 0823/96, T 0329/99

Catchword:

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Case Number: T 0399/99 - 3.3.7

D E C I S I O N
of the Technical Board of Appeal 3.3.7
of 9 March 2004

Appellants 01: Perstorp AB
(Opponents) S-284 80 Perstorp (SE)

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Appellants 02: SÜD CHEMIE MT S.r.l.
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Decision under appeal: Interlocutory decision of the Opposition
Division of the European Patent Office posted
16 March 1999 concerning maintenance of
European patent No. 0591572 in amended form.

Composition of the Board:

Chairman: R. E. Teschemacher
Members: G. Santavicca
B. J. M. Struif

Summary of Facts and Submissions

I. The mention of the grant of European patent 0 591 572, in respect of European patent application 92 119 803.2, filed on 20 November 1992 and claiming a right of priority in Italy of 6 October 1992 (IT MI922301), was published on 4 June 1997. The patent as granted comprised 12 claims. Claims 1 and 12 read as follows:

"1. Catalytic material in form of granules of cylindrical shape, displaying a cross section with at least three points of contact with the circumscribed circumference and endowed with at least three through-bores having axes which are substantially parallel to each other and to the axis of the granules, and substantially equidistant from each other, said granules showing a ratio of the height of the granules to the distance between the bore axes (pitch) comprised from 1.5 to 2.5 and a ratio of the surface area to the volume of the granules higher than 2.4 mm^{-1} ."

"12. Process for the oxidative dehydrogenation of methanol in order to produce formaldehyde, characterized in that said process uses a fixed-bed reactor containing catalyst granules according to any of the preceding claims."

Dependent claims 2 to 11 concerned preferred embodiments of the granules according to Claim 1.

II. A notice of opposition was filed on 4 March 1998, in which revocation of the patent was requested on the grounds of Article 100, paragraphs (a) and (b), EPC, i.e. that the claimed subject-matter lacked an

inventive step and that the patent did not disclose the invention in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art, respectively. The opposition was *inter alia* based on document EP-A-0 464 633 i.e. D1.

III. In an interlocutory decision notified in writing on 16 March 1999, the Opposition Division found that the patent could be maintained in amended form. That decision was based on a main request and a first and second auxiliary requests, all submitted during the oral proceedings. In the decision, it was held that:

- (a) The amended claims according to the main request contravened the requirements of Articles 84 (lack of conciseness) and 123, paragraphs 2 and 3, EPC.
- (b) In the first auxiliary request, the presence of use claims 10 to 13 in addition to the process claims already contained in that request contravened the requirements of Rule 57a EPC.
- (c) Claims 1 to 9 according to the second auxiliary request fulfilled the requirements of Articles 84 and 123, paragraphs 2 and 3, EPC.
- (d) The objections raised under Article 100(b) EPC in connection with Article 83 EPC had been overcome by the amendments made.
- (e) The claimed subject-matter was novel.

(f) D1 was the closest prior art document for the cylindrical catalyst having a tri-lobed cross-section. The problem to be solved was to provide a catalyst having a low pressure drop, a large actual surface area and good mechanical strength while permitting a high heat exchange coefficient between catalyst particles and reaction gas. According to the results in Table 5 of the patent in suit, that problem had been solved, and the opponents had not shown anything to the contrary. Since D1 neither exemplified catalysts with three through-bores nor gave any hints towards the claimed catalysts, they involved an inventive step.

(g) Therefore, the claimed subject-matter fulfilled the requirements of the EPC (Article 102(3) EPC).

IV. On 15 April 1999, the opponents (appellants 01) lodged an appeal against that decision and paid the fee for appeal on the same day. In their statement setting out the grounds of appeal, received on 26 July 1999, appellants 01 contested the finding that the claims according to the second auxiliary request underlying the impugned decision fulfilled the requirements of Article 123(2) EPC and that their subject-matter involved an inventive step.

In a letter dated 3 March 2004, appellants 01 enclosed an Annex A, to show that not all the requirements stated in Claim 1 according to the main request then on file were compatible with each other.

V. On 14 May 1999, the proprietors (appellants 02) lodged an appeal against the interlocutory decision of the Opposition Division and paid the fee for appeal on the same day. In their statement setting out the grounds of appeal, received on 14 July 1999, appellants 02 contested the finding that the main request underlying the impugned decision extended the protection, contained added-matter and was not concise.

In reply to a communication of the Board, addressing the points to be discussed during the scheduled oral proceedings, the proprietors enclosed new sets of claims as the main request and the first to sixth auxiliary requests, respectively. In addition to the above requests, the main request underlying the impugned decision and the second auxiliary request found to be allowable in the impugned decision were maintained as further auxiliary requests (letter dated 9 February 2004).

In order to overcome the objections to the new claims, raised in the opponents' letter dated 3 March 2004, the proprietors submitted amended Claims 1 for the main request and the first, the third, the fourth and the sixth auxiliary requests (letter dated 8 March 2004).

Claim 1 according to the main request and the first to third auxiliary requests read as follows, respectively:

Main request

"1. Catalytic material in form of granules of cylindrical shape displaying a cross section with three points of contact with the circumscribed circumference

and endowed with three through-bores having a circular cross-section with axes which are substantially parallel to each other and to the axis of the granules and substantially equidistant from each other and defining, on the cross-section of the granule, vertices of a substantially equilateral triangle, oriented towards the points of contact of the cross section with the circumscribed circumference, the radius of the circumscribed circumference being of 2.8 to 3.0 mm, the ratio of the height of the granules to the distance between the bore axes (pitch) being of 1.7 to 2.3 and the ratio of the bore pitch to the diameter of the bore being of 1.3-1.4,

said granules having three substantially cylindrical-circular lobes equal to each other and coaxial with the through-bores and the ratio of the bending radius of each lobe to the bore pitch of 0.7 to 0.8, the ratio of the diameter of the lobes to the diameter of the bores of 1.8-2.1, the ratio of the radius of the circumscribed circumference to the bending radius of the lobes of 1.7-1.85, the ratio of the surface area to the volume of the granules higher than 2.4 mm^{-1} , or

said granules having a substantially triangular cross section with rounded vertices and the ratio of the bending radius of each rounded vertex to the bore pitch of 0.7-0.8, the ratio of the radius of the circumscribed circumference to the bending radius of the vertices of 1.7-1.85 and the ratio of the surface area to the volume from 2.4 to 3.1 mm^{-1} ."

First auxiliary request

"1. Catalytic material in form of granules of cylindrical shape displaying a cross section with three points of contact with the circumscribed circumference and endowed with three through-bores having a circular cross-section with axes which are substantially parallel to each other and to the axis of the granules and substantially equidistant from each other and defining, on the cross-section of the granule, vertices of a substantially equilateral triangle, oriented towards the points of contact of the cross section with the circumscribed circumference, the ratio of the height of the granules to the distance between the bore axes (pitch) being of 1.5 to 2.5 and the ratio of the bore pitch to the diameter of the bore being of 1.15-1.5,

said granules having three substantially cylindrical-circular lobes equal to each other and coaxial with the through-bores and the radius of the circumscribed circumference being of 2.8 to 3.0 mm, the ratio of the bending radius of each lobe to the bore pitch of 0.6 to 0.9, the ratio of the radius of the circumscribed circumference to the bending radius of the lobes of 1.6-2, the ratio of the surface area to the volume of the granules higher than 2.4 mm^{-1} , or

said granules having a substantially triangular cross section with rounded vertices and the radius of the circumscribed circumference being of 2.8 mm, the ratio of the bending radius of each rounded vertex to the bore pitch of 0.6-0.9, the ratio of the radius of the circumscribed circumference to the bending radius of the vertices of 1.6-2 and the ratio of the surface area higher than 3.1 mm^{-1} ."

Second auxiliary request

"1. Catalytic material in form of granules of cylindrical shape displaying a cross section with three points of contact with the circumscribed circumference and endowed with three through-bores having a circular cross-section with axes which are substantially parallel to each other and to the axis of the granules and substantially equidistant from each other and defining, on the cross-section of the granule, vertices of a substantially equilateral triangle, oriented towards the points of contact of the cross section with the circumscribed circumference, the ratio of the height of the granules to the distance between the bore axes (pitch) being of 1.5 to 2.5 and the ratio of the bore pitch to the diameter of the bore being of 1.15-1.5,

said granules having three substantially cylindrical-circular lobes equal to each other and coaxial with the through-bores and a height of 4, 4.5 or 5 mm, the ratio of the bending radius of each lobe to the bore pitch of 0.6 to 0.9, the ratio of the radius of the circumscribed circumference to the bending radius of the lobes of 1.6-2, the ratio of the surface area to the volume of the granules higher than 2.4 mm^{-1} , or

said granules having a substantially triangular cross section with rounded vertices and a height of 4 mm the ratio of the bending radius of each rounded vertex to the bore pitch of 0.6-0.9, the ratio of the radius of the circumscribed circumference to the bending radius of the vertices is of 1.6-2 and the ratio of the surface area higher than 3.1 mm^{-1} ."

Third auxiliary request

"1. Catalytic material in form of granules of cylindrical shape displaying a cross section with three points of contact with the circumscribed circumference and endowed with three through-bores having a circular cross-section with axes which are substantially parallel to each other and to the axis of the granules and substantially equidistant from each other and defining on the cross-section of the granule vertices of a substantially equilateral triangle, oriented towards the points of contact of the cross section with the circumscribed circumference, the ratio of the height of the granules to the distance between the bore axes (pitch) being of 1.5 to 2.5 and the ratio of the bore pitch to the diameter of the bore being of 1.15-1.5,

said granules having three substantially cylindrical-circular lobes equal to each other and coaxial with the through-bores and a height of 4, 4.5 or 5 mm, the ratio of the bending radius of each lobe to the bore pitch of 0.6 to 0.9, the ratio of the radius of the circumscribed circumference to the bending radius of the lobes of 1.6-2, the ratio of the surface area to the volume of the granules higher than 2.4 mm^{-1} ."

VI. Oral proceedings were held on 9 March 2004. The proprietors withdrew the fourth and the sixth auxiliary requests submitted with letter dated 8 March 2004 and filed further sets of claims as the modified fourth and sixth auxiliary requests. The modified fourth auxiliary request comprises 3 claims, Claim 1 reading as follows:

"1. Catalytic material in form of granules of cylindrical shape displaying a cross section with three points of contact with the circumscribed circumference and endowed with three through-bores having a circular cross-section with axes which are substantially parallel to each other and to the axis of the granules and substantially equidistant from each other and defining on the cross-section of the granule vertices of a substantially equilateral triangle, the vertices being oriented towards the points of contact of the cross section with the circumscribed circumference, said granules having three substantially cylindrical-circular lobes equal to each other and coaxial with the through-bores, said granule having the following features:

Height h (mm)	5.00	5.00	4.00	4.50
Angle β (rad)	0.89	0.78	0.78	0.78
Bore diameter d_1 (mm)	1.70	1.70	1.70	1.70
Minimal thickness s (mm)	0.90	0.80	0.80	0.80
Bore pitch p (mm)	2.20	2.35	2.35	2.35
Maximal dimension of cross section M_1 (mm)	5.70	5.65	5.65	5.65
Minimal dimension of cross-section M_2 (mm)	5.41	5.34	5.34	5.34
Solid cross section surface area (mm ²)	15.64	14.69	14.69	14.69
Side surface area (mm ²)	170.77	171.18	136.94	154.06
Total surface area (mm ²)	202.06	200.56	166.32	183.44
Volume of space occupied by catalyst particle ("solid space") (mm ³)	78.22	73.46	58.76	66.11
Equivalent diameter (mm)	2.32	2.20	2.12	2.16
Ratio of surface area/volume S/V (mm ⁻¹)	2.58	2.73	2.83	2.78
Ratio of bore pitch/diameter p/ d_1	1.29	1.38	1.38	1.38
Lobe diameter d_2 (mm)	3.5	3.3	3.3	3.3
d_2/d_1	2.06	1.94	1.94	1.94
Lobe radius R_1 (mm)	1.75	1.65	1.65	1.65
R_1/p	0.79	0.70	0.70	0.70
Ratio of height/bore pitch h/p	2.27	2.13	1.70	1.91
Radius of circumscribed circumference R (mm)	3.02	3.01	3.01	3.01
R/R_1	1.72	1.82	1.82	1.82"

Claim 2 concerns a preferred composition of the catalyst granules according to Claim 1. Claim 3 concerns a process for the oxidative dehydrogenation of methanol to formaldehyde, in which a fixed-bed reactor containing a catalytic material according to any one of claims 1 and 2 was used.

VII. Appellants 01 (opponents) argued essentially as follows:

- (a) Since the proprietors' main request underlying the decision under appeal had contained a range of heights and the present main request no longer contained any limitation in that respect, the proprietors asked for more than they had lost before the first instance. Hence, the proprietors were not defending their case within the limits of what they had defended before the first instance. In particular, the proprietors were now asking for a height going beyond the value of 7.9 mm present in the main request rejected by the Opposition Division. However, the frame of the appeal was set by the amendments in the requests before the Opposition Division, such that the proprietors were adversely affected only by those amendments turned down by the Opposition Division. Consequently, the appeal on the basis of the present main request and the first auxiliary request was not admissible under Article 107 EPC.
- (b) As regards the gist of the alleged invention, many parameters in combination were present in Claim 1, which relevance however was not apparent, since they represented an arbitrary collection aiming at something allowable.

- (c) Claim 1 according to the main request inter alia contained a range for the radius of the circumference circumscribed around the cross-section of the granule, not disclosed in the application as filed, hence without any relevance.

Although some values for that radius were given in the examples, the end values of the new range had been made by rounding up the lower exemplified value and rounding down the upper exemplified value, which values concerned specific embodiments, such that the new end values did not correspond to the exemplified radii. Moreover, the lack of any basis for the rounding up or down of the exemplified values was apparent from the fact that the approximation of the values in the application as filed was not consistent.

Further, a new range had been created from individual values given in the specific context of the examples, which exemplified parameters were interrelated, as also admitted by the proprietors, such that the situation was different from that in T 201/83 (OJ EPO 1984, 481).

Furthermore, also the end values of the ranges for other parameters had been rounded up or down with respect to those disclosed initially and the new range for the ratio between surface area and volume of the granule of 2.4 to 3.1 mm⁻¹ was not disclosed in the application as filed.

Therefore, the amendments contravened the requirements of Article 123(2) EPC and the request was not allowable.

- (d) Claim 1 of the first auxiliary request *inter alia* contained the same range for the radius of the circumscribed circumference as the main request, albeit for the tri-lobed embodiment, and additionally a specific value thereof for the triangular embodiment. Hence, that request was objected to for the same reasons as the main request, such that it was not allowable either.
- (e) Claim 1 of the second auxiliary request *inter alia* included three individual values for the height of the granule, which had been taken from the examples and inserted in Claim 1. However, these heights were exemplified in connection with further specific ratios of dimensions. For instance, the height of 4.5 mm of Example G was associated to a ratio between the bending radius of the lobes and the pitch of the bores of 0.7, whereas in Claim 1 the same height was now connected to a ratio ranging from 0.6 to 0.9. The same happened to the further ratios exemplified, also for the triangular embodiment. Therefore, the amendments did not comply with Article 123(2) EPC and the request was not allowable either.
- (f) Claim 1 of the third auxiliary request was objected to for the same reasons as the second auxiliary request.

- (g) Claim 1 according to the modified fourth auxiliary request defined the geometrical parameters taken from the examples but did not include the exemplified composition of the granules nor the further properties of the examples. Thus, despite the inclusion of the geometrical parameters of the examples, the missing definition of the remainder of the details amounted to a generalization, which was not allowable. Therefore, Article 123(2) EPC had been contravened.
- (h) As to inventive step, there was a substantial increase of features in Claim 1 according to the modified fourth auxiliary request. However, it was not apparent what technical effect was related to these features. For instance, the exemplified granules did not produce any unexpected pressure drops compared to conventional cylindrical catalysts. Further, the data in Table 5 of the patent in suit showed that the pressure drop for a given geometry was independent from the parameters defined in Claim 1.

The closest prior art document was D1, which showed in Figure 5 a granule having a tri-lobed cross-section with three through-bores. Figure 5 was not further illustrated, since the effects of the use of that embodiment on the pressure drops were not mentioned in D1.

However, it was not apparent from the patent in suit or from any further evidence that any merits could be associated with the claimed catalysts in comparison to that shown in Figure 5 of D1.

Comparative example 14 in the patent in suit related to hollow cylinders causing a pressure drop comparable to that of the claimed granules. Thus, the proprietors had not shown that a lower pressure drop was a merit of the claimed granules.

Claim 1 did not specify any compositions nor any reactions or properties related to selectivity. Therefore, selectivity was no suitable argument to support any merits of the claimed granules, thus no support for the presence of an inventive step.

Further, the hollow cylinders used in the comparative examples in the patent in suit did not represent the closest prior art. Therefore, no effect over the granule in Figure 5 of D1 had been shown.

Thus, the problem to be solved was the mere provision of further catalyst granules. Solving that problem by arbitrarily specifying particular geometrical parameters not disclosed in the prior art did not involve an inventive step.

Therefore, the claimed subject-matter did not involve an inventive step, and the request for revocation of the patent was justified.

VIII. Appellants 02 (proprietors) argued essentially as follows:

- (a) As regards the argument that the proprietors had only been adversely affected by the impugned decision to the extent of the amendments made

before the Opposition Division, the proprietors disagreed and maintained the requests objected to by the opponents.

- (b) The gist of the invention was a catalytic material in form of granules with a particular shape that led to unexpected advantages. That shape was defined by a number of parameters relating to the geometry, inter alia the radius of the circumscribed circumference and/or the height of the granule. All the essential parameters were defined in Claim 1 and the interrelations among the parameters were shown and exemplified in the patent in suit. The catalytic granules fulfilling these parameters showed an unexpected performance.
- (c) The amended claims according to the main request, in comparison to the claims as granted, included a range of absolute values for the radius of the circumference circumscribed around the cross-section. These absolute values were directed to measured dimensions and were related to other dimensions by the ratios mentioned in the patent in suit. These dimensions and relations were derivable from the application as filed.

The patent specification was directed to a skilled person, who understood that the size and shape of the claimed granules were defined by interrelated dimensional parameters. If the parameters and their relations were fulfilled, then the granules were within the invention.

Although the ranges of the absolute values for the heights of the granules and for the radius of the circumference circumscribed around the cross-section of the granules were not disclosed in the application as filed, the suitable ranges for the height and the circumscribed circumference radius could be gathered from the specific values exemplified, which were not linked in a unique manner to the other features.

Thus, the range for the radius of the circumference circumscribed around the cross-section, added to Claim 1, had been made from values taken from the examples and rounded to one figure after the decimal point. The importance of that radius was apparent from the description as filed, which showed that the relations between the parameters were important, not their single values.

The formation of a numerical range for a feature from the values exemplified without adopting the values for the co-exemplified parameters was acceptable to the Boards of Appeal of the EPO as shown in decisions T 343/90 (EPOR 1996, 216) and T 526/92 (EPOR 1995, 306), according to which, when deciding on the basis of the application as filed, a literal interpretation was not appropriate, since the skilled person would not stick to the words but to the actual content of any disclosure in the light of common general knowledge.

In the present case, the radius of the circumscribed circumference as well as the height of the granules were not linked so closely to the other particulars such that the value taken from the example could lead to a non-obvious embodiment of the invention. Although one could calculate specific parameters from the definitions in Claim 1, no new matter was generated by the amendments because these parameters would nevertheless be obviously derivable from the application as filed.

Further, the range for the ratio between the surface area and the volume of the granule was disclosed initially or corresponded to the values exemplified. The further ranges included in Claim 1 as amended had been either disclosed initially or made by rounding up or down the end values of the range disclosed initially without added-matter.

Therefore, the requirements of Article 123, paragraphs 2 and 3, EPC were met and the main request was allowable.

- (d) As regards the first auxiliary request, it was immediately apparent that the definition of the last feature was incomplete and could be corrected on the basis of the original application. The ratio between the radius of the circumscribed circumference and the bending radius of the lobes had been disclosed in the application as filed.

- (e) Regarding the second auxiliary request, it contained the same error as the first auxiliary request, which could be rectified. Additionally, Claim 1 according to that request contained specific values for the height taken from the examples as alternative solutions which fulfilled all of the other ratios specified, such that no new matter was generated.

- (f) The amendments to the third auxiliary request were similar to those of the second auxiliary request but for the circular cylindrical tri-lobed granules.

- (g) In the modified fourth auxiliary request, the dimensions of the tri-lobed embodiment exemplified in Table 1 had been inserted in Claim 1. Tables 4 and 5 instead referred to further parameters of the catalyst bed and of the reaction conditions carried out on that bed. According to the description, the exemplified geometries of Table 1 were not associated to the specific characteristics of that catalyst bed and to the specific chemical reaction exemplified. Therefore, no new matter had been generated.

- (h) As to inventive step, the closest prior art document was D1, Figure 5, which showed a catalyst granule with three, through-bored circular lobes. Although no dimensions for that embodiment were given in D1, it was apparent from Figure 5 that the granule had geometrical characteristics which were different from those of the claimed granules. The embodiment exemplified in D1 was not that of Figure 5 but the hollow cylinder of Figures 1 and 9.

The problem addressed by the patent in suit was to provide bored catalyst granules for fixed bed reactions, in order to obtain high selectivity while providing low resistance to fluid flow.

The granules having the configuration as claimed represented the solution to that problem. Three parameters in combination particularly characterised the claimed granules having the trilobed configuration with three through-bores: the height of the granules, the ratio height/pitch of the bores and the ratio surface area/solid space volume of the granule.

Compared to the conventional ring-shaped or hollow-cylindrical shaped granules of the same compositions, the claimed granules provided unexpected benefits such as low pressure drop and high selectivity. As regards the low pressure drop, the bed containing the granules of Example 5 and that containing the granules of Comparative Example 14 (both in Table 5 of the patent in suit) were fully comparable. The comparison showed a significant lower pressure drop for the claimed granule. The opponents had not shown that under comparable conditions the other granules exemplified did not perform better than the comparative rings and hollow cylinders. Nor had they produced any evidence with respect to the embodiment of Figure 5 of D1.

Further, according to the examples in the patent in suit, the selectivity obtained with the claimed granules was higher than that provided by ring-type granules. With respect to ring-type catalysts providing similar selectivity, the claimed granules provided a much lower flow resistance. Moreover, the claimed catalysts allowed to increase the selectivity at higher reaction temperatures, which benefit was in contrast to the known behaviour of such catalysts.

Concerning the fluctuations in the results shown in the tables, objected to by the opponents, they were due to the preparation of the granules by tablet compression of powders. Nevertheless, these fluctuations were small and within the measurement error.

Therefore, the problem had been solved.

As to the obviousness of the solution, Figure 5 of D1 showed a catalyst granule having three circular lobes with through-bores, however with a much higher dimensional ratio between the height of the granule and the pitch of the through bores than that specified in Claim 1 in suit, which higher ratio would result in increased pressure drop.

The only general information on the dimension for the hollow cylinders given in D1 was that its length was limited by the danger of breaking.

D1 did not give any data regarding the geometry and the performance of the catalyst granule of Figure 5. Nor did it disclose that the embodiment of Figure 5 would give better performance than the rings or hollow cylinders exemplified. However, the comparative examples in the patent in suit showed that the performance of ring-shaped and hollow cylinder granules was worse than that of the claimed granules. Consequently, the skilled person could not find any suggestion in Figure 5 of D1 to arrive at the claimed solution showing low pressure and high selectivity in use.

- (i) Therefore, the embodiment with three lobes as defined in Claim 1 of the fourth auxiliary request was not obvious and involved an inventive step.

IX. Appellants 02 (proprietors) requested that the decision under appeal be set aside and that the patent be maintained in amended form according to the main request, or, alternatively, according to any of the auxiliary requests 1 to 6, the main request and auxiliary requests 1, 3 and 5 as submitted with letter dated 8 March 2004, auxiliary request 2 as submitted with letter dated 9 February 2004 and the modified auxiliary requests 4 and 6 as submitted during the oral proceedings, or, as a further alternative, according to the main request or the second auxiliary request underlying the decision under appeal.

Appellants 01 (opponents) requested that the appeal be dismissed.

Reasons for the Decision

1. The appeals are admissible.

Main request

2. *Amendments - Reinstating broader claims in appeal proceedings*

- 2.1 According to appellants 01, the main request and the first auxiliary request, which no longer contained a range for the height of the granules, compared to Claim 1 according to the main request underlying the decision under appeal, were such that the proprietors had not been adversely affected by that decision.

- 2.2 As to the facts of the present case, the Board notes the following:

- 2.2.1 The range of the heights of the granules mentioned in Claim 1 according to the main request underlying the decision under appeal - (and a height in the range from 2.5 and 7.9 mm) - was based on end values that had been calculated from the dimensional ratios defined in the description of the patent in suit, taken in combination with the lower and the upper exemplified values for the radius of the circumscribed circumference (calculation in Annex 2 to the minutes of the oral proceedings before the Opposition Division). However, since no relation between the height and the radius for the circumscribed circumference was present in that Claim 1, the radius of the circumscribed circumference could assume any value.

2.2.2 The range for the radius of the circumscribed circumference included in Claim 1 according to the present main request has been derived from the examples, in which the end values for that circumference are shown in combination with specific values for the height of the granules. Claim 1 according to the present main request includes all the ratios of the dimensions as necessary to characterise the geometry of the granule, in particular to permit the calculation of the heights related to the radii of the circumscribed circumference. Appellants 01 have argued that the heights are interrelated with the radii of the circumscribed circumference by the given ratios. Hence, the height of the granule cannot assume any value, but only those values which satisfy the now claimed range for the radius of the circumscribed circumference.

2.2.3 Therefore, it has not been shown that Claim 1 according to the present main request goes beyond the scope of Claim 1 according to the main request underlying the decision under appeal.

2.3 In addition to the above considerations, the objection of appellants 01 prompts the following observations:

2.3.1 According to Article 107, 1st sentence, EPC, any party to the proceedings adversely affected by the contested decision may appeal. This is an admissibility requirement of the appeal which has to be fulfilled when the appeal is filed in accordance with Article 108 EPC. The impugned decision is an interlocutory decision concerned with the maintenance of the patent in amended form. It did not accede to the main request of appellants 02. Therefore, they were entitled to appeal

(Case Law of the Boards of Appeal of the EPO, 4th edition, 2001, VII.D.7.3.2).

- 2.3.2 In fact, appellants 01 do not contest the entitlement of appellants 02 to appeal but to submit requests which do not contain limitations present in the requests underlying the decision under appeal. This is not a question of the admissibility of the appeal but of allowability of an amendment. In this respect it is consistent case law that proprietors requesting maintenance of the patent in limited form do not, by virtue of such limitation, irrevocably abandon subject-matter covered by the patent as granted, but not by the request as thus limited. In appeal proceedings, the proprietors may come back to a version which they did not defend in first instance proceedings, provided that this does not constitute a procedural abuse (T 123/85, OJ EPO 1989, 336, and the further decisions cited in Case Law, *supra*, VI.I.3.1.2(b)).
- 2.3.3 Hence, there is no general principle that the proprietors/appellants are bound to their requests before the Opposition Division. In the course of the proceedings the proprietors may be confronted with many objections, even new objections in appeal proceedings. Rule 57a EPC permits the proprietors to make "appropriate and necessary" amendments occasioned by the grounds for opposition specified in Article 100 EPC, even if the respective grounds were not invoked by the opponents.
- 2.4 Therefore, the argument that the proprietors were not adversely affected in respect to the main request is

technically not convincing and has no legal basis either.

3. *Amendments - Formal requirements*

3.1 Compared to Claim 1 as granted, Claim 1 according to the present request *inter alia* contains the following added feature: "the radius of the circumscribed circumference being of 2.8 to 3.0 mm" (lines 8 and 9).

3.2 In the examples of the application as filed, the radius of the circumscribed circumference has the following values: 2.77, 3.01 and 3.02 mm (Tables 1 and 2). Therefore, the end values of the range now claimed, i.e. 2.8 and 3.0 mm, have not been individualised as such.

3.3 It follows from the above that, in amending Claim 1, the following steps have been taken: the exemplified lower (2.77 mm) and upper (3.02 mm) values for the radius of the circumscribed circumference have been isolated from their specific contexts; then, the lower value 2.77 has been rounded up to 2.8 mm and the upper value 3.02 has been rounded down to 3.0 mm; further, these rounded values have become the end values of a range for the radius of the circumference circumscribed around the cross-section of the granules, which end values were not disclosed in the application as filed.

As a consequence thereof, the initially exemplified dependencies of the radii of 2.77, 3.01 and 3.02 mm from e.g. the constant bore diameter of 1.70 mm, or from the lobe radii of 1.50, 1.65 or 1.75, have been generalised. The new end values for the range of the radius of the circumscribed circumference are no longer

associated to the bore diameter of 1.70 mm, as originally disclosed, but can be combined with other specific values of the bore diameter and the lobe radius, in accordance with the ratios defined in Claim 1.

It is now possible to calculate new specific values for the dimensions of the granules by simply associating any end values for the radius of the circumscribed circumference to e.g. the lower end value of the ratio between that radius and the radius of the lobe. The thus calculated value for the lobe radius can then serve to calculate the bore diameter, and so on, as defined in claim 1.

From the above it is apparent that the insertion of specific numerical values not disclosed initially as end points of a generic range, when associated to several other generic ranges of ratios, makes available new species simply by calculating their geometries. Such new calculated embodiments are not directly and unambiguously made available from the application as filed.

3.4 Appellants 02 took the view that the new range built from the three specific values in the examples was allowable under Article 123(2) EPC in view of decisions T 343/90 and T 526/92 (*supra*).

3.4.1 T 526/92 concerns a quite different situation, since a broader vague range ("high TBN") was restricted on the basis of a value in the examples. Therefore, the amendment did not result in a generalisation as in the present case but in a limitation. Further, that

limitation nevertheless constituted a new, open-ended range having no basis in the application as filed, which consequently was found to be not allowable under Article 123(2) EPC.

3.4.2 As far as T 343/90 is concerned, it is true that the creation of a range was allowed on the basis of values in the examples. In that case a polyester as part of a composition was defined by four properties expressed in ranges. The contested amendment concerned the viscosity of the polyester as a further property expressed in a range which was as such not expressly disclosed. The Board held the amendment allowable since:

- The lower and upper limits were specifically mentioned as such in the application as filed;
- the importance of the viscosity was apparent from the description of the patent, which disclosed means to adjust its values;
- further specific values for the viscosity had been disclosed in the numerous examples, which supported the new range;
- the specific facts of the case indicated that the end points of the new range had not to be seen only in the context of the other data in the respective examples on the properties of the polyester (point 2.2 of the reasons).

3.4.3 The facts of the present case are different from those of T 343/90. Throughout the description of the patent in suit the emphasis is on the shape of the granules as

defined by a number of relations among the dimensions. Only in the context of a particular process the information is given that the shape and the size of the catalyst are of basic importance for achieving particular advantages (page 3, lines 47 to 49). Therefore, it is doubtful whether the person skilled in the art would immediately recognise the importance of the radius of the circumscribed circumference.

3.4.4 More important appears the fact that in T 343/90 the five properties expressed in their respective ranges were not directly interrelated. In contrast, it is the particularity of the present case that ratios defining the shape of the granules create relations by which insertion of one absolute value for one measurement inevitably implies specific data for the other measurements as will be clear from the following.

3.5 The application as filed discloses two embodiments for the cylindrical catalyst granules with three through-bores:

- The first embodiment has a cross-section displaying three circular lobes (Figure 1);
- the second embodiment has a triangular cross-section with rounded vertices (Figure 2).

3.6 Throughout the application as filed, the following parameters are used to define the size and the shape of the above embodiments for the catalyst granules:

- The height of the granule;

- the bore pitch, i.e. the distance between the respective axes of the through-bores;
- the radius or the diameter of said bores;
- the bending radius of the lobes, for the tri-lobed embodiment;
- the bending radius for the rounded vertex, for the triangular embodiment;
- the radius of the circumference circumscribed around the cross-section of the granules;
- the surface area, i.e. the total surface area;
- the volume of space occupied by the granule (page 6, line 3 to page 7, line 13).

3.7 The above parameters are not disclosed in terms of ranges of absolute values but of ranges of ratios, i.e. as relative values. Therefore, the application as filed does not disclose any ranges of absolute values for the radius of the circumference circumscribed around the cross-section of the catalyst granules nor for the height.

3.8 Instead, the application as filed more specifically defines the granules by a number of (preferred) ranges of ratios between selected pairs from the above parameters, namely:

- A range for the ratio of the bore pitch to the diameter of the same bores of from 1.15 to 1.5, preferably of from 1.3 to 1.4;
- a range for the ratio of the height of the granule to the bore pitch of from 1.5 to 2.5, preferably of from 1.7 to 2.3;
- a range for the ratio of the bending radius of the lobes or of the bending radius of the rounded vertices to the bore pitch of from 0.6 to 0.9, more preferably 0.7 to 0.8;
- a range for the ratio of the bending radius of the lobes to the radius of the through-bores of from 1.4 to 2.4, more preferably of from 1.75 to 2.05;
- a range for the ratio of the radius of the circumscribed circumference to the bending radius of the circular lobes or to the bending radius of the rounded vertices of from 1.6 to 2, more preferably of from 1.7 to 1.85;
- a range for the ratio of the surface area to the volume of each granule of higher than 2.4, preferably larger than 2.7 mm^{-1} for the multi-lobed embodiments and higher than 3.1, preferably larger than 3.3 mm^{-1} for the triangular embodiment (pages 6 and 7).

3.9 The application as filed does not disclose which of the above parameters can be set independently from the others, in order to calculate all the other parameters defining the desired size and shape of the granules

from the given ranges of ratios. Nor does it disclose that any parameters are more important than others. In that respect, Claim 1 as filed did not include any parametric definition, and Claim 1 as granted mentioned the ratios height/pitch and surface area/volume.

Throughout the examples in the application as filed (Catalyst granules A to G (Table 1) and H to Q (Table 2)), the following specific values have *inter alia* been individualised: a height of 4.0, 4.5 and 5.0 mm; a bore pitch of 2.20 and 2.35 mm; a radius of the circumference of 2.77, 3.01 and 3.02 mm; a bending radius of the lobes or the rounded vertices of 1.50, 1.65 or 1.75 mm; a bore diameter of 1.70 mm for all of the above embodiments. Moreover, six dimensional ratios are exemplified in Table 1 and five in Table 2.

It follows from the above that, for any embodiments, the radii of the circumscribed circumference are directly associated with the cross-section of the granules and the heights are interrelated with the bore pitches. These absolute values are then connected with all the other claimed parameters by the given ratios. In particular, all of the exemplified circumference radii and heights are always associated with the sole bore diameter exemplified. Therefore, the application as filed does not disclose that the radius of the circumference circumscribed around the cross-section of the granules and the height of the granules are independent from the other parameters disclosed or exemplified.

Since the numerical features are closely associated in combination with the other features exemplified, they

cannot be singled out from the specific disclosed contexts and generalised without contravening Article 123(2) EPC (Case Law of the Boards of Appeal, *supra*, III.A.1.1, in particular T 201/83 and T 1067/97 of 4 October 2000, unpublished in the OJ EPO).

3.10 In this respect, the proprietors argued that the embodiments of the granules resulting from these calculations would nevertheless be within the teaching of the patent, since the skilled person could work out all of the possible geometries within the given ranges of ratios.

3.11 These new embodiments might well be covered by what is derived obviously from the application as filed. However, a clear distinction must be made between what has been directly and unambiguously made available by the application as filed, either explicitly or implicitly, and what can be merely rendered obvious by the content of the application as filed (Case Law of the Boards of Appeal, *supra*, III.A.3.3, in particular decisions T 823/96 of 28 January 1997 (EPOR 1999, 417) and T 329/99 of 5 April 2001, unpublished in the OJ EPO).

In the application as filed only those particular embodiments of the catalyst granules are disclosed which are clearly and unambiguously implied by the explicit disclosure, whereas the amended features make available new species which are obtained by the calculation of the other dimensions of the granules from those amended values as defined in Claim 1 in suit. These new species do not belong to the explicit or implicit disclosure of the application as filed but may

be merely rendered obvious from that disclosure. They cannot serve as a valid basis for amendments.

3.12 It follows from the above that the added range for the generalised radius of the circumscribed circumference is not explicitly or implicitly disclosed in the application as filed, let alone in connection with the further generic ranges defined in Claim 1 in suit. Therefore, Claim 1 in suit contravenes the requirements of Article 123(2) EPC.

3.13 Consequently, the main request is not allowable.

3.14 In view of the above reason, the question whether or not the further amendments made to Claim 1 or to the other claims meet the requirements of Article 123(2) EPC can be left undecided.

First auxiliary request

4. Claim 1 according to the first auxiliary request contains the same amendment as Claim 1 of the main request, namely that "the radius of the circumscribed circumference being of 2.8 to 3.0 mm", albeit only for the tri-lobed embodiment (lines 12 and 13).

4.1 Consequently, the same considerations and reasons apply *mutatis mutandis* to this request as set out in respect of the main request (point 3, *supra*).

4.2 Therefore, the amendment to Claim 1 contravenes the requirements of Article 123(2) EPC and the first auxiliary request is not allowable either.

4.3 In view of that reason, the question whether or not the further amendments to Claim 1 such as that "the radius of the circumscribed circumference being of 2.8 mm", for the triangular embodiment, fulfil the requirements of Article 123(2) EPC can be left undecided.

Second auxiliary request

5. Compared to Claim 1 as granted, Claim 1 according to the second auxiliary request *inter alia* contains the following added features:

- "and a height of 4, 4.5 or 5 mm" (line 12), in the definition of the tri-lobed embodiment;
- "and a height of 4 mm" (line 18), in the definition of the triangular embodiment.

5.1 The application as filed exemplifies the specific heights now mentioned in Claim 1 (Tables 1 and 2). However, in the examples, said heights are always associated to a sole specific value for the bore diameter (1.70 mm) and to few specific values for e.g. the radius of the circumference circumscribed around the cross-section of the catalyst granules, the bore pitch, the lobe radius. Consequently, the values of the heights now defined in Claim 1 were always associated to few specific values for the other dimensions.

5.2 In view of the general definitions of the parametric features in Claim 1, the heights of 4, 4.5 and 5 mm may be used to calculate further specific dimensions from the given ratios of dimensions. Any claimed ratio is defined by two end values, from any of which the

calculation of other specific dimensional values associated to the claimed heights is possible, the calculation resulting in species that will not have the exemplified dimensional values associated to the claimed heights, such as a bore diameter of 1.70 mm as disclosed in the application as filed.

- 5.3 Therefore, the above amendment contravenes the requirements of Article 123(2) EPC, such that the second auxiliary request is not allowable either.

Third auxiliary request

6. Compared to Claim 1 as granted, Claim 1 according to the present request *inter alia* contains the following added feature: "and a height of 4, 4.5 or 5 mm" (line 12). This amendment adds subject-matter for the same reasons as outlined above (point 5, *supra*) for the second auxiliary request. Consequently, the third auxiliary request is not allowable either.

Modified fourth auxiliary request

7. *Amendments*

- 7.1 Compared to Claim 1 as granted, Claim 1 according to the fourth auxiliary request contains the following amendments:

- The addition of the features defined in Claims 2 and 3 as granted;

- the specific geometrical features of granules A, B, E and G as detailed in Table 1 of the description of the patent in suit.

- 7.2 All the added features were already present in the application as filed.
- 7.3 The opponents argued that the features taken from Table 1, which is part of Examples 1 to 14, had been isolated from the further features given in the context of these examples, such as the process conditions and the materials for the preparation of the granules. This isolation contravened the requirements of Article 123(2) EPC.
- 7.4 The features contained in Table 1 only concern the size and shape, i.e. the geometry of the catalyst granules, without defining any features related to the kind of material used for the preparation, such as the porosity and the specific surface area BET, which are only present in Table 4. This finding is in line with claims 1 to 13 as filed, in which the catalyst granules are defined by their geometrical features.
- 7.5 The description of the patent in suit (page 3, lines 24 to 26) and that of the application as filed (page 7, lines 14 to 20) explicitly mention that "the shape of the catalyst according to the present invention lends itself to be used in a wide range of catalytic processes, such as, e.g., hydrogenation and dehydrogenation of organic compounds, alkylation or dealkylation of benzene derivatives, isomerization, conversion of olefins into methanol, thermooxidation of methane to yield olefins, for example."

- Since these processes use different materials as catalyst, which fact has not been contested, it follows that the shape and the dimensions given in Table 1 are independent from the materials and the process conditions used for the preparation of the granules.
- 7.6 Claim 2 corresponds to Claim 11 as granted, which is identical to Claim 14 as filed. Claim 3 corresponds to Claim 12 as granted, which is identical to Claim 15 as filed.
- 7.7 Therefore, the amendments to the present Claims have a basis in the application as filed and comply with the requirements of Article 123(2) EPC.
- 7.8 The protection conferred by the claims, compared to the protection conferred by Claim 1 as granted, is restricted by the amendments. Thus, the requirements of Article 123(3) EPC are also met.
- 7.9 The amendments are occasioned by the grounds of opposition raised by the opponents and thus comply with Rule 57a EPC.
- 7.10 The clarity of the claims has not been objected to by the opponents. The Board has no reason to take a different position.
- 7.11 Therefore, the amended claims fulfil the formal requirements of the EPC.

8. *Novelty*

8.1 The novelty of the claimed subject-matter is not contested. The Board has no reason to take a different position.

9. *Inventive step*

9.1 The patent in suit concerns catalyst granules, in particular for the oxidative dehydrogenation of methanol in order to yield formaldehyde.

9.2 Such catalyst granules are disclosed in D1, which was considered by both parties as the closest prior art document.

9.3 Document D1 discloses a carrier having at least one passing-through channel used for a catalyst for producing an unsaturated ester by gas-phase reaction (Claim 1).

Preferably, the carrier has a shape of a hollow cylinder (Claim 2), which has an outside diameter of 3 to 10 mm, an inside diameter of at least 1 mm, a wall thickness of not more than 3 mm and a height of 2 to 10 mm (Claim 3). That carrier is preferably made of silica and/or alumina (Claim 4).

D1 addresses the production on industrial scale and the necessity to increase the volume of the raw material, in order to prevent formation of hot spots on the catalyst, which is caused by an increase of catalytic activity when the formation reaction is exothermic, and to maintain the conversion of oxygen within an

appropriate range while maintaining the oxygen gas content in the gas below a certain level in order to keep the gas composition outside the range of explosion. An increase in the volume of raw material creates a problem of increasing pressure loss in the catalyst, which phenomenon had been a barrier against advantageous commercial production when it was attempted to employ a highly active catalyst while using existing equipment (page 2, lines 17 to 27).

The purpose of D1 is to provide a carrier used for a catalyst, for producing unsaturated esters by gas-phase reaction, that minimizes the problem mentioned above (page 2, lines 32 and 33). It was further desired that the use of a catalyst comprising the carrier decreases the amount of by-products with high boiling point (page 5, lines 2 to 8).

As a solution thereto, several carrier embodiments are shown in the figures, in particular a carrier with one passing-through channel (Figure 1), a carrier with 3 passing-through channels (Figure 5) and carriers with a multiplicity of passing-through channels (Figures 6,7).

The advantages of the carrier of D1 are as follows: By using the catalyst when an apparatus is newly constructed, the volume of the reactor can be decreased, thereby significantly reducing the equipment cost; or, when an existing apparatus is used, the production can substantially be increased without increasing the capacity of the existing reaction vessel, thereby saving the expense for expanding the apparatus which would otherwise be required for increasing the production. Furthermore, by using this catalyst,

significantly higher selectivity in the desired product can be attained in a production than when using conventional catalyst and with the same space time yield, thereby greatly cutting down the amount of olefin consumed (page 5, lines 31 to 38).

9.4 From the above considerations it is apparent that there is a similarity of purposes and structure (embodiment of Figure 5) between D1 and the patent in suit, such that D1 represents the closest prior art document for assessing the presence of an inventive step.

9.5 In view of D1, the problem was to provide a configuration for catalyst granules showing a high ratio of surface area to volume, which makes it possible to improve the results obtained in terms of pressure drop, heat exchange coefficient and selectivity over conventional granules, in line with the patent in suit (page 2, lines 42 to 44 and 51 and to 59).

9.6 The solution to that problem is represented by the catalyst granules having the geometrical features delineated in Claim 1.

9.7 Catalyst granules A, B, E and G, whose geometrical features are defined in Claim 1, show a ratio between the surface area and the volume of the granule of 2.58, 2.73, 2.83 and 2.78 mm^{-1} , respectively (present Claim 1 and Table 1 in the patent in suit).

In contrast thereto, comparative granules X and Y as defined in Table 3 of the patent in suit, which granules have the shape of a ring (Height < Outer

diameter) and a hollow cylinder (Height = Outer Diameter), respectively, show a ratio between the surface area and their volume of 2.53 (i.e. 90.48/35.81) and 2 (i.e. 147.26/73.63) mm^{-1} , respectively.

Comparative ring granules X and hollow cylinder granules Y both fulfil the dimensional requirements established in Claim 3 of D1 and can well represent the hollow cylindrical carriers exemplified in D1. Since D1 does not disclose that the carrier according to Figure 5 has a ratio surface area to volume better than that of the hollow cylinders exemplified and no evidence to the contrary has ever been submitted by the opponents in this respect, it follows from the above that the claimed granules have been improved in that respect. It is not contested that a higher ratio surface area/volume results in a better contact of the reaction gases with the catalyst surface, such that both heat exchange and conversion of reactants are favoured, in line with the statement in the patent in suit (page 2, lines 55 to 59).

In table 5 of the patent in suit, catalyst granule B of Example 5 and hollow cylinder catalyst Y of Comparative Example 14 have been tested in a reactor under the same bulk density (0.73 g/mm) and temperature (280°C). The pressure through the reactor bed is 45 mmHg for catalyst B and 50 mmHg for catalyst Y. Therefore, under comparable catalyst bed conditions, claimed catalyst granule B produces a lower pressure drop than comparative hollow cylinder catalyst Y according to D1.

The results of the further catalysts according to Claim 1 in suit, shown in Table 5; gave the following results:

- Catalysts A, in Examples 11 and 12, at the same bulk density of 0.69 g/mm, shows an increase of the pressure drop from 45 mmHg at 270°C to 50 mmHg at 310°C.
- Catalyst B, in Examples 3, 4, 8 and 9, at the same bulk density of 0.69 g/mm, shows: a pressure drop of 40 mmHg at 280°C; of 45 mmHg at 275 and 290°C; and of 50 mmHg at 300°C. Only in Example 1, catalyst B, at a bulk density of 0.61 g/mm and at a temperature of 265°C causes a pressure drop of 55 mmHg.
- Catalyst G, in Example 10, at a bulk density of 0.65 g/mm, shows a pressure drop of 40 mmHg at 280°C.
- Catalyst E, in Example 7, at a bulk density of 0.70 g/mm, shows a pressure drop of 55 mmHg.

Since the patent in suit does not contain any comparative examples with catalysts X and Y under the conditions of the further catalysts other than those of Examples 5 and 14, and since the opponents have not submitted any evidence in this respect, the only conclusion that can be drawn from the above results is that, in view of the little influence of the operating temperature at the conditions exemplified on the pressure drop caused by the claimed catalyst granules,

a higher reaction temperature for the gases can be used without an increase in pressure drop.

Such a higher temperature appears to be advantageous. In fact, when using the highest temperatures exemplified, 300 and 310°C, respectively, the yield of the formaldehyde obtained is higher than that of the other examples.

With respect to the examples other than Examples 5 and 14, the opponent had the burden to prove that the results of the granules exemplified were worse than those of the comparative carriers disclosed by D1, at least with respect to the pressure drop. However, no facts have been established which could disprove the picture resulting from the comparison between Examples 5 and 14. Therefore, this burden has not been discharged by the chain of arguments submitted by appellants 01 during the proceedings, even if the Board accepts that these arguments are technically plausible.

In summary, the examples in the patent in suit show that the claimed granules have a higher surface area/volume ratio than the hollow cylinders of D1. This document does not disclose that the carrier of Figure 5 have any such higher ratio over conventional hollow cylinders. Nor has any evidence been produced by the opponents in this respect. Such a higher surface area ratio/volume can favour heat exchange and conversion of reactants. Additionally, the claimed granules, under comparable bed operating conditions, cause a lower pressure drop, which does not appear to be substantially influenced by the temperature, so that higher temperatures can be used for the reactions,

without any negative impact on selectivity, at least for the exemplified reaction.

Therefore, the problem has been effectively solved.

9.8 It remains to be decided whether or not the claimed granules were made obvious by the cited prior art.

9.8.1 D1 discloses a catalyst comprising a carrier having at least one passing-through channel, in particular having the shape of a cylinder with a hollow channel therein (hereinafter referred to as "hollow cylinder").

The carrier used in D1 may have any shape, as long as it has at least one passing-through channel. The figures show a hollow cylinder, a ring, honeycombs having one or at least 2 passing-through channels, a block having a cross-shaped passing-through channel.

However, the examples of D1 are only concerned with hollow cylinders, wherein D , d , h and l represent outside diameter, inside diameter, i.e. diameter of hollow space, wall thickness, i.e. the width of solid part in the cross section and height, respectively.

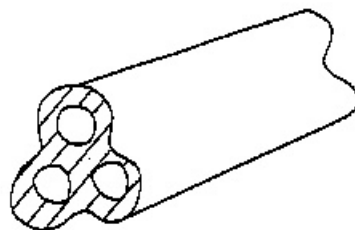
D1 prefers for the size of the hollow cylinder that the outside diameter (D), inside diameter (d), wall thickness (h) and height (l) be within ranges of 3 to 10 mm, at least 1 mm, not more than 3 mm and 2 to 10 mm, respectively. If the outside diameter (D) and the height (l) exceed these ranges, it will be difficult to appropriately pack a multiplicity of such carrier pellets in a reaction tube of a fixed bed reactor. On

the other hand, if these dimensions are smaller than the above ranges, the pressure loss will be too large. The wall thickness (h) is preferably as thin as possible within the range that permits the strength of the carrier to be industrially usable. If the inside diameter (d) is less than 1 mm, the pressure loss will increase. The carrier may be formed by moulding and pressing (page 3, lines 19 to 26).

Example 1 of D1 concerns a carrier having a hollow cylindrical shape of the following dimensions: outside diameter (D) 5.1 mm, inside diameter (d) 2.0 mm wall thickness (h) 1.55 mm, height (l) 4.1 mm. This carrier was compared to a spherical carrier, a cylindrical carrier with no channels and a cylindrical carrier having hemispherical ends. The comparative carriers give worse results, in particular a larger pressure loss, than the hollow cylinder embodiment (Table 1).

The embodiment of Figure 5 of D1, shown herein below, shows similarity of shape with the claimed granules. However, D1 does not contain any statement of size, of use or of advantage of that embodiment.

Fig. 5



- 9.9 Thus, D1 gives no indication to the skilled person to select the dimensional features shown in Claim in suit, let alone in order to solve the problem posed.
10. Therefore, the opponents have not shown that the claimed subject-matter is made obvious by the carrier of the embodiment of Figure 5 of D1. The opponents have not based their obviousness objection on any further prior art document or evidence. Therefore, it has not been established that the claimed subject-matter lacks an inventive step.
11. Consequently, the claims according to the modified fourth auxiliary request are considered to fulfil the requirements of the EPC.
12. In view of the above decision, the Board does not need to decide on the further auxiliary requests.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The case is remitted to the department of first instance with the order to maintain the patent on the basis of the modified fourth auxiliary request submitted during the oral proceedings and a description yet to be adapted.

The Registrar:

The Chairman:

C. Eickhoff

R. Teschemacher